Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/engineeringnewsr87newy

# Engineering News-Record

*A Consolidation ngineering News and Engineering Record*

A JOURNAOF CIVIL ENGINEERING
ANCONSTRUCTION

SSUED WEEKLY

---

OLUME LXXXVII

---

Jul to December 31, 1921

---

174601
14/10/22

McGRW-HILL COMPANY, INC.
10TH VENUE AT 36TH STREET
NEW YORK

TA
1
E6
v.87
cop.2

# ENGINEERING NEWS-RECORD

## INDEX TO VOLUME LXXXVII

July 1 to December 31, 1921


PAGES

July 7 ..... 1 to 46
July 14 ..... 47 to 88
July 21 ..... 89 to 130
July 28 ..... 131 to 172
Aug. 4 ..... 173 to 218
Aug. 11 ..... 219 to 260
Aug. 18 ..... 261 to 302
Aug. 25 ..... 303 to 344
Sept. 1 ..... 345 to 388
Sept. 8 ..... 389 to 428
Sept. 15 ..... 429 to 468
Sept. 22 ..... 469 to 508
Sept. 29 ..... 509 to 548
Oct. 6 ..... 549 to 592
Oct. 13 ..... 593 to 632
Oct. 20 ..... 633 to 672
Oct. 27 ..... 673 to 712
Nov. 3 ..... 713 to 756
Nov. 10 ..... 757 to 796
Nov. 17 ..... 797 to 838
Nov. 24 ..... 839 to 878
Dec. 1 ..... 879 to 922
Dec. 8 ..... 923 to 962
Dec. 15 ..... 963 to 1006
Dec. 22 ..... 1007 to 1044
Dec. 29 ..... 1045 to 1084

A

ACCIDENTS (See also FAILURES, ENGINEERING)
Brooklyn theater collapse ..... e923, n*954
Crane, gantry, 30-ton, blown off pier ..... n666
Curved-wall girder falls when collision knocks out middle posts (W. W. Bigelow) ..... letter*618
Dust explosion and collection in grain elevators ..... 847
Grain elevator explosion, Chicago, cause of ..... 719
Penstock bursts during tryout ..... e634, 640
Accounting records for engineers (A. L. Mullergren) ..... *685
Activated Sludge, see Sewage Treatment
Adams, H. J., on diagram aids slope determination in hopper design ..... *513
Adams, R. M., on handling breaks in irrigation canal embankments ..... *561
Advertisers, engineering conference plan ..... n301

AERONAUTICS
Airplanes:
Classification work planned ..... n667
Design, safety factors (A. S. Niles) ... 490
Shed with special shed and roof construction ..... *565
Saves large sum in railroad survey .. 71
Sheds, roofs suspended by cables ..... *688
Balloons, Cape May hangar for dirigibles built from two small ones ..... *698
Balloon, dirigible, collapse of Z R 2 ..... e346
Faulty design responsible ..... n663
Lugs, tests of small, eyebar heads ..... 438
Patrick, Col. M. M., new chief of Army service ..... n*543
Photographic maps as engineering aids ..... e595, *596, (P. J. Barry) letter *828
Rock crusher repair parts shipped by airplane ..... n747
Survey Canadian drainage project by airplane ..... n870
Wind tunnel built by Bureau of Standards ..... n125
Aggregates, see Concrete
Agricultural inquiry see Farm inquiry
Air, compressed, rules for work in ..... n912
Air compressor driven by truck motor ..... h*336
Portable ..... n*299
Portable, tractor-driven ..... n*1003
Airplanes, see Aeronautics
Akron, Ohio, rubber plant, underground water supply for (F. L. Roache) ..... 411
Alabama highways, see Highways, Alabama.
Alabama Power Co., Coosa River power project, permit granted ..... n84
Alameda, see Naval Base, Pacific Coast
Alaska railways, see Railways, Alaska
Albert Lea, Minn., swamp lands reclaimed (M. H. Dappert) ..... *552
Alberta & Great Waterways Ry., relocation to eliminate slide ..... *18
Allegheny County, Pa., bond issues defeated ..... n1001
Allen, T. W., on Government road survey ..... e133, 138
Alum, see Water Treatment, Filters
Aluminum sulphate solutions, testing and calculating (C. H. Capen, Jr.) ..... *574

AMER. ASSN. OF ENGINEERS
Arkansas Chapter organizes advancement society ..... n1040
Committee to confer with Fed. Am. Eng. Soc. ..... n84
Dept. of Public Works, statement on ..... e550, 563
Directors' meeting; action taken ..... n*84
Directors urge support for local public service ..... n957
Employment Bureau shows technical unemployment small ..... n788
Kansas City Engineers' Club leaves A. A. E. ..... n256
Missoula Chapter publicity work ..... *353
Officers and board of directors, new ..... *84
Seattle Chapter favors Skagit project ..... n209
Amer. Assn. of Highway Officials, convention and discussions, etc. ..... n996
Amer. Assn. of Port Authorities, Convention ..... n502, n706
Amer. Auto. Assn., D. L. Morgan elected chairman ..... n503
H. G. Shirley heads good roads board ..... n544
Objects to further vehicle taxes ..... n253
Amer. Bar Assn. for more pay for Patent Office force ..... n543
Amer. Civic Assn. meeting ..... n338
Amer. Concrete Institute, meeting ..... n956
Amer. Engineering Council, see Federated Am. Eng. Soc.
Amer. Engineering Standards Committee, specifications for steel and explosives ... n584
Amer. Fed. of Labor, see Labor
Amer. Locomotive Co., large orders ..... n710
American Lumber Congress, Apr. 5-6, 1922 ..... n1080
"American plan," see Labor
Amer. Pub. Health Assn., convention, jubilee, etc., ..n543, e595, n667, n790, n869, abstracts 904
Meeting, Am. Soc. C. E. meeting to accord with ..... n667
Amer. R.R. Assn., safety section created ... n423
Amer. Ry. Bridge and Building Assn., meeting ..... n583, n706
Amer. Road Builders' Assn. meet Jan. 16-17 ..... n501
Convention program ..... n1076
Meeting, election, etc. ..... n790, n874
Amer. Soc. for Munic. Improvements, abstracts and reports (Prof. A. H. Blanchard and others) ..... 778
Convention ..... e714, n745
Program ..... n626
Amer. Soc. for Testing Materials, convention, back to Atlantic City ..... n791

AMERICAN SOCIETY OF CIVIL ENGINEERS
Board of Direction quarterly meeting ... n663
Candidates ..... n706
Conferences on housing problems, etc.. n1078
Conference on sanitary engineering .... n790
Constitution, new, balloting on, etc. e261, e429, 459, n584, n623, n873
Constitution amendments, further .... n873
Constitution revised, criticisms of (G. S. Williams and R. L. Humphrey) ..... letters, with editorial comment ..... 459
Honorary members, election .... e346 (F. I. Winslow) letter 459.
Junior members may get equal rights .. n957
Meetings plan, new ..... e345, n380
Members' professional records to be filed ..... n911
Membership ..... n543
November meeting to accord with Health Service jubilee ..... n667
New York section, program of meetings, Discusses Zoning of City ..... n1077
Port problems discussed ..... n464
Portland, Ore., Section, unconventional society notes ..... n792
Proceedings, publication of papers resumed ..... n380
Rainfall and run-off the subject for meeting ..... n543
Rea, S., and A. Swasey, elected honorary members ..... e346 (F. I. Winslow) letter 459
Sanitation conference ..... 904
Sections and chapters, number of .... n706
Am. Soc. of Mechanical Engineers, annual meeting ..... n789, n999
Railroad Division to discuss waste .... n663
Snow problem discussed ..... e510, n540
Amer. Surety Bldg., New York, extension .*152
Amer. Wood Preservers' Assn. to establish service bureau ..... n295
Bridge floor construction, creosoted, to be studied ..... n1078
Anchoring shaft hangers, etc., steel sections for ..... n793
Antioch, Cal., decision against town in suit over brackish water ..... e997
Antioch College needs books and instruments (A. E. Morgan) ..... letter 536
Angas, Lieut. W. M., and E. M. Bredin, on crane set in place by larger crane .... n*210
Appleby bill, see Motor Vehicles, Taxes

ARCHES
Concrete, 97-ft. built in one month .. n747
Eccentric, two old (W. E. Condon) .... letter *826
Grouted, between high column and low walls (P. Thompson) ..... *515
Argentina, internal loan for sanitary work proposed ..... n957
Arkansas, local improvement bonds sold at premium ..... n1039
Arkansas Advancement Soc. organized by A. A. E. Chapter ..... n1040
Arkansas River dammed by single large blast (I. E. Houk) ..... n601
Armament Conference, see Disarmament Conference
Armstrong, J. W., on loss of head as a criterion for washing filters ..... *1060
Army, U. S., Corps of Engineers, two veterans on (Col. W. G. Atwood and F. G. Chamberlain) ..... letter 784
Over emphasizing of .... e550, e563 (J. Lansdale) letter 909
Patrick Col. M. M., new chief of air service ..... n*543
Art and the engineer ..... e173
Ash-handling plant, railway ..... *310
Ashley C. S., mayor of New Bedford, Mass., 22 terms ..... e469, 495
Ashpit, railway, cleaned by steam jets from locomotives ..... *476

ASPHALT
Block press, new ..... n*506
Developments in paving practice ..... n503
Elastic viscous deformation expressed by formula ..... 22
Highways, see Highways, Asphalt
Kept from running by whitewash ..... n251
Plant, Philadelphia, new (H. T. Macfarland) ..... *102
Mixtures, slate dust for ..... 113

ASSO. GEN. CONTRACTORS
Changes in organization ..... n542
Conference, national ..... n671, d871
Hollow metal doors, etc. decision upon is upheld ..... n544
Meeting to be held in Cleveland ..... n504
Program ..... n1038
Nominations for 1922 ..... n956
Associations, Trade, see Trade Associations
Atchison, Topeka and Sante Fe, see Santa Fe R.R.
Atlanta, Ga., water supply, bids for filters and clear water reservoir invited ..... n1079
Atlantic-Hudson Assn., see Waterways .... n37
Atlantic City, hotel roof collapse .... e262, *271, n294, *323 (E. Godfrey) letter 418, e509 (F. W. Chappell) letter 618
Atlantic City-New York hard paved route opened ..... n630

AUSTRALIA
American firm gets contract ..... n344
Bridge, large, specifications issued .... n871
Public health dept. created ..... 202
Railways, electrification ..... 156
Rails, standard sections and specifications ..... *611
Standard gage ..... n705, 910
Automobiles, see Motor Vehicles
Average engineer, issue for, Sept. 29
Avery Co., new road blade-grader ..... n*42
Aviation, see Aeronautics

B
B. Welchii, see Water Treatment, Tests
Backfilling, see Excavation
Bailey, C. C., on locomotive track scale shows load on each wheel ..... *808
Ballict, L., on heating rivets with gas .el, 21
Balloons, see Aeronautics
Baltimore, garbage disposal, temporary and permanent methods ..... 694
Sewage works, enlargement (C. E. Keefer) ..... e634, 654 (see also page 50)
Nine years' operation (T. C. Schaetzle) ..... e48, *50, 97
Baltimore, water supply, filters, loss of head as a criterion for washing (J. W. Armstrong) ..... *1060
Zoning commission appointed ..... n339
Bamboo reinforced concrete piles for bridge foundations, China ..... 32
Bank, world reserve ..... e759, 757
Bank, world, F. A. Vanderlip on ..... n878
Barge Canal, N. Y. State, see Canals
Barrett dam, see Dams
Bascule bridges, see Bridges, Bascule
Bass, Prof. F., on training engineer for industrial and social service ..... 979
Bathing waters, public, sanitation of .... n908
Beach, bathing, how can coral strand be used? (W. Cryder) ..... letter 460

BEAMS
Concrete:
Diagram for T-beam permits direct designing and checking (A. V. Karpov and V. T. Givotovsky) ..... *520
Fail through rusting of steel (H. H. Braun) ..... letter *827
Trestles, timbers, shearing stresses in stringers (A. M. Van Auken) ..... letter 119, (G. E. Strehan) letter *419
Unstayed, diagram for capacity of ..... *513
Wooden, computing shear in (E. E. Bellinger) ..... letter 335
Joint plate for ..... n*586


*Illustrated; e editorials; h, hints; n, news notes; a, abstracts

Page

Beck, J. M., address on "Mechanization of society" ..... e430
Beetle, powder-post, see Timber
Beke, J., on stresses in eyebar heads..... e219, *234, 438, (J. M. Paris) letter 621, (C. L. Christensen) letter 865
Belle Isle Bridge, see Detroit
Belmont Park racetrack, grandstand jacked up for enlargement (E. Robinson)..... *818
Belt conveyor, see Conveyor
Bennett, C. J., review of "Highway Engineering" ..... 116
Best, B. G., on lowering mine locomotive through shaft ..... n*910
Bethlehem Steel Co. cuts prices..... n42, e48, n86, (Chemung Iron & Steel Co.) letter 250, (F. O. Lewis) letter 333
Bids wanted on big jobs ...n917, n960, 1004, ..... n1043, n1082
Big Creek hydro-electric plant, penstock bursts during test ....n501, e634, 640, e758
Big Wichita River dam, contract awarded..n914
Bigelow Boulevard slide, see Pittsburgh
Biltmore Clubhouse, Rye, N. Y., labor dispute..... n547, correction n588
Biltmore Hotel, Providence R. I. labor dispute ..... n588
Birmingham, Eng., sewage sludge, power gas from ..... 637
Bitulithic patents, status of ..... e963, 969
Blasting, see Dynamite
Blocks, concrete, surfacing ..... n662
Blue River, Kansas City, see Kansas City
Boiler as reservoir when steam shovels use air ..... n120
Scale-proof locomotive crane ..... n*466
Bolivia retains F. Lavis to advise on new railway ..... n166
Bolt puller used in renewing Lucin trestle deck ..... n*787
Bolts through concrete beam, bearing strength tested (F. C. Sharrow)..... *413, correction 454

**BONDS**

Market improved ..... e923, n961
Premiums, see Contractors
Public sales in September heavy ..... n830
In July and August ..... n546
In Sept. and Oct., 1921 ..... n795
In 1921 exceed $1,000,000,000..... e1045
Bookkeeping for engineers (A. L. Mullergren) ..... *685
Books, copyright dates in catalogs urged (Prof. T. C. Mead) ..... letter 114
Books, scientific, catalogue of ..... 117

**BOOKS**

"Activities of the Bureau of Yards and Docks," U. S. N., book review ..... 989
"American Railroad Problem" (Scharfman) ..... 990
"Analysis of Electric Railway Problem" (Wilcox) ..... 457
"Bibliotheca Chemico-Mathematica" ..... 117
"Case Hardening of Steel" (Brearley) .. 116
"Centrifugal Pumps" (Cameron) ..... 658
"Collection and Disposal of Municipal Refuse" (Hering)..... 115, correction 458
"Columns" (Salmon) ..... 822
"Concrete, Manufacture and Use" ..... 117
"Concrete Designer's Manual" (Hool and Whitney) ..... 288
"Concrete Railway Sleepers" (Royal-Dawson) ..... 824
"Concrete Work" (Hatt and Voss .... 658
"Diversion of Water from Great Lakes and Niagara River" ..... 288
"Economic Development of U. S." (Lippincott) ..... 457
"Economics of Bridgework" (Waddell).. 286
"Efficiency of Pumps and Ejectors" (Powden-Smith) ..... 287
"Engineer, The" (Hammond) ..... 289
"Engineering Index, 1920" ..... 456
"Festigkeitseigenschaften," etc., of construction materials (Bach and Baumann) ..... 116
"Financial Engineering" (Goldman)... letters by O. B. Goldman and H. Barker, 114
"Glossary of Terms in Use on Punjab Canals (Nicholson) ..... 115
"Government Control of Industry During War" (Baker) ..... 457
"Graphic Production Control" (Knoeppel) 658
"Highway Engineering" (Chatburn), review by C. J. Bennett ..... 116
"Graphical Methods for Schools," etc. (Marshall), book review ..... 990
"Material Handling Cyclopedia (Wright, Little and Augur) ..... 824
"Notes on Irrigation," etc. (Strange) .. 458
"Public Health Survey" (Horwood) .. 989
"Reinforced Concrete Design" (Faber) ..117
"Results of Chemical and Bacteriological Examinations of London Waters" (Houston), book review ..... 990
"Roadway and Track" (Rench) ..... 824
"Sanitary Entomology" (Pierce) ..... 287
"Story of English Public Health" (Morris) ..... 823
"Studies in Cooling of Fresh Concrete in Freezing Weather" (Yoshide) ..... 824
"Studies in French Forestry" (Woolsey) 658
"Tests on Railway Bridges in Respect of Impact Effects" ..... 287
"Thermal Conductivity and Diffusivity of Concrete" (Carman and Nelson) .... 824
"This World of Ours" (Curle) ..... 117
"Unsolved Riddle of Social Justice" (Leacock) ..... 822
"Waste in Industry" ..... 823
"Who's Who in Engineering" ..... 658
Boom, goose-neck, for crane ..... n*709
Borers, marine, see Teredos
Boring, see Tunnels

**BOSTON**

Bridge, fire damage ..... n337
Engineers against licensing law ..... 104
Garbage disposal, bids invited ..... n82
Two bids ..... n465
City advised to accept offer ..... n788
Molasses tank failure ..... e346, 372
"Bowls," see Stadiums
Brackett, F. E., on field methods on running land lines ..... *519
Bradford, E. S., on unemployment in building trades ..... n*710
Bradstreet, H. N., on simplified method of plotting traverses..... 160, (E. Low) letter 292
On triangulating under difficulties .... 899
Brass goods for water-works, standardization ..... 568
Braun, H. H., on pile holes blasted for ocean pier ..... h*1035
On open pier deck to resist storms....*1055
Braune, Prof. G. M., and Jacob Feld, on large apparatus for lateral earth pressure tests ..... *314
Brazil to provide water storage for semi-arid states ..... n301
Breakwaters, see Ports and harbors
Bredin, E. M., and Lieut. W. M. Angas, on crane set in place by larger crane ....n*210
Breakwaters of precast concrete, Lake Erie*352
Breed, H. E., on cost of steel in concrete road ..... *139

**BRICK**

Buffalo makers indicted ..... n343
Clay products research begun ..... n87
Conditions in industry ..... n214
Freight rates as deterrent to construction (T. C. Powell and R. P. Stoddard) ..... letters 205, (C. F. Loweth) letter 460
Increased demand equalizes prices ....n752
Kiln tests, laboratory car for ..... 895
Outlook improves ..... n507
Pavement, see Highways, Brick
Price decline in May ..... n41
Production in 1920 ..... n343
Production increases ..... n586
Brick walls, hollow, to be tested ..... 190

**BRIDGES**

Action, Swiss study of ..... e965, *982
Australian, large, specifications issued ..n871
Bascule:
Chicago River, put in service..*606, n996
Failure, at Soo ..... n870
Overbalanced by careless handling ..... 978
Strauss Co. sues Seattle ..... n421
Substructure reconstruction, sinking of foundation ..... *188
Twin spans for Mystic River, Mass. ..n338
Belle Isle, see Detroit
Boston, fire damage ..... n337
Bridge viewed as a whole..... e965, *982
Cables, wire, questions ..... e841
Camden, see Bridges, Phila.-Camden
Cantilever, new Ohio River, begun ..... *613 (C. S. Davis) letter 702
Sydney, Australia ..... n542
Chicago:
Bascule, put in service ..... *604, n996
Drawbridges ..... 817
Collision, resistance to ..e549, e550, n582
Columbia River, Seattle, see Seattle
Columbia River highway toll bridge assured ..... n300
Columbus, Ohio, two, opened for traffic..n423
Concrete:
Contract held illegal ..... n37
Fairmont, W. Va., three 250-ft. spans (E. H. Harder) ..... *472
Nashville, Tenn., deterioration.. e924, *934, (W. C. Watson) letter 1072
Construction joints in concrete girders of 62½-ft. span ..... *348
Delaware, toll, abolished ..... n38
Delaware, toll, abolished ..... n38
Camden ..... 115
Desiem, long span (G. Lindenthal), e839, 861
Detroit, see Detroit
Drawbridges, Chicago ..... 817
"Economics of Bridge Work" (Waddell), review by C. E. Fowler ..... 286
Eyebar heads, stresses in (J. Beke) ..... e219, *234, 438, (J. M. Paris) letter 621 (C. L. Christensen) letter 865
Failures, see Failures, Engineering
Floors, concrete replaced by wood ..... 773
Creosoted, to be studied ..... n1078
Wooden, safety in service ..... e49
Foundations, bamboo-reinforced concrete piles, China ..... 32
Franklin County, Ohio, contract illegal .. n37
Grand Canyon, completed ..... *312
Gulf Coast, see Louisville & Nashville R.R.
Highway:
Fairmont, W. Va., concrete arch of three 250-ft. spans (E. H. Harder) .*472
Fire protection studied ..... 1071
Inadequate (H. Goldmark) ..... letter 784, e759
Rondout Creek, Kingston, N. Y., first N. Y. highway suspension bridge...n*424
Howe-truss spans, long, being replaced ..... *452, (J. Jacobs) letter 579
Hudson River, see Hudson River
Impact, see Bridges, Railway
Iron, pure, in early American bridge (D. M. Strickland) ..... 819
Long span design, some thoughts on (G. Lindenthal) ..... e839, 861
Lynn, Mass., 400-ft. pile bridge built in 14 days ..... n*339
Mystic River, Mass., to have twin bascule spans ..... n338
Named for engineer ..... n996
Nashville, Tenn., deterioration ....e924, *934
Niagara River, project again active n422, n832
Ohio River, Cairo, Ill., to be double tracked ..... n912
New cantilever begun..... *613, (C. S. Davis) letter 702
Pend Oreille River, Ore., planned..... n1077
Philadelphia, to be examined ..... n501
Philadelphia-Camden:
Bidding, close, for main piers..... n1040
Construction surveys begun ..... n252
Engineering board, permanent ..... n84
New Jersey commission authorizes bonds ..... n957
Piers, bids asked ..... n834
Plans taking form ..... n788
Pier settled, replaced by concrete girders jacked up (W. J. Titus) ..... *638
Pittsburgh, see Pittsburgh
Point Bridge report recommends immediate repairs ..... n668
Pontoon across Hudson proposed, e173, n207
Pontoon, Hudson River, preliminary plans ..... 244
Proposed for Seattle..... n502
Portland-Vancouver makes big profit.... n707
Railway:
American and European standards of service and construction (P. H. Chen) ....e49, *58, correction 110 (B. A. Marshall, C. E. Fowler, G. H. Pegram, B. R. Leffler and A. W. Buel) letters 290, (I. F. Stern and A. F. Robinson) letters 375 (J. H. Ehlers) letter 866
Amer. Ry. Bridge and Building Assn. meeting ..... n583
Des Moines River bridge, A. T. & S. F., moved to new piers ..... n83
Howe-truss spans, long, being replaced ..... *452
(J. Jacobs) letter 579
Impact, British experiments, book review ..... 287
Tests in England....e635, *642, (P. L. Pratley) letter 1073
Loadings, old and new standards, Swiss .*242
Ohio River, Cairo, Ill., to be double tracked ..... n912
Replacement, quick ..... 453
Rondout Creek, see Bridges, Highway
San Francisco Bay, report on..... 268
Scioto River, Columbus, Ohio, opened...n166
Seattle, Wash., Columbia River bridge, city raises funds ..... n427
Shadesville, Ohio, may be deferred ..... n581
South St., Philadelphia, reconstruction to be readvertised ..... n745
St. Johns River, Jacksonville, Fla., opened ..... n166
Strauss Co. sues Seattle ..... n421
Suldbach, Switzerland, study of...e965, *982
Susitna River, Alaska, description of ..... e90, *92
Suspension eight-cable, for Detroit ....524
Williamsburg, N. Y. City, Cables well preserved ..... e924, 939
Wire cabble questions ..... e841
Swing, operated by gasoline engine.... n793
Sydney, Australia, cantilever..... n542
Toll, Delaware, abolished ..... n38
Traffic loads (C. S. Davis) ..... letter 702
Williamsburg, N. Y. City, cables well preserved ..... e924, 939
Construction joints in concrete girders ....*348, (W. S. Tait and M. Thompson) letters 620
Wire cable questions ..... e841
Yellow River, China, bids on ..... e957
Briggs W. C., on tunneling in deep loose-ground subway section ...*676, (C. Prelini and W. C. Briggs) letters 867, (J. F. Fouhy) letter 1033
British highways, etc., see Great Britain
British Columbia highways, winter work ..n712
Britt, G. T., on moving part of church. .*691
Brockton, Mass., sewage pumping plant, open vs. closed impellers (H. S. Crocker) ..... 854
Brockway, W. C., on elimination of water tastes, Marquette, Mich. ..... *72
Bronze, manganese, for valve stems (W. R. Conard) ..... 575, Correction 621
Brooklyn, see New York, City
Brown, C. F., on drainage reclamation of alkaline irrigated lands..... 772
Brown, N. A., on sludge disposal at Rochester sewage disposal plant..... n781
Bucket, five-ton ..... n*709
Bucket loader rigged as crane ..... h*163
Budget, Federal ..... e963
Provides for engineering work..... n1036

**BUFFALO, N. Y.**

Brick makers indicated ..... n343
Engineers and other in conference ..... n664
Garbage feeding, city takes over ..... n627
Material dealers indicted ..... n427
Niagara River bridge project again active ..... n422, n832
Ohio Basin, concrete river wall poured inside large steel forms ..... *716
Open shop for builders (F. N. Farrar).. ..... letter 248
Water filters, city votes for .... n167, n869


*Illustrated; e editorials; h, hints; n, news notes; a, abstracts

Page

**BUILDERS (see also CONSTRUCTION, BUILDINGS)**
British who employ ex-service men to get contracts ..... t156
Natl Assn. of Builders' Exchanges and of others ....ed, ("Subscriber") letter 201
New York City ask wage cut ..... n88
Or engineers to supervise work....e923, *954, (G. S. Williams and F. O Lewis) letters 1073.

Building, see Construction
Building Trades Employers' Assn. meeting..n956

**BUILDINGS**
Cement, bulk, for buildings ..... e303, 324
Chicago Federal Reserve Bank, structural features ..... *180
Cities, buildings in 1914-20 ..... n301
Code, Pennsylvania, planned again ..... n81
Code revision, Indianapolis ..... 566
Concrete, light-weight aggregate economical ..... *765
Plant layout for limited room (C. A. Markgraf) ..... *325
Poured in one operation, Germany ... *201
Structural steel top story ..... *229
Extension of tall steel building, New York City ..... *157
Floors, safety in service ..... e49
Inspection, city and private (F. P. Cartwright) ..... *195, e219
Metal lumber ..... n*341
Mill construction, fire tests of new post cap (C. B. Muldaur) ..... *922
Newspaper, special structural design .... *412
Reconstruction of Washington Bldg., N. Y. City (T. K Thomson) ..... *774
Steel houses built by Internatl Housing Corp. ..... n87
Steel top story on concrete building.... *229

Bulkhead construction, waterfront, Chicago and Milwaukee ..... *614, Correction 947
Bulletin board posts public on work progress ..... *690

**BUREAU OF PUB. ROADS**
Engineers to meet ..... n872
*Public Roads* discontinued ..... n1079
Research program begun ..... n789
Study of gravel and sand-clay road economies ..... e303
Surplus equipment charges denied by Mac Donald ..... n295

**BUREAU OF STANDARDS**
Asks $175,000 for structural study ... n1039
Housing materials, Bureau to study .... n35
Publishes data on impact ..... e965
Tests:
Duralmin ..... 309
Hollow brick walls ..... 190
Machine, large, calibrated ..... *723
Soil corrosion of iron and steel pipe.. n833
Steel, medium-carbon ..... 194
Wind tunnel ..... n125

Burr, Prof. W. H. on liberal courses as prerequisite for engineering, editorials, letters, etc. ....e2, n35, e47, 65, 229, 248, 332, 376, 536, 578, 949

Bus companies, see Motor Vehicles

**BUSINESS**
Business men or statesmen ..... e594
Business papers, what they can do to speed business revival, by J. H. McGraw ..... 740
Chiefs confer with Commerce Dept. heads ..... n258
Conference, biggest ..... e674
Depression and recovery British view.. n831
Disarmament conference and business ...e924
Industry leadership in ..... e839
Revival ..... e593, n794
Revival seen in Federal Reserve Board report ..... n791
Survey, monthly ..... *85
Tax relief as business stimulant ..... e509
Trend ...n752, n794, n836, n877, n917, n961, n1005, n1043, n1083

Business Paper Editors, conference ..... n707
Butler, M. on air compressor driven by truck motor ..... h*336
Butler County, Ohio injunction holds up road job ..... n309
Butterfield, E. E. and F. H. Shepheard, on dirt roads treated with steam ashes and cold road oil ..... 477 e510 (O. F. Weisgerber) letter 661

**C**

Cable pull for road grading ..... n*126
Cable reel, electric, self-winding ..... n*293
Cable wire, questions ..... e841
Cableway, aerial supplanted by stone carriers ..... *645
Automatic, single-rope, for handling materials ..... *67
Cabot, P., on engineer a failure as manager ...e674, n692, (R. L. Sackett) letter 826, (C. E. Muhs) letter 867, (C. E. Drayer) letter 950
Caisson sinking in Mexico (T. Hind) ..... *818
Calaveras Dam to be raised ..... n549

**CALIFORNIA**
City planning, short courses in ..... 316
County engineer act held unconstitutional ..... n789
Highways, see Highways, California.
Irrigation bonds, market improves .... n1043
Metal Trades wage cut ..... 1059
Power administrator's office abolished... n82
Motor carriers do large business..... *322
Public works department ... n166, n1076
Water commission has new head, moves to Sacramento ..... n1076
Water power, campaign for..... n294
Tabulated ..... 156
Water resources board begins inventory.n1077

California, Gulf of, see Gulf of California.
California University, stadium planned... Campaign nets million dollars..... n1040
Calumet Harbor, see Chicago.
Camden, N. J., plan commission created... n668
Cammen, L., on centrifugal casting of concrete shapes ..... *366
Campbell, J. L., on engineering education.. 240
Camps, hot water supplied by homemade device ..... h*206

**CANADA**
Freight rates, no reduction now..... n543
Labor, wages lower ..... n588
Niagara power, see Queenston-Chippawa.
Railways, light ..... *899
Railways, rates cut ..... n941
Unemployment, construction relieves stress ..... n631

Canal Zone, labor policy, changes recommended ..... n837, n705

**CANALS**
Cape Cod, Government may buy..... n1078
China, improvement studies completed.. n463
Crawfish borers in bank elimination of (F. Eddy) ..... *887
Chesapeake and Delaware, enlargement begun ..... *922
Chippawa power, sliding form for lining ..... *20
Irrigation, see Irrigation, Canals.
Lining, sliding form for ..... *20
New York State Barge, Ford to operate barges on ..... n254
Ohio River-Lake Erie, opposed by Army engineers ..... n626
Panama, see Panama.
Punjab, glossary of terms (book review) ..... 115
Suez, see Suez.

Cannon, W. B., on mixer mounted on truck chassis ..... h*34
On portable water tank for concrete paving ..... h*120
Canton, China, city planning proposed.... 694
Cape Cod Canal, Government may buy...n1078
Capen, C. H., Jr., on testing and calculating aluminum sulphate solutions ..... *574
Cappelen, F. W., Minneapolis bridge named for ..... n996
Car, batch box, improved ..... n*241
Cars, see Railways, Cars; also Freight.
Carter, C. E., on repairing wind-indented standpipe ...*601, (E. N. Fales) letter *950
Cartwright, F. B., on housing regulations. *318
On municipal and private building inspection ..... *195, e219
Catskill aqueduct, see New York City, Water supply.
Cattle guard saves time on track hauling job ..... h*99
Cedar Rapids, Iowa, water works plan... 187

**CEMENT**
And aggregates, business in..... e132, n171, (E. G. Sutton) letter 500
Atmospheric conditions hasten initial set (C. L. Jenken .....700), (E. L. Conwell) letter 865
Bulk for buildings ..... e303, 324
California Highway Commission receives bids ..... n631
Cincinnati dealers indicted ..... n630
Duty on, House fixes ..... n11
Firms sued in equity ..... n751
Manufacturers' association, civil suit against ..... n40, e47
Output in various months..n342, n546, n710, n876
Output in 1920 highest on record....n630
Plant, state, held legal in South Dakota. 154
Portland chemical analysis, interpretation of (J. C. Witt) ..... 650
First mill in Straits Settlements is American-built ..... *22
Portland Cement Assn. engineers met...n667
Prices ..... n86, n259, n507, n546, n916
Quick hardening, developed by French (E. C. Eckel)... 566, (P. H. Bates) letter 742
Sack shaker, homemade, saves cement ..... n*1075

Cement gun, repair of concrete pavement with gunite unsuccessful..... 682
Used in building flumes, King Hill project (W. Ward) ..... e923, *964, *1044
Used in lining tunnel (W. D. Shannon). *14
Cement, stucco covering for small railway buildings ..... *8
Census in 1925 advocated by Hoover....e1045
Census, traffic, see Highways, Traffic, and Cities, Traffic.
Centrifugal machine casts solid concrete shapes (L. Cummens) ..... *366
Chadwick, H. M., on new curtain wall drop for irrigation canals ..... *179
Chain-testing machine, large, calibrated.. 273
Chambers, R. H., on foundation problems in erecting Standard Oil Building, New York ..... *542
Channels, open, effect of curvature upon flow (H. P. Eddy) ..... 54
Chautauqua Co., N. Y., $1,000,000 highway issue authorized ..... 1044
Chemical device, dry-feed, new Wallace & ..... n1044
Chemist successor to alchemist ..... e169
Concrete, colloidal, ..... n1044
Cheney, P. H., on American and European railway bridge construction..e49, *58, correction, 110, (R. A. Marshall, C. E. Fowler, G. H. Pegram, B. R. Leffler and A. W. Buel) letters 290, (I. F. Stern and A. F. Robinson) letters 375, (J. H. Ehlers) letter 866
Chesapeake & Delaware Canal, enlargement begun ..... *232
Chester, Pa., bridge collapse...n462, e469, (E. Piercy) letter 618
Chezy formula, see Hydraulics.

**CHICAGO**
Bridges beside, put in service ...*604, e396, ..... n1123
Rush St. swing bridge removed.....n123
Building industry, outside contractors recognized ..... n123, n836, n876, e964
Carpenters, city practically open shop.n1043
Situation still unsettled ..... e964
Restrictions laxed, City to rid itself of ..... n876
Calumet Harbor planned ..... n208
City permitted to ..... n122
Civil service employee restored after 13 years ..... n1078
Elevated railway raised ..... *448
Federal Reserve Bank building, structural features ..... *180
Labor chiefs indicted ..... n388
Mail terminal, structural design...*1010, (see also *1068)
Union station, new, center of attractive group ..... *894
Waterfront bulkhead construction..... *614, correction 947
Zone commission ..... n294, n707
Chic., Burlington & Quincy R.R., ash-handling plant at Depew ..... *440
Chic., Rock Island and Pacific R.R., tentative valuation reported ..... n791
Chicago Sanitary District to have expert commission ..... n596
Chile halts public works ..... n1078
Chile, railway electrification ..... 976
Chimneys, brick, felled by dynamiting at base (H. B. Hommon) ..... *370
Concrete, short cut design of (W. W. Christie) ..... *512, (J. T. N. Hoyt) letter 867
China, canal improvement studies completed ..... n183
Chinese question a business matter..... e674
Chivvis, T., on waterworks exhibit, St. Louis ..... *1066
Chloride of zinc, see Wood Preservation.
Chlorine and Chlorination, see Water Supply, also Sewage Treatment.
Chlorine gas made at point of use (C. W. Marsh) ..... 648
Chlorine gas cylinders, Keeping track of.. *1051
Christie, W. W., on short cut design of concrete chimneys..... *512, (J. T. N. Hoyt) letter 867
Church, stone, part moved (G. T. Britt).. *691
Cincinnati, Ohio, belt-line rapid-transit railway (F. L. Rawles) ..... *264
Canal boulevard bond issue defeated...n300
Material firms indicted ..... n630
Planning commission to choose expert. n36
Planning studies to be made ..... n378
Cincinnati University, recent developments (E. J. M.) ..... 977

**CITIES**
Administration by amateurs or experts 619
Amer. Civic Assn. meeting ..... n338
Amer. Soc. of Munic. Improvements convention program ..... n1044
Assess (C. S. Hyde of New Bedford) ..... n1044
Bond issues defeated Kansas City, Mo. ..... 1044
Defeated Oklahoma City ..... 1044
Bond sales recent total $60,890,970..... n877
Dallas, Tex. bonds issue for ..... n1044
Building code revision, Indianapolis... 566
Building in 1914-20..... n301
Building inspection, city and private (F. P. Cartwright) ..... *195, e219
Camden, N. J., plan commission created.n668
Canton, China, planning proposed..... 694
City Managers' Assn. meeting.... n338, n871
Civil service employee, Chicago, restored after 13 years ..... n1078
Commission government, court decision ..... n1123
St. Paul, Minn., to vote on abandoning 782
Commissioner-manager plan, Kalamazoo ..... n925
Lockport, N. Y., rejects..... n869
Classification an issue in appeal for road ..... 941
Cleveland, Ohio, ..... n1044
Dallas, Tex., city hold bonds for premium ..... n1044
Dallas, Tex., industrial district, work begun ..... n832
Engineering problems, transportation, etc. ..... 1044
Engineers, city engineers in name only.e1008


*Illustrated; e, editorial; h, hints; n, news notes; p, ...

Page

Engineers, two, elected to Parliament, B. ...1040
Engineers, standard specifications need ... failure to ...
Flint, Mich., freight belt-line plan.....n503
Graham, Tex., to extend water ... lines .....n1048
Growth, railway, obstacles to .....n1045
Horses, fever, in cities.....247
Housing, see Housing.
Indianapolis flume works program .....n878
Local improvement errors based on actual property values .....n967
Mail distribution, London, rapid.....*1054
Manager, practical advantages under .....1025
Manager plan adopted by Cleveland, Ohio .....n791, e798
St. Paul to vote on manager plan .....n1045
Mapping from the air .....n1045, e990
Massachusetts small plan again in Lowell, Mass .....1013
Municipal ownership, Jersey City favors city-owned gas works .....n833
Paterson votes to acquire water works .....n827
Toronto takes street railways.....611
New London, Conn., commission-manager plan in effect .....1004
Natl. Munic. League meeting.....n338
Planning:
Canton, China, proposed .....694
Cincinnati commission to choose expert .....n36
Cincinnati studies to be made.....n378
City traffic analyzed by diagram (H. Herrold) ..... letter *33
Indianapolis commission appointed....n338
Linear city in theory and practice.. 367
Progress in U. S. (J. L. Crane, Jr.).. 526
St. Paul, Minn., projects .....*735
Regional surveys and city planning.... 201
Short courses in California ..... 316
Population density as basis for housing regulations (F. B. Cartwright) .....*318
Public utility properties, court gives Los Angeles right to take ..... 452
Railway obstacles to city growth..... e033, *046
Residences follow street car lines ..... 183
San Antonio, Tex., all construction work under city engineer ..... 705
Sewers, see Sewers.
St. Paul, Minn., to vote on abondoning commission plan ..... 782
Streets:
Asphalt plant, Phila., new (H. T. Macfarland) ..... *102
Cleaning, Phila., full municipal service ..... n298
Cleaning officials meet in Chicago....n395
Concrete blocks mark cross walks (J. S. Sheafer) ..... *203
Contour map of intersection ..... *932
Dallas, Tex., removes railway tracks.. e633, *646
Intersections, irregular, tables for computing (R. D. Gladding) ..... *518
One-way traffic on Broadway, New York, ends ..... n505
Paving Conference ..... n704
Cleaning, Phila., by contract ends ..... n132
Signs, San Francisco, new..... *805
Traffic control, engineering ..... e1046
Traffic control, London ..... 335
Traffic, Fifth Ave., N. Y. City, signal towers, design selected ..... *788
Swift Current, Sask., dismisses city engineer and board of trade .....n1045
Traffic and transportation (Prof. A. H. Blanchard) ..... 728
Control in operation ..... 348
Data in 1st analyzing (C. H. Herrold) ..... letter *42
Mfg. ... vehicles ..... n790
St. Louis, Mo., suburban and rapid transit plans ..... 805
Transit, St. Louis plans ..... *105
Tr... (R. ...) ..... 778
Subways, neglectable vibration effects.. 60
Water commission, Kansas City, Mo., created ..... n1046
Water supply, see Water Supply.
Water works, St. Louis, shares in exhibit of city activities (T. Chivvis) ..... *1066
Water works school for city employees..n1040
Zoning and living conditions, factors affecting ..... n1045
Baltimore commission appointed ....n339
Chicago ordinance ..... 707
Dept. of Commerce ... to handle ... building .....
Dept. of Commerce names committee...n871
Health value ..... 948
New York City, discussed by Am. Soc. C. E. Section ..... n1077
City Managers' Assn. meeting ..... 735
City Paving Conference ..... n704
Civil Service Examinations ..384, 508, 517, 834, 1002
Civil Service, to appoint ... near ...
Civil Service, Chicago, employee restored after 13 years ..... n1078
Clamshell buckets ..... 10
Clark, C. C., ... ..... 10
Clark, E. E., resigns from I. C. C..... n255
Cleanup ..... e1211, 158
Cleaning ..... n643
Removal ... ..... 785
Clearance, H. ... device for ... upgrade ..... *116
Cleveland, Ohio, adopts manager plan..... 791, 798

Page

City reverts to asphalt filler for brick pavement (F. R. Williams) ..... 633
Public Square station, mayor for relocation ..... n379
Cl... ..... n902
A... ..... *1040
C... ..... 333
A... F... ..... 333
Coal cars, reduced demand for ..... n1172
Coal ... ..... 1
Coaling barge combines dragline bucket and conveyor ..... *603
Coast and Geodetic Survey wants computers ..... n384
Coe, T. H., on determining wages of building trade mechanics ..... n1083
Co... ..... 10
Cofferdams for improvement (S. N. Petrenko) ..... *943
Sheet ... (E. E. ...) ..... *806
... ..... 887
Cold weather ... ..... n957
Collapsible ... ..... 140
Colloidal ... ..... 1
Colloids removal from sewage (W. S. Coulter) ..... 571
Colleges, see Education; also Universities.
Collins, A. L., on new use of pitot tube in testing pumps ..... *616
Colorado, floods, rainfall records and flood ... ..... *23
Colorado highways, see Highways, Colorado.
Colorado-Wyoming water rights case to be ... ..... 968
Colorado River ... ..... n791
Comm... ..... n1075
One ... ..... n81
Power development ..... n1001
Pleasure ... ..... 617
Colorado Soc. of Engineers plans building...n956
... ..... n918
Columbia, District of, see Washington, D.C.
Columbia Basin Irrigation Project, dam ... ..... n83
Columbia River highway toll bridge ... ..... n300
Columbia River power development, Umatilla Rapids ..... 803
Columbus, Ohio, flood-protection work near completion ..... n503
Scioto bridges, two, opened ..... n423

**COLUMNS**

Building, fire resistance as shown by test (R. E. Wilson) ..... e90, *106, 145
Cap, new, for mill construction, fire tests of (G. E. M...) ..... *968
Co... ... by ... (W. ...) ..... 822
Fire resistance of (G. E. Strehan) ..... letter 292
High tension in exterior concrete columns ..... *218 (W. S. ... and M. Thompson) ..... letters 620
Supported by temporary trusses (E. V. Smith) ..... h*377
Timber, to be ... ..... n255
New tests ..... 1075
Colwell Lime ... ... 300 ft. ... ..... 538
Commerce Chamber, U. S., see Chamber of Commerce.
Commerce Dept., see Dept. of Commerce.
Commission, offering, a form of bribery..e1007
Committee on Elimination of Waste, Engineering Council, reports on metal ... ..... n214
Communism, failure in Russia ..... e219
Competition, open, Supreme Court decision ... ..... 1003, 1013
Co... ..... n912
... ..... n719
Compressor, portable, tractor-driven ....n1003
Co... ..... 1029
Computers wanted by Coast and Geodetic ... ..... n384

**CONCRETE** (Material) see also Concrete Beams, etc.

Aggregates:
And cement, business in....e132, n171, (E. G. Sutton) letter 500
Gravel, river, unwashed and ungraded, makes good concrete (J. S. Kennedy) ..... letter 418
Large, used in proportioning and making concrete on Barrett dam (H. N. S...) ..... *695
Light-weight economical in building...*705
S... ..... 1
... site ..... h580
Cement and aggregates, business in.... e132, n171 (E. G. Sutton) letter 500.
C... ..... *80
Cold weather concreting, see Concreting. ..... 117
Corrosion, see Concrete, Reinforced.
Flowability, see Concrete, Mixing.
Forms:
C... ..... *956
Flat slab, for floors, 1¾-in. plank used ... ..... *140
R... ..... *32
River wall poured inside large steel ... ..... *16
... ..... *80
Traveling, cut expense in pouring stadium ..... *
W... ..... *1
... ..... *1

Page

Gasoline, burning, cleans concrete.....h*703
Highway, see Highways, Concrete.
Joint Committee, see Joint Committee.
Lime in, more knowledge needed (L. G. Hall) ..... letter 334
Mixers and mixing, see also Concrete, Proportioning:
Batch buckets carried on flat cars used in building retaining wall .....h*580
Belt conveyor used in mixing and placing (J. S...) ..... h*420
Cement stocked on wheeled platforms moving with mixer ..... h34
Central plant for roads (C. S. Hill)... 636
"Concrete, Manufacture and Use" (book review) ..... 117
Concrete hauled three miles from central plant ..... e174, *176
Flow-table, use of (Prof. G. M. Williams) ..... letter 993
Mixers on city paving work charged by batch-box method (T. W. Dieckmann) ..... h*830
Mounted on truck chassis (W. B. Cannon) ..... h*34
Paving mixers, poor care of ..... e964
Portable conveyor fitted to central mixing plant ..... *267
Pr... use of ... and (R. W. Cram) ..... e798, *812
Simple loading hopper proportions aggregates from stock pile .....h*743
Specifying proportions ..... e798
Tu... ..... n*289
Placing, belt conveyor used (J. Stearns). ..... h*420
Plant, see Concreting plant.
Porous, for well strainers and casings..*853
Proportioning (see also Concrete, Mixing):
Proportioning and making on Barrett dam (H. N. Savage) ..... e673, *695
Specifying concrete quality....68, e91, (W. A. Slater) letter 331
Strength; responsibility on engineer or contractor ..... e964, n997
Proportioning, tests at Washington University ..... 491
Vo... in ... proportioning, by (Prof. A. N. Talbot) ..... e133, a*147
Quality, specifying...68, e91, (W. A. Slater) letter 331.
Reinforced:
Bamboo reinforcement for piles for bridge foundations, China ..... 32
Bars, steel, properties to be tested....n789
Corrosion of reinforcement (L. R. Ferguson)...e262, *271, n294, *323, (E. Godfrey) letter 418, e509, (F. W. Chappell) letter 618.
Design (book review) ..... 117
Diagrams, book review ..... 288
Corrosion, Marlborough Hotel, Atlantic City, N. J., roof failure...e262, n294, *323, letter 418, e509, letter 618.
Corrosion (Nashville bridge)...e924, *934, (W. J. Watson) letter 1072.
Corrosion due to sea water or electrolysis (W. A. Stowe) ..... *528
Corrosion of steel, some examples (Prof. F. P. McKibben)...e509, *531 (N. C. Johnson) letter 620.
Failure, another, due to poor design (H. Cudwell) ..... *860
Set, time of, studied by flow table (W. ... ..... 30
Ships, see Ships.
Specifications, Joint Committee to discuss ..... n874
Strength, see Concrete, Proportioning.
Tests:
Abrasion test, new laboratory (C. H. Sch...) ..... e169, *488
Proportioning at Washington University ..... 491
Set, time of, studied by flow table (W. Davis) ..... 30
Strength at ... intervals after mixing (Prof. R. ...) ..... 773
Strength tests on pre-mixed concrete on Detroit street railways (W. R. Hu...) ..... 881
Thermal properties (book review) ..... 824
Void theory revived (Prof. A. N. Talbot) ..... e133, a*147
Winter concreting, see Concreting.
Concrete beams, see Beams, Concrete.
Concrete blocks, mark cross walks (J. S. Sheafer) ..... *203
Precast, and concrete in dam coping (D. C. Fenston) ..... *371
Surf... ..... 1002
Concrete bridges, see Bridges.
Concrete building plant layout for limited room (C. A. M...) ..... *225
Concrete columns, see Columns.
Concrete floors, see Floors.
Concrete flumes, see Flumes.
Concrete ... see ...
Concrete houses, German, poured in one operation ..... *201
Concrete Institute, see Amer. Concrete Institute.
Concrete piers, see Piers.
Concrete piles, see Piles.
Concrete shapes, centrifugal casting (L. ... ..... *360
Concrete sleepers and ties (book review).. 824
Concrete ships, see Ships, Concrete.
Concrete warehouse, 850-ft., without joints. 273
Concrete ... ..... h*34
Concrete wireless tower, design of (K. Shi... ..... letter 205
Concrete work, book review ..... 658


*Illustrated. †Editorial. ‡Contributed. a Abstracts

Page

**CONCRETING**

River wall poured inside large steel forms ..... *716
Chutes, keeping clear (G. Goodwin) .... h336
Concreting, forms, see Concrete, Forms.
Plant, chuting plant for dam laid out in miniature (C. W. Garrison) ..... *231
Layout for limited room (C. A. Markgraf) ..... *235
Material handling unique in grain elevator construction ..... *974
Mechanical plant reduces gang (H. W. Yonts) ..... h*703
Conduits, electric, explosions in ..... 645
Coney Island, N. Y., West Coast lumber for ..... n877
Conference, international, on economics urged ..... e1046
Connecticut, highways, see Highway, Connecticut.
Connecticut, stream pollution commission... n745, e757
Conrad, W. R., on manganese bronze for water-works valve stems..... 575, correction 621.
Consoer, A. W., on determining highway grades by more exact methods..... *514

**CONSTRUCTION, see also Construction, Steel,**

Assoc. Gen. Contractors plan conferences. ..... n671
British, builders who employ ex-service men to get contracts ..... n130
Camps, see Camps.
Cities, building in ..... n558
Comparison of various years ..... e220
Conditions, when are they good?..... e389
Contracts, large, let ..... n1004
Cost index number, *Engineering News Record's* ..... n137, n382, n567, n670, n730, n918
Costs, ignorance about ..... e549
Course, Univ. of Wisconsin ..... n378
Credit, easier, needed (F. O. Lewis) ..... letter 333
Data collected by Commerce Dept..... n911
Dwelling house, increases in 1921..... n962
Equipment distributers meet ..... n508
*Engineering News-Record,* construction news, how presented ..... n837
Gains ..... n250
Industry waits for steady prices ..... n*878
Labor, see Labor, Building.
Masonry vs. Steel ..... e924, n*954
Materials:
British prices ..... n214
Buffalo dealers indicted ..... n427
Cement, steel and stone, duty fixed.. n41
Cincinnati firms indicted ..... n630
Dealers sentenced ..... e879
Handling, automatic single-rope cableway ..... *67
Iron and steel reduced in price..... n343
Manufacture, engineers and others should learn processes ..... e389
Manufacturers, case against ..... n1004
"Material Handling Equipment" (Wright, Little and Angier) ..... 824
Materials in New York, and railroad strike ..... n711
Metallic (book review) ..... 116
Missouri seeks to dissolve "trusts"... n427
Monthly prices ..... 942
Prices and unemployment ..... e551
Prices lower in August ..... n508
Production and stocks ..... n960
Steel, Bethlehem Co. reduces prices... n42
Tests, hardness testing device, prize offered ..... 15
New York City, survey made ..... n838
New York State..... n42, n171, 690
November, 1921 ..... e879
Open shop in Buffalo (F. N. Farrar)..... letter 248
Operation at 60% capacity ..... e429
Pine pile prices ..... n877
Prices, *Engineering News-Record's* .... n877
Prices, steady, waited for by construction ..... n*876
Projects, 25, entail $60,000,000 expenditure ..... n313
"Public-be-damned" policy ..... e594
Residential building increases ..... n750
Revival cure for unemployment..... n507
San Francisco situation improves ..... n259
Seattle, increase ..... n712
Supervision by engineers or builders? (Brooklyn theater collapse) ..... e923, n*954
Ten projects more than $20,000,000.... n171
Time to build, when costs lack deflated expense ..... n300
Unemployment (E. S. Bradford)..... n*710
Volume index number ..... n750, n918
Waste in, committee report on.... e131, n169

**CONSTRUCTION, STEEL**

Achievement in detail (J. W. Pickworth) ..... e839, *842
Airplane shed with special roof and door construction ..... *565
Book reviews ..... 116
Bridges, see Bridges.
Concrete arch bridge of three 250-ft spans (E. H. Harder) ..... *422
Construction joints in concrete girders 62½-ft. span, Williamsburg Bridge... *348
Curious layout in new British reservoir *535.
Diagram for capacity of unstayed beams ..... *512
Erection of steel building and 150-ft truss (W. J. Howard) ..... *1078
Foreign projects ..... n1083
Mail terminal, Chicago design; has largest steel truss ..... *1010

Page

Railway bridge construction, see Bridges, Railway.
Special design for newspaper building... *412
Steel top story on concrete building ... *229
Temporary trusses support columns (E. U. Smith) ..... h*377
Tests on full-size high voltage transmission towers (E. F. Kriegsman) .... *350
Construction Corps, Division, Service, see Army.
Construction engineer, see Engineers, Construction.
Construction engineering not contracting.. e1008
Consulting engineers, see Engineers, Consulting.

**CONTRACTORS, see also CONTRACTS**

Assoc. Gen. Contractors, see Assoc. Gen. Contractors.
Bond premium case appealed by Government ..... n169
Equipment, locating ..... h*539
Construction engineering not contracting. e1008
Owner and contractor, mutuality of interest (E. Haupt) ..... letter 704
Technique not being developed... e925, *940

**CONTRACTS, see also CONTRACTORS**

August, one week ..... n260, n302
August, 1921, exceeds August, 1920.... n382
First six months of 1921 ..... n10
Highway and others, November... e879, n918
Lump-sum-fee tried by Texas county.. *607
July lettings ..... n212
Large, let ..... n1087
Let contracts now ..... e390
October, $104,318,674 ..... n750
September contracts ..... n548, n586
Standardization conference called ..... n873, e1008, n1036
Value, Aug., 1921, greater than Aug., 1920 ..... e389
Value in July week third highest of year n88
Controlling water after blowing out 16-in. pipe (M. Maffitt) ..... 226
Conveyor and dragline bucket combined in coaling barge ..... *603
Conveyor, belt used in placing concrete (J. Stearns) ..... h*426
Convention programs, overloading ..... e510
Convicts on California road work ..... 534
Cooley, Dean M. L., new pres. of Federation ..... n581, n*583
Coosa River power project, see Alabama Power Co.
Copper-bearing steel in tests..... 61
Copyright dates in book catalogs urged (Prof. T. C. Mead) ..... letter 114
Coral rock, advice on removal sought (W. Cryder) ..... letter 460
Corporation income tax returns include engineering services ..... 158
Corps of Engineers, U. S. A., see Army
Cost index numbers, 1915 to 1921, etc., see "Engineering News-Record."
Cost keeping on asphalt paving (H. C. Browne) ..... *13
Costa Rica-Panama boundary commission.. n379
Costs and estimates in public works..... e131
Coulter, W. S., on removal of colloids from sewage ..... 571
Cox, C. R., on non-bacterial population of sewage trickling filters ..... 720
Cox, F. I., new member I. C. C..... n255
Crane, J. L., Jr., on city planning in U. S.. 526

**CRANES**

Boiler, scale-proof, for locomotive cranes. ..... n*466
Boom, goose-neck ..... n*709
Bucket loader rigged as crane..... h*162
Business improving ..... n507
Crane of 300 tons weight set in place by larger crane (Lieut. W. M. Angas and E. M. Bredin) ..... n*210
Crawling tractor, general purpose.... n*341
Gantry, 30-ton, blown off pier ..... n666
New seven-ton, road-type ..... *257
On push car handles stringers ..... h*622
Pier, N. Y. City, bids to be readvertised ..... n954
Crawfish borers in Canal bank, elimination of (F. M. Nash) ..... *887
Credit easier building, a plea for (F. O. Lewis) ..... letter 333
Creosote, see Wood Preservation
Creeting, J. D., on new precise leveling tripod ..... *968
Crocker H. S., on open vs. closed impellers in Brockton sewage pumping plant .... 854
Crum, R. W., on practical use of excess sand in concrete mixtures..... e788, *842
Crusher, gyratory, invented ..... n*1041
Cubic equations, see Equations
Curvature, effect upon flow in open channels (H. P. Eddy) ..... 516
Curves, highway and railway, see Highways, Curves, and Railways, Curves

**D**

D. L. & W. Ry., see Lackawanna
Dabney, A. L., heads Tennessee highway board ..... n666
On building of emergency Mississippi River levees ..... e17, *6
Dallas County, Tex., highways, bids rejected ..... n712
To let contracts for 67 miles of roads.. n838
Dallas, Tex., bonds held for premium bid. n1036
Contractors and contracts with Labor ..... n*787
Flood protection channel project ..... *492

Page

[illegible] enumeration, city [illegible]
[illegible]
[illegible] district work begins ..... *
Investigates delay in building fort Worth sewage disposal plant..... n1040
Railway tracks removed from streets.. ..... e633, *640
Santa Fe R.R. plans industrial extensions ..... n1039
Sewer contract to relieve unemployment. n788
Zoning ordinance urged to stimulate building ..... e465

**DAMS**

Arcade (C. Prelini) ..... 556 (C. Prelini and N. B. Hunt) letters 1033
Arkansas River dammed by single large block (J. E. Brady) ..... *601
Barrett, proportioning and making concrete on (H. N. Savage) ..... 663, *691
Big Wichita River contract awarded ... n914
Calaveras, to be raised ..... n540
Columbia River, see Columbia Basin.
Concrete chuting plant laid out in miniature (C. W. Garrison) ..... *231
Construction, new proviso in permits... n81
Earth, highest, Reclamation Service building, Tieton Dam ..... *890
Failure danger exaggerated (F. W. Scheidenhelm) ..... letter 119
Foundations, pressure grouting experiences lead to hydraulic machine (S. C. Hulse) ..... *74
Germantown, see Miami Flood Protection Works.
Hetch Hetchy, see San Francisco, Water Supply.
Hydraulic core, exposed by washout ..... e713, n744
Lockington, completed ..... *730
Precast blocks and concrete in dam coping (D. C. Finston) ..... *371
Rimrock, height fixed ..... n464
San Pablo, see Oakland, Cal.
Small, two, good examples of amateur engineering ..... *1018
Teton height fixed ..... n464
Taggart, M. H., on reclaiming Mare swamps for farms ..... 552
Davis, G. A., on simple scaffold carries floor center on high tower ..... h*953
Davis, W., on study of concrete set..... a30
Day of visions ..... e430
Deaths, see Obituaries.
Debts, world's, now and in 1914..... e220
Dee River, England, tidal bore studies (W. Gore) ..... *491
Defiance, Ohio, water-supply, tastes and odors in ..... 771
Deformation, elastic viscous, expressed by [illegible] ..... 22
Delaware, bridges, toll, abolished ..... n38
Delaware River bridge, see Bridges, Philadelphia-Camden.
Dent, Col. E. J., on practical economics of dredge pump design ..... e389, *529
Denver, Civic and Commercial Assn. to pick water consultant ..... n36
Engineering office-club building planned. n956
Water problem, engineer commission suggested ..... n833
Engineer to make survey ..... n165
Denver & Salt Lake Ry., may be junked.. n915
Dept. of Commerce, conference with business men ..... n258
Industrial machinery division's wide field ..... n1005
Leadership in industry ..... e839
Zoning committee named ..... n874
Dept. of Public Works, Corps of Engineers overemphasized ..... e661, 563
Derricks, concrete weight cheaper than iron ..... h*34
Mast, 90-ft., hauled on two trucks.... h*580
Deschutes River power and irrigation project ..... n501
Design, see Engineering, Design.
Detour reports ..... e304

**DETROIT**

Belle Isle bridge authorized by state commission ..... n871
Work progressing ..... n871
Detroit-Windsor bridge ..... *524
City may be lighted by Niagara Falls power ..... e912
Highways, see Highways, Wayne County.
Memorial hall voted ..... n914
Sewer, Highland Park, construction systematized in soft ground tunnel. e925, *940
Water supply, Lake Huron, city gets estimate ..... n464
Water works, valve closing trucks..... *95
Det., Toledo & Ironton R.R., Ford's operation [illegible] letter 579
Diamond mining, Arkansas, hydraulic plant for ..... n464
Dickman, T. W., on mixer charged by batch hopper ..... h*530
Dikes, spur, see Rivers.
Dirt [illegible] with W. S. Murphy ..... letter 856
Disarmament, plea for, from building materials maker ..... n795
Dispersal [illegible] ..... e797, e879, e924, e1005
[illegible] ..... n*384
Division of Housing, see Housing
[illegible] ..... *96
Docks, Rivers [illegible] ..... n*1041
[illegible] N. Petrenell ..... *91
Dock, dry, see Dry dock.


*Illustrated, e editorials, h, hints, n, news notes, a, [illegible]

Page

DRAINAGE

East St. Louis board cancels contract...n668
East St. Louis, Ill., canal.....56, n668
Everglades, Fla., tests on run-off from
Ground water control, Florida (F. Teich-
Grundy County, Mo., to spend $1,172,-
King County, Wash., district enjoined....n745
Minnesota swamp land reclaimed for
New river planned for flood protection
Draw knife digs Detroit sewer tunnels ...h*163
Pumps, centrifugal, economics of design.
Suction, 20-in., operated entirely by
Drift-bolt puller speeds renewal of Lucin
Drills, diamond cut 4½-in core from con-
Drought in British Isles .....*820
Effect on British roads .....641
Dry dock, Balboa, Panama, traps fish .... 146
Sheet-pile cofferdam built in 28-ft. tide,
St. John, N. B. (H. E. Huestis).....*806
Dry-feed chemical device, new Wallace &
Dryland, A., English road engineer, visits
U. S. .....n*423
On American highway practice.....e880, 892
Dunham, W. R., Jr., on strength tests on
pre-mixed concrete on Detroit street rail-
Duralumin made brittle by corrosion .... 309
Durst, R. C., Prof., on strength of concrete
at increasing intervals after mixing .... 773
Dust explosion and collection in grain ele-
Dwelling house construction increases in
Dwight, Col. A. S., British honors..... n82
Blasting pile holes blasted for ocean pier.
(H. H. Braun) .....h*1035

E

Earth, ... (W. S. Mer-
rill) .....letter 826
Earth fills, see Fills, Earth.
Earth handling rapid, on Stanford Stadium 953
Earth moving, see Excavation.
Earth pressure, see Fills, Earth.
Earthquake investigation, Japan ..... 137
East St. Louis, Ill., drainage canal....56, n668
Drainage board cancels canal contract...n668
Eastman, J. B., address on railroads as na-
Eckel, E. C., on new French quick harden-
ing cement.....566 (P. H. Bates) let-
ter 742.

ECONOMICS

"Economic Development of U. S." (Lippin-
Wealth now as great as in 1914.....e220
On significance of hydrogen-ion concen-
Edge, W. S., on new design reinforced-

EDUCATION

Cincinnati University, recent develop-
ments (E. J. M.) ..... 277
Construction course, Univ. of Wisconsin n378
Industrial publishing, training course an-

Irrigation school, secondary ... 373
... sional status (Prof. ... hmbuilding and
Lehigh ... 34
... gineering, editorials, letters ... e2, n35, 578, 949
Princeton Univ., enlarge ... gineering ... n208
Registration of engineer students, Illinois Univ. ... 952
Soc. for Promotion of Engineering Edu- ... 2, n35, e47, 536, 578, 949
Solidity and success ... e839
Wheaton Congregational College, expan- sion program ... *856
Edwards, H. H., on wide asphalt joints not essential in brick pavement- ... *1026
Effert, C. H., on dragline ... piles in 10 hours ... n*120
Electric power, 1,000,000-volt tests ... n501
Electrical power stations, fire protection ... 824
Electric Short Line Ry. Co., ... ut order. n711
Electric welding, see Welding
Electrification of railways ... Railways, Electrification
... ... 821
Elevated railways, see Railways, Elevated
Engine house, see Railways, locomotives
... Corps of En- gineers
Engineer Dept., U. S., see U. S. Engineer Dept.

ENGINEERING

... e1008
Design, thunderstorm breeding spots and. 241
Failures, see Failures, Engineering.
Financial, see "Financial Engineering."
Highways, see Highways, Engineers.
Odor engineering ... e880
Periodicals, getting full value of (P. ... 456
Sanitary, 50 years of (G. W. Fuller) ... a904
Service in corporation income tax re- ... 158
Engineering Advertisers Assn. conference plan ... n301
Engineering Council, Committee on Elimi- nation of Waste, see Committee on Elimi- nation of Waste
Engineering Foundation, research narra- ... 659
"Engineering Index, 1920," review ..... 456

ENGINEERING NEWS-RECORD

... for Sept. ... 29
... n127
Construction news, how presented.....n837
... n1004
Cost index number, 1915 to date....n1084
... n1007
... n960
... n*876
History and editorial staff ..... e1
... n 877
... n*502
... 15, 22
... Committee, see Amer. Engineering Standards Committee.

ENGINEERS

... *685
... n82
And railroads ..... e1
Approaching great problems (G. Linden- ... e809, 861
Army, see Army.
Art and the engineer ..... e173
Average, issue for Sept. 29
... *685
... n1007
Concrete, responsibility for strength, on ... n997
... n1008
... Ex Serv- ... letter 1072
Consulting, accounting records for (A. L. ... *685
... n127
... 1143
... n854
Employment shows year-end pause.....n1076
... 289
... 140
... 712
... 333
... 649
... 1143

Licensing:
... n954, h*579
... passed by Boston ... 104
... n211, n879
... 1541
... n166, 1666
... n999
... n789
Mining, travel sketches (book review).. 117
... Engineers
... n880
Oil ... letter 1072
... n*954
... W. S. Williams and F. O. Lewis) letters 1073.
Overwork and mortality ..... e261, 284
Park ... engineers on ... 21
Pay, high ... highway engineers ... e2
... pay position, U. S. Service ... letter 1072
Navy ... personnel, reduced pay ... n790
Professional ... limitation ... e263
U. S. Engineer Dept., assistant engineers' ... standardized ....n379
Plumber or sanitary engineer (Old Civil Engineer) ... letter, with editorial comment, 538.
... Milwaukee sewer tunnel flooding ... e2, *4
Production, Civil Service to appoint... n259
... e874, n882
(R. L. Sackett) letter 826, (C. E. Muhs) letter 867, (C. E. Drayer) letter 950.
Proposals for engineering services.....e880
Railways, (see also)
D. L. & W. advertises its engineers....e509
... n*422
... n709
Registration, see Engineers, Licensing.
... e873
... n878
... e89, e303
Training engineer for industrial and so- ... Prof. F. Bass and Prof. H. Sutherland ... 929
Unemployment ..... n503
Lower in Colorado ..... n918
Small ..... n788
World's, movement for unity ..... n503
England, see Great Britain.
... Dam, see Miami
English Channel, train ferry ..... 803
... 639
... (Prof. E. Kurtz) .... 973
Erie, Lake, see Lake Erie.
Erie, Pa., Mill Creek flood works, comple- tion celebrated ..... n958
Reciprocating pumps have lowest cost.. 59
... 28
Estimates and costs in public works.....e131
Ethics, code, adopted by Natl Assn. of Builders' Exchanges.....e1, ("Sub- scriber") letter 204.
Offering commission a form of bribery..e1007
Evansville, Ind., public works for unem- ... n913
Everglades, Florida, drainage work ..... 101
Everglades, Fla., tests on run-off from ... e157

EXCAVATION

... n*257
Conveyor for use in narrow alleys...n*341
Drainage ditches, side slopes in unstable ... *927
Pneumatic hammer scoop ..... n*341
... 953
... n*299
... n*257
Tractor grading outfits, operation and ... *800
Trench excavator, new, small ..... n*959
Trusses, temporary support columns (E. V. Smith) ... *377
... *927
Width limits, new device to extend...n*506
Explosion, grain elevator (Chicago, cause of ... 749
In electric conduits ..... 645
... n884
Exports, see Trade, Foreign
Exeter bridge ... (J. Beloe)
e319, *234, 438 (J. M. Paris) letter 621, (C. L. Christensen) letter 865.
Eyes, protection in electric welding (C. W. ... h*120

F

FAILURES, ENGINEERING

... n870
... *872
... e316, 372
... letter 1072
... *234, 438 (J. M. Paris) letter 621, (C. L. Christensen) letter 865.
Brooklyn theater roof collapse....e924, *954, (E. R. T. Boergren) letter 1072.
Chester, Pa., bridge collapse.....n402.
... *886
Dam failure danger exaggerated (F. W. ... 119
... n290
... bursting of high ... plant ..... e634, 640

Page

Roof-slab failure in seashore hotel (L. K. Ferguson) e262 •271 n294 •323 (E. Godfrey) letter 418, e509 (F. W. Chappell) letter 618
Salina, Kan., Masonic Temple falls during construction n•165 e431 •432
Sewer tunnel flooded at Milwaukee e2 •4
Truss, wooden, failure by splitting (H. K. Phelps) .....•514. (H. J. Schenfeld) .....e431 n521
ZR2, dirigible balloon, collapse .....e346

Fairmont, W. Va., concrete arch bridge (E. H. Harber) .....•472
Farm products, rates cut, I. C. C. agrees..n1044
Farms, appraisers, opportunity for engineers as (F. H. Schreiner) .....letter 333
Inquiry commission, transportation division formed .....n298
Lands, Iowa checking erosion .....28
Motor vehicles on .....n65
Federal-aid roads, see Highways, Federal-aid
Federal Cement Co. pamphlet on tile .....n411
Federal Council, see Amer. Assn. of Engineers.
Federal Highway Commission, Williams, S. M., not candidate .....n295
Federal Highway Council, commended ...n208
To cease activities .....n706
Federal Power Commission, see Water Power.

**FEDERATED AMERICAN ENGINEERING SOCIETIES**

Amer. Engineering Council, annual meeting Jan 5 .....n872
Committee on Elimination of Waste in Industry, report .....e131, n169
Plans for engineering assembly committee .....n378
Committee to confer with A. A. E. .... n84
Cooley, Dean M. L., elected pres. n581, n•583
Employment service for engineers to be organized .....n581
Membership now 27 .....n255
Plans .....n255
Vermont and Spokane societies join....n625
Fees, professional .....e263
Feld, J., and Prof. J. M. Braune, on large apparatus for lateral earth pressure tests .....•314
Fellows, A. L., on interstate water controversies .....94
Fender logs, maintenance .....143
Ferguson, L. K., on small concrete roof-slab failure in seashore hotel....e262, •271, n294, •323, (E. Godfrey) letter 418, e509, (F. W. Chappell) letter 618.

**FILLS**

Cohesion in earth (H. Chatley) ....letter 161
Earth pressures, lateral large apparatus for testing (Prof. G. M. Braune and J. Feld) .....•314
Foundation problems and laboratory research (Dr. C. Terzaghi) .....letter •77
Hydraulic, retained by fence of wire cloth (R. R. Lundahl) .....•317

Filters and Filtration, see Water Treatment, Filters, also Sewage Treatment, Filters.
Finance, bank, world F. A. Vanderlip on..n878
Securities, tax-exempt .....e964
"Financial Engineering" (O. B. Goldman and H. Barker) .....letters 114
Financing engineers hear discussion ....n708
Finston, D. C., on precast blocks and concrete in dam copings .....•371

**FIRES**

And shipping piers .....e345, n378
Columns, building, fire resistance as shown by test (R. E. Wilson) ....e90, •106, 145, (G. E. Strehan) letter 292.
Forest, see Forest fires.
Highway bridge, protection studied.....1071
Non-fireproof hospitals, Wisconsin may prohibit .....n1076
Pittsburgh bridge .....n581, •1357
Pressure, water, increased, opposed by Iowa Section, Amer. Water Works Assn. .....n833
Resistance tests of new post cap for mill construction (G. B. Maldaner) .....•928
Prevention in electrical power stations..•874
Seattle wharves burn .....n1076
Shipping piers .....e759, 757, n•788

Fish sales a dry dock product .....146
Fletcher, A. B., new head Calif. division of water rights .....n1076
Flies, fighting with fire and formcut.....e31
House-fly breeds of .....e67
Flint, Mich., freight belt-line plan.....n503
Sewage-disposal studies (J. R. Pollock).•272

**FLOODS AND FLOOD PREVENTION**

Colorado rainfall records and flood estimate .....•22
Colorado reservoir sites studied .....n1043
Columbus, Ohio, work near completion.n502
Dallas, Tex., channel project .....•327
Erie, Pa., celebrates completion of Mill Creek works .....n•1055
Low-grade logs saves pavement from flood damage (C. L. Jenkins).... •341
Minnesota River reforests reservoirs .....•119
Mississippi River, emergency levee lost in record time (A. L. Dabney)...e47, •62
New River planned for flood protection and drainage Yazoo delta .....•484
Phoenix, Ariz .....e•24
Protective measures listed .....e•24
Pueblo, Colo., city arranges for stage of protection .....n•24
Overflow channels proposed .....•520

Page

Tacoma pipe line threatened .....n208
Texas, caused by heavy rainfall .....e467 •491
Tunnel, 20,000-sec.ft., driving for Turkey Creek sewer ..... •888
Turkey Creek sewer, Kansas City, Mo., one of largest yet built (A. D. Ludlow) .....•814
Uncompahgre River .....728

**FLOORS**

Bridges, see Bridges, Floors.
Cap, new, for floors .....n•426
Concrete, early overloading of (W. H. Wheeler) .....letter 826
Flat-slab using 1¾-in plank for forms (J. E. Garvin) .....•400
Joists, safety in service .....e19
Florida, drainage work, ground water control (F. Teichman) .....•406
Highways, see Highway, Florida.
Everglades, see Everglades
Florida East Coast, tentative valuation....n423
Flow curves, see Hydraulics.
Flow table, see Highways, Concrete.
Flumes, concrete and gunite, on King Hill project (W. Ward) .....e928, •926 •1014
Foch, Marshal, honored by societies .....n997, n•1036
Food and wages .....n1042
Food prices, retail, changes in .....n127, n427, n547, n631, n672
Footway built in quick time .....n251
Forbes, H., on underground water storage on Santa Ana cone .....•683
Ford, H., offers to buy Muscle Shoals plant .....n125, e305, 698
Ideas on railroading .....698
Operation of railroad.....e345, (L. J. Carmalt) letter 579.
To operate barges on N. Y. State Canal n254
Ford trucks with flanged tires haul concrete cars .....n•910
Foreign construction projects .....n1083
Foreign Fields, see Notes From Foreign Fields.
Foreign trade, see Trade, Foreign.
Forest fires, danger to timber windfall.. 182
Forest Products Laboratory, tests on built-up timbers .....316
Forest Service, new experiment station ... n87
Forestry investigation continued.....n791
39 states engaged in .....368
French studies in, book review..... 698
Forms, see Concrete, Forms.
Fort Worth, Tex., sewage disposal plant delayed, Dallas investigates .....n1040

**FOUNDATIONS**

Bascule bridge, sinking substructure...•188
Data on settlement wanted .....n255
Hetch Hetchy dam, excavating .....•222
Piers, test of, with 1,000-ton jack.....•763
Problems and laboratory research (Dr. C. Terzaghi).....letter •77
Standard Oil Building, New York, foundation problems (R. H. Chambers) .....•732
Subsoil, sounding rods determine character (E. E. Parker) ....n•539, (G. E. Horr) letter 579, (S. Worthington) letter 909.

Fowler, C. E., review of "Economies of Bridge Work," by Waddell..... 286
France, forestry, studies in, book review. 658
Highways, see Highways, France.
Railways, electrification .....323
Reconstruction .....66, 614
Reconstruction, material to come from Germany .....n823
Franklin County, Ohio, bridge contract illegal .....n37
Free port zone advocated .....n421

**FREIGHT**

Bulk handling plant, Portland, Ore. (G. B. Hegardt) .....•760
Car loadings, decrease and increase...n41, n87, n172, n259, n384, n427, n670, n711
Car movements .....n300
Car priority order protested .....n427
Cars, bad order, drop in number .....n547
Flint, Mich., belt-line plan .....n503
Gravel, sand and stone, cut in rates approved .....n168
Lumber rates reduced .....n313
Local, California, moves by truck .....726
Rates, as deterrent to construction (T. C. Powell and R. P. Stoddard), letters 205, (C. F. Loweth) letter 460
Canadian, no reduction now.....n543
and wages .....n792
Canadian reduction .....n916
Extended steel .....n1005
Farm products, cut, I. C. C. agrees...n1044
Farm and dairy products cut ...e830, n872
Heavy, on lumber, injure industry...n837
Iron tubes higher on scrap than on pig .....n67
Lumber, reduced .....n1005
Materials, road-building, Ohio investigates rates .....n•88
Materials hearings set .....n1083
Reductions .....n86, e820, n872
Road materials, rate on, ordered lowered in Ohio .....n671
Steel, increase, freight on .....e593
Tonnage in 1920, railway .....n128
Freight Keep right road clear .....518
Freight yards, see Railways, Terminals.
Fresno, Cal., city hall and courthouse .....n•626
Fuel oil, see Railways, Locomotives ....e673
Fuel, pulverizing, mill for .....n585
Fuller, G. W., on 50 years of sanitary engineering .....n904

Page

Fuller, G. W., Zeolite water softening patents upheld .....n1085

**GARBAGE**

Baltimore, temporary and permanent disposal methods .....694
Boston, bids invited .....n87
Two bids for disposal .....n106
Chosen to accept offer .....n•788
Buffalo, N. Y., city takes over feeding contract .....n627
Conference on Disposal of Municipal Refuse (Herring) .....book review, 111
Contracts, bids .....n•1085
Conditions, unstable .....n908
Dallas, Tex., awards incineration contract. n627
Incinerator for mill refuse made of brick and concrete .....•737
Los Angeles accepts hog feeding..n81, n256
Montreal, incinerator, city asks bids...n627
New York City, $2,000,000 for disposal. n209
Philadelphia asks bids on incinerator .....n259
Incinerator bids opened .....n667
Providence, R. I., feeding contract....n582
Pulverization in English towns .....735
Seattle, city's right to restaurant garbage is to be tested .....n627
City's right to restaurant garbage upheld .....n1080
Street cleaning officials meet in Chicago. n295

Garrison, C. W., on concrete chuting plant for dam laid out in miniature.....•231
Gas from sewage sludge used as motive power (J. D. Watson) .....1062
Gas holder crown ruptured by unknown cause .....n296
Gas, power, from sewage sludge .....637
Gasoline, burning cleans concrete .....n•703
Tax, see Highways, Gasoline tax
Geffert, Prof. H. H., new secretary British civil engineers .....n914
Geiger, C. W., on protecting eyes in welding .....n•120
On protecting hose from vehicles.....h•80
On brick for steam shovel made of timber sections .....h•162
Gen. Elec. Co. cuts wages at Lynn.....n259
Pittsfield, Mass., million-volt tests.....n501
Geological Survey, activities .....1028
Assisting by engineers (C. H. Birdseye) .....letter 1074
Germany, concrete houses poured in one operation .....•201
Port equipment barred from New York .....e221, n252, 417
Settlement (H. W. Durham) .....letter 204
Girders, concrete, construction joints in 62½-ft. span....•348, (W. S. Tait and M. Thompson) letters 620
Concrete, jacked up to replace settled bridge, letter (W. J. Tatsch) .....•638
Curved-wall girder falls (W. W. Bigelow) letter •618
Givotovsky, V. T., and A. V. Karpov, on concrete T-beam diagram for designing and checking .....•520
Gladding, R. D., on tables for computing irregular street intersections.....•518
Goethals, Gen. G. W., completes Lake Dallas survey .....n744
Goldman, O. B., "Financial Engineering" (O. B. Goldman and H. Barker) ..... letters 114
Gompers, S., on autos and ice cream for workers .....e345
On unemployment .....n391
Plans to decrease seasonal unemployment .....n213
Good Roads Show .....n911
Goodwin, G., on keeping concrete chutes clean .....h330
Gore, W., on tidal bore studies, River Dee, England .....•491
Government, control during war (Baker), book review .....797
Budget .....n963
Engineering work, budget provides for..n1038
Part in solving housing problem .....n129
Sanitary engineers, Federal...e261, n294, n540
Tax bill, six salient features.....n1042
Grade crossings, see Railways, Grade Crossings
Grader, scarifier .....257
Grading outfits, tractor, hints on operation and maintenance .....•800
Graham, Tex., to extend water and sewer facilities .....n1038
Grain export rates leading .....n89
Movement heavy .....n759
Grain elevator explosion, see Accidents
Granulated pumice, see Pumice
Grandstand, concrete, jacked up for enlargement (E. Robertson) .....•818
Granite block pavers, see Bricklayers (H. W. Durham), letter 618.
Gravel, specific gravity, central book review. 659
Graphical representation, art of (Marshall), book review .....900
Gravel, freight cut approved .....n168

**GREAT BRITAIN**

Builders who employ ex-service men to get contracts .....n58
Cement factory .....n69, 1
Coal strike, see Labor, Strikes
Contractors' plant, see .....n114
Depression and recovery, British view...n831
Dockyards .....•81
Exports .....n•1

•Illustrated. e, editorial; h, hints; n, news notes; s, statements.

Page

Highways, see Highways, Great Britain
Hoisting engines ..... 365
Hollow-core floors ..... *891
Hospitals, see Buildings
Power ..... n259
Lab... ..... 56
Pow... ..... 803
Railways, see Railways, Great Britain
Relief works for unemployed not eco- ..... n671
Sa... ..... 145
Tu... ..... n915
Wa... ..... 227
Wa... ..... 104
Great Falls power development, Winnipeg, started ..... n986
Great Lakes, Ill., harbor, breakwaters of three types ..... *1069
Great Lakes and Niagara River diversion, book review ..... 288
Great Lakes, Hudson & Atlantic Waterways Assn., W...
Green, R. M., ... paper comes a menace to asphalt pavement ..... *649
On Topeka mixed bituminous pavement ..... 725
Gregory, J. H., review of Efficiency of Pumps and Ejectors," by Bowden-Smith 287
Greve, Prof. F. W., on flow of water through galvanized spiral riveted steel pipe ..... *159
Grouting, pressure experiences lead to ... ..... *74
Grouting sewer tunnel cavity from test pits avoids building settlement (L. G. Hall) ..... h*293
Grundy County, Mo., to spend $1,172,556 ..... n833
Guard rail ... for highways ..... 821
Gulf Coast bridges, see Louisville & Nashville
Gulf of California water-rail terminal pro- ..... n543
Gunite, see Cement Gun
Gurvin, J. E., on using 1¾-in. plank for ... ..... *400
Gurvus, C. W., on engineering education 239
Gypsum makers ... ..... n467

H

Hackney, lever handled ..... n*835
Hall, H. S., and G. W. Watson, on British ... ..... *9
Hall, L. G., on grouting sewer tunnel cavity from test pits, etc. ..... h*293
On man-hours and material cost for cast- ... ..... 413
On oyster shells as road surfacing ..... 352
On preventing undermining of small sea- ... ..... *854
Hammer ... ..... n*341
Hammer, water, see Water Works
Hammers, pneumatic, tools for tunneling h*206
Hammond, John Hays, heard on The Engineer ..... 289
Hanna, F. W., review of "Notes on Irriga- ... ..... 458
Harbors, see Ports and Harbors
Harbors ... $27,000,000 ..... n*98
... ..... 1016
Harder, E. H., ... with heads of three 25-... ..... *173
Harding, P... ... on ... ..... n383
... ..... 964
Harding, R. J., on San Antonio flood ..... 494
Hardness testing device, prize offered ..... 15
... ..... 1016
Harrigan, D. D., on San Antonio flood ..... 494
Hartford, Conn., water works, abolition of ... ..... 390
... report on ... ..... n164
Hart Proof W... ... ... 

Page

Essay board Dean A. N. Johnson heads. n379
Federal aid:
Bills—consideration, passage, etc. 27, 355, e81, e81, n122, n164, n211, n253, n295, n337, e345, n378 n380, n422, n543, n587, n625 n666 n704 n747, n788, e799 n831 n871
Highway officials want continuity. . . n996
Minnesota and New Jersey to ask Congress to double, to relieve unemployment . . . . . n587
Senate resolution for probe . . . . . n378
Senators want aid extended . . . . . n997
Work begun under new act. . . . . n871
Financing see Highways Bonds.
Florida, bids on roads costing $2,500,000 to be received . . . . . n1040
Bonds unsalable within legal limits. . . n1037
Flow table, see Highways, Concrete.
France, national office proposed. . . . . n81
Fresnos clear plank road . . 518 (C. Kooy) letter 701
Gasoline tax in 14 states . . . . . n501
Louisiana, proposed . . . . . n123
Good Roads Show demand for space. . . n911
Grade crossings, Michigan, reduced . . . n298
Grade line, low, saves pavement from flood damage (C. L. Jenken) . . . . . 41
Grade line location, diagram for final adjustment (S. E. Reed) . . . . . 517
Grades, determining by more exact methods (A. W. Consoer) . . . . . *511
In side-hill county, locating (G. A. Tilton, Jr.) . . . . . 455, *455
Grading, cable pull for . . . . . n*428
Grader-scarifier . . . . . n*757
Machine cuts grade for forms . . . n*120
Granite block, bituminous filler for . . . . 868
Specifications (H. W. Durham) . . letter 618
Gravel-road economies . . . . . e303
motor truck with scraper blade, for maintenance . . . . . n*875
Test road for heavy traffic . . . . . 400
Great Britain:
Dressings for tar macadam . . . . . 73
Drought, effect of . . . . . 639
Policy . . . . . 84
Regulations, revised . . . . . 601
Roadmen's wages . . . . . 570
Tax receipts . . . . . n39, 430
Transportation minister, power under roads act . . . . . 271
Guard rail concrete, inexpensive . . . . . *821
Hawaii, old trail teaches subgrade lesson (Col. R. R. Raymond) . . . . . letter *619
Illinois:
Bridge program for 1922 large. . . . . n546
Bridges, 61, state wants bids . . . . . n540
Contracts for concrete roads average less than $30,000 mile . . . . . n259
Contracts for 283 miles let . . . . . n428
F. T. Sheets new head . . . . . n*542
Traffic endurance test begun (C. Older) . . . . . e263 274
Impact on pavement slabs shown by tests . . . . . *944
Bureau of Public Roads publishes research data . . . . . e965
Internatl. Assn. of Road Congresses, dues advanced . . . . . n748
New members . . . . . n421
Postponed to 1923 . . . . . n338
Contracts, large, planned . . . . . n1002
Iowa, practical use of excess sand in concrete mixtures (R. W. Crum) . . e798, *812
Kentucky, department to decentralize activities . . . . . n913
Legislation, see Highways, Federal-aid
Louisiana, proposed legislation on motor vehicle taxes, gasoline taxes, etc. . . . n123
Road and motor vehicle legislation . . n503
Macadam, tar dressings for . . . . . 73
Machinery, exports in September . . . . . 943
Maine, maintenance costs . . . . . 1035
Map service weekly, Wisconsin . . . . . 360
Maryland, accident records as guide to improvement . . . . . n667
Contracts awarded . . . . . n507
Materials, Colorado to make survey . . . n161
Ohio investigates freight rates . . . . n258
Ordered lowered . . . . . n671
Prices and recent contracts . . . . . n1035
Michigan grade crossings reduced . . . n298
Minnesota, inter-work state gets low prices . . . . . n1037
Missouri $60,000,000 bill becomes law n380
Moisture, see Highways, Subgrades
Motor vehicles, effect on roads and legislation, see Motor Vehicles.
Nebraska, earth road maintenance costs. 76
New Hampshire contract price for mile $16,332 . . . . . n130
New Jersey:
Cores taken from roads and research . . 807
Department issues "The Highwayman" . . . . . n 43
New, cost $1,885,741 . . . . . n836
New York State:
Bids on 68 miles 86% of estimate . . . . . n178
Bids received . . . . . n631
Contractors and itemized bids . . . . 344
Contracts $2,000,000 let . . . . . n343
Double slab concrete roads . . . . . e797
*804. (R. R. Arnold) letter 1033
Fall letting of contracts . . . . . n541
Traffic census map . . . . . n*224
North Carolina $50,000,000 program . . . . .
Work active . . . . . n1040
Ohio:
Bids to be opened Aug. 19 . . . . . n*55
Bids far below estimates . . . . . n*55
Bids 86% of estimates . . . . . n154
Brick filler . . . . . 22

Page

Freight rate on materials ordered lowered . . . . . n671
Lettings worth $1,847,907 . . . . . n213
State investigates freight rates on materials . . . . . n258
Ten-ton motor truck limit opposed . . n125
Work active . . . . . n507
Work averages $1,000,000 weekly . . . n129
Oil heater hand, fills pavement joints . . h*336
Oil-heating outfit, homemade, for small jobs . . . . . h*461
Oyster shells as surfacing (L. G. Hall) 352
Pavement, breaker improvised from steam shovel . . . . . h*163
Joints filled by hand oil heater . . . . h*336
Pavement patents, Warren, status of. . . . e963, 969
Paving mixers, poor care of. . . . . e964
Pennsylvania:
Bids on 60 miles of durable pavement received . . . . . n129, n258
Concrete, state builds 520 miles . . . . n547
Contractors hold conference. . . . . n1037
Contracts let . . . . . n631
Durable for 1921 . . . . . n1082
Funds needed . . . . . n548
Report card, daily . . . . . *571
State ahead of 1920 in building . . . . n41
Widening planned . . . . . n166
Work on concrete roads . . . . . n212
Permanent Internatl. Assn. of Road Congresses, see Highways, International, etc.
Pitch, elastic viscous deformation, formula for . . . . . 22
Plank road kept clear by fresnos . . . 518, (C. Kooy) letter 701
Repair compact outfit . . . . . n*506
Homemade oil-heating outfit . . . . . h*461
Portable water tank (W. B. Cannon) h*120
Research program, outline by Prof. W. K. Hatt . . . . . 450
Data, new . . . . . e965
Federal Bureau starts new program . . n789
Prof. Hatt made director . . . . . e132, n164
Rollers, charges cut . . . . . e89, n128
Safety, aids a railroad engineer . . . e549, n882
Sand-clay road economies . . . . . e303
Sand drifts, fresnos keep road clear . . 518, (C. Kooy) letter 701
Scarifier grader . . . . . 257
School for state employees planned in Wisconsin . . . . . n1037
Soft, see Highways, Earth
South Carolina, bond issue, movement begun . . . . . n207
St. Louis County, Minn., to let $2,000,000 work . . . . . n87
Standards, progress of . . . . . e963, 969
State departments announce policy on fall lettings . . . . n623, n664, e674, n707, n790
Steel in concrete, cost of (H. E. Breed) . *139
Comment . . . . . *446
Subgrades, old Hawaiian trail teaches lesson (Col. R. R. Raymond) . . letter *619
Tar paper over . . . . . 690
Unfinished, effect of tires on (H. W. Slauson) . . . . . letter *994
Subsoil tests begun in California . . . . n958
Surface treatment, of dirt roads, with steam ashes and cold road oil (F. H. Shepherd and F. E. Butterfield) . . 477, e510, (O. F. Weisgerber) letter 661
Surfacing (C. Manchester, Eng. . . . . 609
Survey, Government, planned (T. W. Allen) . . . . . e133, 138
Tennessee, bulletin, "Tennessee Highways" issued . . . . . n707
Tests, Illinois (C. Older) . . . . . e263, 274
Pittsburg, Cal. . . . . e1045
Subgrade, new device for testing. (H. F. Clemmer) . . . . . *146
Subsoil began in California . . . . . n958
Test road, gravel, for heavy traffic . . . 400
Trucks start to . . destroy fresh concrete roads . . . . . n873
Texas close bidding . . . . . n795
Payments, distribution of . . . . . n1043
Unemployed to have work . . . . . n671
Work totals $26,955,348 . . . . . n87
TNT for road construction . . . . . 353
Townsend bill, see Highways, Federal-aid
Traction resistance data wanted . . . . n540
Traffic, New York State, census map . . *233
Recreation, British . . . . . 271
To meet education conference needs . . n251
Transport progress shown in pageant . . n583
Warren patents, status of . . . . . e963, 969
Washington, D. C., paving policy announced . . . . . n583
Washington State city classification assails appeal for road funds . . . . . n542
Progress . . . . . n870
Water . . . . . n507
Wayne County Mich., detours in service-to-traffic policed (E. N. Hines) . . . . . *93
Widens old concrete roads . . . . . *767
Wichita County, Tex., lets lump-sum fo. contract . . . . . *607
Wisconsin, gravel test road for heavy traffic . . . . . 100
Map cover weekly . . . . . 360
Road school for state employees planned . . . . . n1037
State builds 2,752 miles in 1921 . . . 895
Hill, C. S., on central mixing for concrete road . . . . . 636
Hind, T., on pneumatic caisson sinking n*548
Hind, J., on tables for designing tunnel and sewer linings . . . . . 693
Hines, E. N., on detours in service-to-traffic . . . . . 93
Hickey, W. O., on engineering education . 240

Page

Hoboken pier fire . . . . . e445, n478
"Hoe, steam," for excavation . . . . . *257
Hoe with straightened blade speeds paving hand . . . . . h1035
Hoist and compressor combined . . . . . n*749
Hoist runners—not engineers . . . . . n1037
Hoisting engine, "Turbinair Hoist" . . . . . n*299
Hoists, new line . . . . . n629
Holden, Prof. C. A., on later work, not education, raises professional status . . . 949
Holland, C. M., visits European tunnels n164, n252
And R. Ridgway return from Europe . . n625
Hollow metal doors, etc., decision upon upheld by Assoc. Gen. Contractors board. n544
Hollow tile, see Tile
Holy Land, see Palestine
Home ownership in U. S. . . . . 1060
Hommon, H. B., on telling brick chimneys by dynamiting at base . . . . . *370
Hoover, H. C., confers with industry chiefs n258
Endorses trade associations . . . . . n911
For census in 1925 . . . . . e1045
Message to business paper editors . . . . . n707
New York Engineers' Club honors . . . . n667
On Colorado River Commission . . . . . n1076
On housing problem . . . . . n129
Urges fall letting of road contracts e174, n210
Hopewell, Va., war waterworks and houses sold . . . . . 847
Hopkins, A. D., and T. E. Snyder, on powder-post beetle damages to wood . . . . . *269
Hopper, design of, diagram aids slope determination (H. J. Adams) . . . . . *513
Horr, G. E., on determining subsoil with sounding rods . . . h*539, (G. E. Horr) letter 579, (S. Worthington) letter 909
Horses, fewer, in cities . . . . . 247
Horton, R. E., review of "Centrifugal Pumps" (Cameron) . . . . . 658
Hose protected from vehicles, (C. W. Geiger) h*80
Hospitals, non-fireproof, Wisconsin may prohibit . . . . . n1076
Houk, I. E., on damming Arkansas River by single blast . . . . . *601
On high rainfall and run-off from small areas . . . . . *480
House ownership in U. S. . . . . 1060
Houses, see Buildings:

**HOUSING**

Division begins work . . . . . n171
Government's part in solving problem . . 129
Great Britain, contracts . . . . . 365
Government policy . . . . . n259
Nationalization fails . . . . . 436
House ownership in U. S. . . . . 1060
Houses, steel for housing, built by Internatl. Housing Corp. . . . . n87
Investigation, New York, halts . . . . . n546
Materials, Bureau of Standards to study n35
Phila. association makes survey . . . . n212
Regulations based on population density (F. B. Cartwright) . . . . . *318
Houston, Sir A., on bacterial tests of water . . . . . e389, e470, 484, correction e509
On London's water supply, book review. . 990
Howard, W. J., on erection of steel building and 150-ft. truss . . . . . *1058

**HUDSON RIVER VEHICULAR TUNNEL**

Bids to be called for. . . . . n103
Bids, new received . . . . . n124
Bonds authorized by N. J. commission . . n957
Consulting engineers, "dismissal" . . e90, n122
Deadlock . . . . . e470, n583
Holland visits European tunnels . . n164, n252
Status still unchanged . . . . . n912
Work resumed . . . . . e47, n82
Huestis, H. E., on building sheet-pile cofferdam in 28-ft. tide . . . . . *806
Hulse, S. C., on hydraulic machine in pressure grouting . . . . . *74
Hunsaker, A. G., on aeration period in activated-sludge process of sludge . . . . . *610
Hydraulic dams, see Dams
Hydraulic excavation, see Excavation
Hydraulic fill, see Fills, Earth

**HYDRAULICS**

Computing reservoir outflow and height from inflow and capacity (J. C. Stevens) . . . . . *1031
Curvature, effect upon flow in open channels (H. P. Eddy) . . . . . 548
Flow-duration curves, time units (M. R. Sherbondy) . . letter *250, (E. H. Sargent) letter 400
Flow of water through galvanized spiral riveted steel pipe (Prof. F. W. Greve) *159
Formula, Manning's better than Kutter's *96
Loss of head for pipe discharging under water into reservoir (C. O. Wisler) . . *886
Measurements, in India, use of photography (S. C. Majumdar) . . . . . *111
Pitot tube, new use in testing pumps (A. L. Collins) . . . . . *616
Tables for designing tunnel, pressure water and sewer tunnels (J. Hind) . . . 693
Hydro-electric power, see Water Power
Hydrogen-ion concentration significance of. (H. P. Eddy) . . . . . 498
Hudson River bridge, see Bridges, Hudson River

**I**

Idaho, water power, Federal permit for . . n422
Illinois Central [illegible] approved . . . . . 661
Illinois, bridges on Lake Michigan . . . . n1037
Illinois Engineering Experiment Station . . . . . 1060
Illinois, R.R. and [illegible] . . . . . *1
Illinois, [illegible] . . . . . 1
Illinois, [illegible] . . . . . 1


*Illustrated. †Contributed. h Hints. n News notes. e Editorial.

Page

Illinois Society of Engineers, duties for [illegible] n831
Income tax from loan associations, legality to be tested .... n630
Returns, corporation, include engineer- .... 158
Index numbers, American and European .n*1004
Industrial photography (S. C. Majumdar) .... *414
Industrial plants enter new fields .... e910
Industrial railways, see Railways, Industrial.
Industrial relations conference, Harrisburg, Pa. .... n667
Injunctions in strikes, see Labor, Strikes. 824
Insects and disease, book review .... 659
Inspection, building, see Buildings.
Institution of Civil Engineers, controversy in .... e132
Prof. Geffcot new secretary .... n914
International Chamber of Commerce to meet in .... n833
International understanding among engineers, opportunity missed .... e673

INTERSTATE COMMERCE COMMISSION

Chicago office of valuation bureau .... n956
Clarence Cox opposed .... n559
Rates on farm products, com .... n1044
Labor inefficiency, decision on .... e304
Plan for grouping railway companies .... n685, e550, n881
Valuation, see Railways, Valuation.
Interstate water, see Water Rights.
Invention, military, to be encouraged .... n204
Iowa, farm lands, checking erosion .... 28
Highways, see Highways, Iowa.
Sewage plants not well operated .... n987
Iowa Section, Amer. Water Works Assn., opposes raising pressure for fires .... n833
Iron and steel, see Bridges, Railways, also Highways, Impact.
Irrigation, see Water Rights.
Jackson, Miss., New Orleans & Northeastern Ry., see Railways, New Orleans & Northeastern.
Jacobs, W. W., see Bridges.
Jacobson, C. A., death of .... n*155
Jaffa, Palestine, water supply of .... n*727
Jaw crusher frames, [illegible] .... e*1014
Jenkins, C. L., on atmospheric conditions .... 700, (E. L. Conwell) letter 805.
On low grade line saves pavement from [illegible] .... 741
Jersey City favors city-owned gas works .... n833
Jetties, ocean, wooden ships suggested for .... letter 161
Johnson, Dean A. N., [illegible] .... n379
On engineer [illegible] .... n779
Johnson, G. A., on Cambridge, Mass., mechanical [illegible] .... e391, 416
Joint [illegible] report on .... n666
sale .... e713
Report, two-day discussion .... n791
Specifications, discussion of .... e964, n997
Specifications, tentative .... 68, e91, (W. A. Slater) letter 331.
Jones, F. E., on aerial photographic map[illegible] .... e595, *596
[illegible] Road of Ideas .... 822

K

Kalamazoo retains commissioner-manager plan .... n625
Kansas City, Mo., bonds for water, etc., defeated .... n913
Sewers, Blue River problem .... 439
[illegible] .... *815
Tunnel work [illegible] .... *882
Water commission elected, bond issue .... n956
Kansas City Engineers' Club leaves A. A. E. .... n256
Water supply, concrete pipe line aug. .... *1029
Karpov, A. V., and V. T. Givotovsky, on [illegible] .... *520
Keefer, C. E., on enlargement of Baltimore [illegible] .... 631, 654
Keely, R. R., [illegible] .... n881, 896
Keller, Col. C., new engineer-commissioner .... n*541
Kelly, W., [illegible] .... n82
Kendrick, J. W., engineers object to his dismissal as city engineer, Birmingham, Ala. .... n912
Kennewick Irrigation District wins in court .... n791
Kentucky highways, see Highways, Ky.
Kern Canyon power plant in service .... n547
Kern Co., Cal., oil fields, novel strike in .... e674
Kern River, Cal., power plant, automatic [illegible] .... e30, 453
King County, Wash., drainage district engineer .... n745
King Hill project, see Irrigation, King Hill.
King River, see Irrigation, King River.
Kornfeld, E., on industrial development, Pa. .... 32
Kriegsman, E. F., on tests on full-size high[illegible] .... *350
Kulicka, O. C., on use of poisons in [illegible] .... 322
Kurtz, C. M., on preservation of timber .... *942
Kurtz, Prof. E., on life of equipment .... 973
Kutter's formula, see Hydraulics.

L

LABOR

Academy of German [illegible] .... e925
American [illegible] result of San Francisco fire .... n429
Progress of .... e303
Association [illegible] .... e345
[illegible] .... n888
[illegible] .... n705
Chicago [illegible] proposes to [illegible] .... n846
Chicago, carpenter trade virtually open [illegible] .... n1043
[illegible] .... n688
Compensation for death, due to typhoid .n981
Conference [illegible]
American plan probable result of San Francisco strike .... n428

Page

"American Plan," progress of .... e303
Chicago organizations oppose restrictions .... n876
Dallas contractors end contracts .... n382
Disputes in several cities settled .... n129
San Francisco, situation clears .n427, n711
Union control in Chicago doomed .... n961
Unionists gain in number .... n795
Wage settlements made .... n169
Wages of mechanics, determining [illegible] .... n1083
Dallas contractors end contracts with labor .... n382
Employment increases and decreases .... n711
Engineering, dispute in Great Britain .n744
Factory, earnings increase .... n796
Employees in New York, average earnings .... n711
Food and wages .... n1042
Gompers on rates and ice cream for workers .... e345
Great Britain, engineering trades dispute .... n744
Highway, turnover high .... e89 *111
Industrial relations conference, Harrisburg, Pa. .... n667
Inefficiency, I. C. C. decision on .... e304
Jurisdictional dispute halts work .. n547, correction n583
Landis award, Chicago .... n427, n836
.... n876, n961, n1082
Leaders, blindness of .... e873
Diplomacy in .... e880
Loyal Labor Legion formed .... n212
Mechanization, excessive, ills of (W. Bethlehem) .... letter 701
New York State, supply and demand .... n343
Notes .... n836
Oklahoma eight-hour law attacked .... n631
Open shop, see Labor, Unions.
Output, individual, increased .... e221
Picketing, decisions on .... e1009
Railway:
Eight hours' work for ten hours' pay, [illegible] .... e1008
Inefficiency, I. C. C. decision on .. n296, e304
Pay cut order .... n711
Penn. R.R. elections illegal .... n293
Shop craft rules, new, in effect .... n1006
Wage cut to be pressed by executives .... n789, n837
Wage meeting set for Jan. 16 .... n1044
Working agreements, sanity in .... e923
Rates and conditions .... n41, n587, n917
Roadmen's wages, British .... 570
Rowntree, B. S., studies American industrial relations .... e758, e797
Seattle, citizens only on improvement [illegible] .... n882, n884
Strikes:
Building disputes in several cities settled .... n129
Coal strike, British, settlement plan .... e47
Intimidation enjoined .... e797
Kern oil fields, a strike with novel features .... e674
Railroad shop [illegible] .... e633, n667, e673, n705, n711, e713, e715, n748, n789
San Francisco, American plan probable result .... n428
Supply and demand .... 702
Unemployment:
American citizens, preference for .... e593
August, 5,500,000 .... n342
British relief .... n918
Building revival called cure .... n507
Building trades (E. S. Bradford) .... n*710
Canada, construction relieves stress .. n631
Cities lay plans .... n706
City bond sales and unemployment .. n877
Conference, Washington .... n383, e549, e551, 576, n581, n623, n631, e634, 657, n663, n1080
Conference reports about 4,000,000 out .... n631
Conference results .... e634, 657, n663
Conference results cited .... n1
Col. Woods to co-ordinate effort .... n623
Dallas, Tex., to build sewer to relieve unemployment .... n788
England, [illegible] plans public works for unemployed .... n913
Extension [illegible] .... e558
Fear of .... n891
Gompers' views on .... n213
Gompers urges plan to decrease .... n213
Great Britain relief works not economical .... n671
Increases and decreases .. n171, n260, n302, n711
Industries, various .... n547
Lumber industry .... n631
Maintaining worker's standards .... e797
Milwaukee committee recommends relief .... n917
Minnesota and New Jersey to ask U. S. to double Federal aid on highways .... n587
New York City, bureau recommended .n507
New York in October .... n918
New York State .. n42, n428, n443, n792
October, lower .... n918
Ohio plans relief .... n507
Ontario to extend railway to provide [illegible] .... n588
Public works [illegible] .... n581
Public works urged .... n259
Rawles, Wise, relief work .... n794
Relief plans .... e797
Rowntree, B. S., views on .... e758, e797
Standard Oil plans work .... n671
Statistics .... n631
Texas [illegible] .... n788
Texas unemployed to [illegible] .... n671
Tons lost yearly in [illegible] .... n631
Wage loss yearly in [illegible] .... n631


*Illustrated. †Editorial. ‡Contributed. §Leading article. a, abstracts

Pag

Wilmington, Del., provides pavement work ..... n961
Worcester, Mass., emergency work ..... n504, n882
Unions open shop for builders in Indianapolis (F. N. Farrar) ..... letter 248
Wage reductions:
Approach deflated living costs ..... 1442
Average, 1662 ..... 1710
Building employers, New York, ask cut ..... 1888
California metal trades ..... n169
Canada ..... n888
Chicago and Navy Dept. Lands decision ..... e429, n405 1813
Gen. Elec. Co. at Lynn ..... 1759
Newark, N. J., dispute settled ..... 1501
Providence, R. I., electricians' union makes offer ..... 1501
Paper mill ..... 1762
Railway, plan for ..... 1837
Settlements made ..... 1759
Tidewater Oil Co. ..... n631
Worker's standards, maintaining ..... 597
Lackawanna Ry. advertises its engineers 1569
Plans electrification both ways from Scranton ..... n622
Lake Cushman, see Tacoma
Lake Dallas project. Goethals completes survey ..... n744
Lake Erie, breakwaters of precast concrete ..... 1362
Lake Erie-Ohio River canal opposed by Army engineers ..... n628
Lake Michigan interstate harbor ..... 1459
Lake Worth, Fla., drainage district, ground water control (F. Teichman) ... *1406
Lakes, Great, see Great Lakes.
Landis, Judge K. M., decision in Chicago building situation ..... e127, e429, n167, n. 36, n876, n961, n1032
Lane, E. W., on Oriental well-drilling rig.. *682
Lane, F. K., peak named for ..... 909
Lath, metal, new ..... n1006
Lath, F. on engineering education ..... 220
Retained on new Bolivian railway ..... n166
League of the Southwest, conference, n956, n1001
Ledoux, J. W., on repairing wood water conduit, Norfolk, Va. ..... e389, *396, (T. F. Wolfe) letter 538, (J. W. Ledoux) letter 621.
On selection of pipe for water-works.. a556

**LEGISLATION**

California county engineer act unconstitutional ..... n789
Free port zone ..... n421
Highways, see Highways, Federal-aid.
Hudson River pontoon bridge ..... e173, 207
Illinois Commerce Commission act ..... 144
Massachusetts, controls tank construction ..... 978
Motor vehicle, see Motor Vehicles
New York soldier preference law invalid ..... n123
Ohio, motor truck limit, law opposed.. n125
Water supply legislation now ..... 846
Oklahoma eight-hour law attacked.... n631
Pollution of navigable waters ..... n997
Phipps bill, see Highways, Federal-aid
Public Health Service engineers, bill to commission ..... e261, n294 n540
Public works, advance planning proposed ..... n913
Railway, indebtedness to Government to be funded ..... e173, n207
Reclamation act, Federal co-operative, favorable report on ..... n1067
Rivers and harbors, $27,000,000 asked.. n1038
Valuation, see Railways, Valuation.
Lehigh Univ. course in ship building and marine transportation ..... 24
Lehigh Valley Engineers' Club meets ..... n741
Leland, Dean O. M., on Costa Rica-Panama boundary commission .. n379, correction 424
Lewis, J. V., on Schenectady sewage works system in use ..... 1037
Lewis, W. B., on fanciful design for Providence Engineers' clubhouse ..... e173, *191, (A. Cincinnati Engineer and W. E. Rolfe) letters 333
Liberty Tunnels, see Pittsburgh
Licensing, see Engineers, Licensing.
Lighting, night construction, locomotive turbines for ..... h*208
Lightning stops pumps, causes water hammer and pipe break ..... 953
Lime in concrete, more knowledge needed (L. G. Hall) ..... letter 331
In water purification ..... 13
Lincoln Memorial not in danger ..... 1414
Linenthal, G. on long span bridge design ..... e829, 861
Lock Belt Co. reduces prices ..... 1362
Lamb, A. D., address before Amer. Chem. Soc. ..... 1339
Little Patuxent bridge accident ..... e549
Loadings, concentrated, said to be cause of Salina, Kan., Masonic Temple collapse ..... e141, *321
Loan associations, income tax from, legality to be tested ..... n1067
Locarno, Dam see Miami
Lockport, N. Y., reports commissioner-manager plan ..... n589
Locomotives, see Railways, Locomotives.
Logs, see Lumber
Loss, fender, see Fender

**LONDON**

Dock improvements ..... 31
Meat distribution, rapid ..... *10 1

Pag

Subway extensions planned ..... n789
Traffic control regulations .... 230, 238, 335
Water supply, partly shut valves reduce use ..... 905
Water supply, chemical and bacteriological examinations (Houston), book review ..... 990
Wine from water conduits ..... 277
Los Angeles, aqueduct irrigates large area. 229
Coliseum planned ..... n967
Concrete highway, special, for motor trucks ..... *55
Court gives city right to take realty properties ..... 452
Garbage disposal, city accepts hog feeding ..... n881, n2256
Union station again ordered ..... n1039
Louisiana, engineer on Board of Health ..... n792
Highways, see Highways, Louisiana
Motor vehicle law to be drafted ..... n209
Motor vehicle taxes revised ..... n123
Louisville & Nashville R.R., Gulf Coast lease renewal held up ..... n36
Lowell, Mass., back to mayor-and-council plan ..... 1013
Lowering mine locomotive through shaft by novel method (B. G. Best) ..... h*910
Loyal Labor Legion formed ..... n212
Lucin trestle deck renewed, drift bolt for steel ..... h*787
Ludlow, A. D., on Turkey Creek sewer, Kansas City, Mo. ..... *815
Lugs, airplane, see Aeronautics.

**LUMBER (see also WOOD and WOOD PRESERVATION)**

Amer. Lumber Congress, Apr. 5-6, 1922 .n1080
Equipment in Northwest, electrification, 860
Freight rates, heavy, injure industry .. 837
Redwood ..... n343, n1005
Logging engineers' convention ..... n789
Metal, for buildings ..... n*341
Mills replenishing stocks ..... n1043
Northwest operations, Atlantic coast ..... n40
Price advance in five cities ..... n939
Production, 1920-21 ..... n258
Production by species ..... 886
Production costs ..... n80
Shipments equal orders ..... n877
Shipments, large, to Orient ..... n382
Standardization aimed at ..... n547
Steel, handbook on ..... n341
Turpentining does not affect value ..... 482
Unemployment in industry ..... n631
West Coast, for Coney Island boardwalk.n877
West Coast production ..... n40, n127 n172, n213, n301, n342, n483, n516
Western, heavy water-borne movement.. n384
Lundahl, R. R., on fence of wire cloth reinforcement ..... *317
Lyons, Mass., bridge, 400 ft., built in 14 days ..... n*339

**M**

MacFarland, H. T., on new Phila. asphalt plant ..... *102
Machinery, construction, skidded on track h336
Foreign barrier from New York Post equipment exhibit ..... e221, n252, 417
Maffitt, M., on controlling water after blowing in Twin Bells ..... 206
Mail distribution, London rapid ..... *1051
Mail terminal, Chicago, structural design.e*1010
Maine highways, see Highways, Maine.
Majumdar, S. C., on photography in hydraulic measurements, India ..... *414
Malaria, anti-malaria work, cost of, in Port Arthur, Tex. (R. G. Upton) ..... *401
Control, engineering aspects discussed..n1078
"Management Engineering," new monthly.. 117
Manganese bronze, see Bronze
Manhattan Borough, see New York City
Manila Bay, open pier deck to resist storms (J. D. Eldridge) ..... *1055
Manning's formula, see Hydraulics
Manufacturer credit to ..... n303
Manufactures, census almost complete ...n918
Map, Government consolidation recommended ..... n665
Photographic, from airplanes .... e595, *596, (P. J. Barry) letter *828
Service, weekly, for Wisconsin road users 366
Marble, white, used box mold in handling (Robert Stahlberg) ..... *810
March, C. W., on making chlorine gas at Niagara Falls ..... 618
Marine Borers, see Teredos
Markgraf, C. A., on concrete building plant ..... *925
Marlborough-Blenheim Hotel, Atlantic City, [illegible] ..... 202
[illegible] ..... *1054, *1222, (E. Gardner) letter 1158, (E. W. Clarke) letter 618
Marquette Mich., observatory of tides in charge of W. S. Rogers ..... *72
Marshall, R. C., on equipment delays in road construction ..... 243
Water supply, time to build ..... n360
Maryland highways, see Highways, Maryland.
Massachusetts, see also Boston, Mass.
[illegible] ..... n*954
[illegible] ..... n1067
Water supplies, qualities of (Prof. G. C. [illegible] ..... 497
Materials, Committee on, Materials ..... 1
Mathematics, law of, exhibit ..... 771
[illegible] ..... 1
[illegible] ..... 1
[illegible] ..... 1
[illegible] ..... 12

Pag

McGill University, architect ..... n*
Civil engineering course ..... n*
McIntyre, J. H., on what business papers can do to speed revival of business .... 740
Mechanical handling equipment, see Conveying Machinery
(W. Bernhardt) letter 701
Mechanics, terminology of, J. R. Griffith) ..... letter 886
Medary, E. J., speaks on Europe before Lehigh Valley Engineers' Club ..... n747
Melbourne, Australia, Amer. firm gets contract ..... n341
Memphis club for commissions for sanitary districts ..... n540
Metal lath, see Lath.
Metal lumber for buildings ..... *341
Metal trades, committee on waste reports ..... n214
Meters, see Water Supply, Meters
Mexico, dissen ambas in ST Land ..... *848
Meyer, A. F., on [illegible] given rates of rainfall ..... *1067
Miami flood protection work Brentwood Dam, core exposed by slope washout.... e713, n744
Lockwood Dam completed ..... *780, *917
Rainfall and run-off high from small areas, J. E. Hedg ..... *480
Taylorsville Dam completed ..... *1079
Michigan highways, see Highways, Michigan.
Military Academy, see West Point.
Mill construction, see Buildings, Mill Construction.
Mill Creek flood works, see Erie, Pa.
Miller, F. E., on concrete pipe line augments Kansas City water supply ..... *1029
Milliken [illegible] ..... n341
Million dollars, what is ..... 1045
Mills, H. F., will of ..... e675, n744

**MILWAUKEE**

Committee recommends unemployment relief ..... n917
Rivers and harbors, city survey of ..... 558
Sewage works, activated-sludge plant to be largest ..... e509, n541
New study of ..... e3, 36
Tunnels, flooded, recovery of ..... *84
Waterfront bulkhead construction ..... *614, correction 947
Water-supply situation, new study of.. e3, e36, n167
Water works, three triple-expansion pumping engines wanted ..... n583
Mine shaft sinking record made ..... 461, (Sullivan Machine Co.) letter, with editorial comment, 578
Minerals, production in U. S. in 1919 .... 567
Mining engineers, see Engineers, Mining.
Minneapolis, lightning stops pump, causes water hammer and pipe break ..... 953
City names bridge for F. W. Cappelen.. n996
Motor truck operators open terminal .. n956
Traffic analyzed by diagram (G. H. Herrold) ..... letter *33
Vehicles registered ..... n796
Minneapolis-St. Paul water district opposed. n542
Minnesota highways, see Highways, Minnesota.
Minnesota, registration board organizes... n211, n379
Swamp land reclaimed for farms (M. H. Dunnell) ..... n566
Minnesota River, flood control reservoirs .. *140
Mississippi River levees, emergency building [illegible] ..... *62
Mississippi Valley Assn. forms 11 [illegible] ..... n
Missoula Chapter, A.A.E., publicity work *353
Missouri highways, see Highways, Missouri.
Seeks to dissolve materials "trusts" ... n125
Missouri River banks protected by tree rows ..... *966
Missouri, Kansas & Texas Ry., engine terminal and line revision, Oklahoma City .. *440
Plans [illegible] ..... 1406
To [illegible] ..... n711
Mitchell, K. G., of India, studies American [illegible] ..... n583
Mixers and mixing, see Concrete, Mixers.
Mobile & Ohio R.R., tentative valuation .. n423
Modified R.R. Rate Decision & Next Issues ..... 416, 372
Mole [illegible] ..... 26
Monitor [illegible] ..... n167
W. [illegible] ..... 958
[illegible] ..... 1041
Montreal, garbage incinerator, city asks bids ..... 837
Must [illegible] ..... 84
To [illegible] ..... 13
Water works pumps [illegible] ..... n*
Morgan, D. L., elected chairman A. A. A.. n503
[illegible] ..... n1013
Mortar, see Concrete, Proportioning.

**MOTOR VEHICLES**

[illegible] ..... than from ..... 1074
California has [illegible] ..... n*322
[illegible] ..... n*
[illegible] ..... b*231
[illegible] ..... *
[illegible] ..... *
[illegible] ..... n*
[illegible] ..... n*
[illegible] ..... n*

Page

Gasoline tax ... n504
Legislation ... R. R. Tomek, Jr. ... W. ... letter ... n1029
Connecticut ... n1029
Louisiana ... n1029, n1209
Ohio ... *939
Motor vehicle taxation ... letter ... 1034
Mules vs. motor trucks ... J. E. Field, letter 331
Pennsylvania should not make ... letter ... 1034
Railways' view ... motor vehicle competition ... c511, (S. B. Moore) letter, with editorial comment) 601
Rates ... 271
Sales ... n549, n582
Specifications for South Africa ... n302
States and the U. S. Army trucks ... n165
States have power to control highways ... W. Watson and H. S. Hird ... *9
Taxation ... 1034
Tax proposed in House bill ... n209, n254, n253
Tax ... 436
Tax on motor fuel proposed ... L. T. Boyd, letter ... 1034
Taxes further ... objects to ... n253
Tires, Government specifications, formulating ... 67
Tires, solid vs. pneumatic ... H. W. Sansom, letter ... H. J. Lemon, letter 335, (C. F. Dingman) letter 620
Tractors, grading outfits, hints on operation and maintenance ... *800
Trailer, for warehouses and terminals ... n*426
New four-wheel truck, properly with trucks ... n545
Trucks:
Connecticut, new ruling ... n1039
Mortality in road construction ... e89, *111, (J. E. Field) letter 331.
Move local freight California ... 736
Ohio, 10-ton limit opposed ... n125
Operating costs on grades ... 32
Operators open union terminal, Minneapolis ... n956
Supplants concrete buggy hoist on small job ... h*888
Two, in lieu of truck and trailer ... h*622
Truck with scraper blade for gravel road maintenance ... n575
Valve closing trucks, Detroit water works ... *95
Moving part of church (G. T. Britt) ... *691
Moving 200-ft. wireless tower (Lieut. A. T. Colwell) ... h420, correction 538.
Moving pictures, New York terminal movements ... n422
Mullergren, A. L., on accounting records for consulting engineers ... *685
Municipal ownership, government, engineers, etc., see Cities.
Muscle Shoals plant, Ford offer to buy ... n125, e305
Muldaur, G. B., on fire tests of new post cap for mail construction ... *972
Mules vs. motor trucks (J. E. Field) ... letter 331
Mystic River, Mass., bridge, twin bascule spans planned ... n338

N

Napoleon, Ohio, water-supply, tastes and odors in ... 771
Nash, F. M., on elimination of crawfish burrows in steel banks ... *887
Nashville, Tenn., bridge, deterioration ... e924, *934
Natl. Assn. of Builders' Exchanges, code of ethics ... e1, ("Subscriber") letter 204.
Natl. Assn. Bldg. Trades Employers meetings ... n956
Natl. Assn. Owners of R.R. Securities appoints engineers on its Board of Economics and Engineering ... e1
Natl. Distributors Assn. of Construction Equipment ... n505
Natl. Drainage Congress ... n165, n541, n584
Natl. Munic. League meeting ... n338
Natl. Paving Brick Mfrs. Assn. urges visit to plants ... e389
Natl. Pressed Steel Co., handbook on steel ... Lumber ... n411
Naval base, Pacific Coast, Alameda site defended (C. E. Hickock) ... letter, with editorial comment, 33.
Navigation workers in New York ... n997
Navy Yard, Brooklyn and Long Island ... n989
New Iberia ... n*926
Newspaper ... n544
Highways, see Highways, Nebraska.
Nebraska Univ., irrigation school ... 373
Newcomb, N. P., engineering ... n561
Wage ... n561
New Bedford Mass., C. S. Ashley memorial ... n*429, 496
New England ... n544
New England Power Co., new Vermont development ... n*1039
New England Water Works Assn., convention program ... 190, 408, n504
New Hampshire highways, see Highways, New Hampshire.
Water ... 736
NEW JERSEY
Bridge ... n*1039
Concrete ... n*1039
New Y ... n*1039

Page

Interstate Commission authorizes bonds ... n1079
State work, residents get preference ... n711
New Jersey Sanitary Assn., meeting ... n1001
New London, Conn., commissioner ... n564
New Orleans—Impressions here and there (W. W. ...) ... 437

NEW YORK CITY

Broadway, one-way traffic ends ... n505
Brooklyn, Ocean Parkway paved with ... *408
Brooklyn theater roof collapse ... e923, n*954, (E. R. T. Bergren) letter 1072.
Bus ... n86
Building in Manhattan Borough ... n86
Charities ... n913
Construction, survey made ... n836
Fifth Ave. signal towers, design selected ... n*788
Garbage disposal, etc., $2,000,000 for ... n209
Manhattan Borough, July building plans ... n258
Narrows tunnel, politics or engineering ... e715
New York City-Atlantic City hard paved route opened ... n630
Port:
Authority meets with rail executives ... n207
Authority reports on plan ... n1038
Foreign equipment barred ... e221, n252, 417
Motion picture shows freight movements ... n422
Narrows tunnel and belt railway facilities ... n704
Pier extension allowed ... n832
Pier project, largest, at Stapleton, S. I., near completion ... *900
Politics or engineering ... e715
Port authority, Congress authorizes ... n254
Quarantine ... e955
Queens Borough bridges ... n547
School, credit for designing (E. A. Fraser ... letters 161
Staten Island Tunnel, engineer staff named ... n37, n125
Stock Exchange, heavy steelwork in (J. W. Prendergast) ... e389, *842
Transit:
Freight transport in subway proposed ... n623
Seven bidders for big contract ... n831
Situation ... e551, n881
"Stripped" work hours suggested ... n869
Subway contract awarded ... n912
Tunneling, see Tunnels.
Turner plan for controlling transit ... e1046
Unemployment bureau recommended ... n507
Unemployment in October ... n918
Views from *Engineering News-Record's* windows ... n*502
Washington Bldg., reconstruction (T. K. Pierpont) ... *774
Water supply, Catskill siphons, bids received for second tube ... n501
Catskill Aqueduct, suit to prevent turning Schoharie Creek into ... n997
Shandaken tunnel advanced ... n464
Zoning, discussed by N. Y. Section, Am. Soc. C. E. ... n1077
New York Engineers' Club honors Hoover ... n667
New York-New Jersey Port Commission confers with rail executives ... n207
New York Section, Am. Soc. C. E., see Am. Soc. C. E.

NEW YORK STATE

Building in cities ... n171, n343, 690
Departments, overlaps and confusion ... e429
Engineering work centralized ... e173, n207
Health dept., new sanitation division ... 313
Highways, see Highways, New York.
Labor ... n343
Roads ... n24
Soldier preference law invalid ... n123
Unemployment ... n128
New York State Barge Canal, see Canals.
Newspaper building, special structural design for, South Bend, Ind. ... *412
Niagara Falls, power, may light Detroit ... n912
Niagara power, Canadian, see Queenston-Chippawa.
Niagara River bridge project again active, n422, n832
Niagara River, water diversion, book review ... 288
Niger Valley, French to irrigate ... 243
Night construction, locomotive turbines for ... h*206
Niles, A. S., on safety in airplane design ... 490
Nitrogen, with special reference to activated sludge ... n311
Norfolk, Va., 50-year rainfall record (E. F. ...) ... *199
Repair of wood water conduit (J. W. Ledoux) ... e389, *396 (T. F. Wolfe) letter 538 (J. W. Ledoux) letter 621.
North Carolina ... n544
Highways, see Highways, North Carolina
Notes from Foreign Fields, Palestine, industrial development (A. E. Kornfeld) ... 32
Noyes, E. B. on Norfolk, Va., 50-year rainfall ... *199

O

Oakland, Cal., water main laying program, ... n1040
... n1065

OBITUARY

Ashley, B. J., 1041
Battle, J. E., 959; Brady, G. P., 873; Baker, W. E., 835; Brookins, A. T., 765
Cross, Prof. C. R., 915; Cappelen, F. W., 709; Chatten, S. H., 256; Cochrane, J. L., 298; Crocker, Prof. F. B., 85
Doherty, W. F., 959; Davis, W. J., 629; Dean, ... 765
Eddy, Prof. H. T., 1039
Fox, Sir D., 915; Fischer, Maj. L. A., 211; Fletcher, G. A., 629; Fortner, S. A., 298; Freytag, C., 381
Grace, W., 875; Goodwin, I. T., Jr., 875; Gamble, W. H., 629; Gillespie, R. H., 168; Girard, J. E., 256; Goble, L. T., 506; Gray, S. M., 835, *872
Hains, Maj. Gen. P. C., 835; Hanson, J., 168; Harvie, H., 749; Henderson, G. R., 793; Hewitt, P. C., 381; Holmes, H. C., 835; Houston, A. B., 256; Hunt, A. L., 126; Hyde, C. L., 585
Kennedy, Sir A., 749; Kinman, H. J., 544
Larkin, C. R., 466; Logan, W. L., 211
Maher, D. W., 40; McMullen, J., 466; Miller, B. A., 1041
Mills, H. F., *627; Morse, S. T., 39; Mount Stephen, Lord, 1003
Newman, G. O., 1081; Nolan, J. J., 1041; Norboe, P. M., 959
Oliveras, A., 168, Owen, J., 85
Patton, F. E., 544; Pierce, J. W., 669; Pope, G. W., 126; Powell, C. E., 298; Prior, C. H., 959; Prouty, C. A., n82
Quintus, J. C., 915
Richards, Dr. J. W., 669; Randolph, E., 379, (P. N. Moore) letter 537; Robinson, W. C., 295; Robson, R. E., 793; Rodgers, W. J., 506; Roys, W. H., 793
Sanders, W. H., *374, Sarber, A., 125, Sing, J. G., 506, Snyder, Col. G. D., 749; Stone, Dr. B. H., 959; Stone, Dr. W. E., 211; Strobridge, J. H., 256
Thurston, R. H., 959
Voorhees, S., 295
Wallace, J. F., 39, e48, *83; Webb, Col. G. H., 835; Wimmer, S., 1003

Ocean Parkway, Brooklyn, N. Y., paved with sheet asphalt ... *408
October contracts valued at $104,318,674 ... n750
Odor engineering ... e880
Odors and their travel habits ... a906
Ohio, highways, see Highways, Ohio.
State plans relief for unemployment ... n507
Water purification plant operators organize ... n914
Water supply legislation, new ... 846
Ohio Basin terminal, Buffalo, N. Y., concrete river wall poured inside large steel forms ... *716
Ohio River bridge, see Bridges.
Ohio River-Lake Erie Canal opposed by Army engineers ... n620
Ohio State University stadium ... n913
Oil, fuel, see Railways, Locomotives.
Oil heater, hand, fills pavement joints ... h*336
Oil wastes, see Wastes.
Oklahoma eight-hour law attacked ... n631
Oklahoma City, bond issue defeated ... n956
M. K. & T. ... terminal and line revision ... *440
Map of water distribution system faulty. ... e131, 158
Sewage works, report on ... 198
Older, C., on Illinois traffic endurance test ... e263, 274
Ontario hydro-electric power, see Niagara Falls.
Ontario, water supply cross-connection rules 374
Open channels, effect of curvature upon flow in ... 516
Open price associations, see Trade Associations.
Orange Co., Fla., to sell road bonds ... n1037
Output, individual, increased ... e261
Owner and contractor, mutuality of interest (E. R. ...) ... letter 204
Oxyacetylene, see Welding.
Oxygen, consumption in sewage, etc. ... 852
Content in water, low, causes tastes and odor ... 771
Oyster shells as road surfacing (L. G. Hall) 352

P

Patswell, G., corrects error in article on transition curve tables, Aug. 26, 1920, issue ... 742
Pacific Coast naval base, see Naval Base, Pacific Coast.
Pacific Logging Congress ... n789
Paducah, Ky., elects two engineers to commission ... 1049
Paint more knowledge needed (Prof. A. H. Sabin) ... e262, 269, letter 291 (H. A. Gardner) letter 829
Palestine, properties of films ... 94
Palestine industrial development (A. E. Kornfeld) ... 32
Panama Canal administration, changes ... n705
Curse ... n1041
Tolls ... 476
Panama-Costa Rica boundary commission ... n379
Paper mill ... n342
Papers read before societies, time limit on ... e879
Papers, business, what they can do to speed progress of business, by J. H. Mc... ... 740
Paris, J. M., on stress coefficients for large ... n768, *768
Park commissioners' ... n1
Park system, Union County, N. J. ... e963, 978


*Illustrated. ... contributions or articles of more than ... words. A, abstracts.

Page

Parker, J. L., on long concrete trestles to cross Southern river swamps ..... *725
Parker, Capt. T. B., on stresses in horizontal pipes on fixed saddles....e303, *306, correction 500
Parsons, W. B., on New York City charter revision commission ..... n913
Patent Office, assistant examiner to be appointed ..... n508
Peore, Bar Assn. for more pay..... n543
Personnel increase ..... n255
Specifications, criticism of first blank page ..... 658
Patents, Gans zeolite water softening, upheld ..... n168
Strauss Bascule Bridge Co. sues Seattle..n421
Warren paving, status of ..... e963, 969
Paterson, N. J., votes to acquire water works ..... n832
Patrick, Col. M. M., new chief Army air service ..... *543
Pavements, see Highways, Pavements.
Paving Conference, Philadelphia ..... n704
Pawling & Harnischfeger donate crane for cleaning Pueblo ..... n426
Pelham Park stadium N. Y. City, traveling forms cut expense ..... *977
Pend Oreille River, Ore., bridge planned..n1077

**PENNSYLVANIA**

Building code planned again ..... n81
Engineer registration board appointed...n541
Highways see Highways, Pennsylvania.
Penn R.R., claims damages from city for Pittsburgh slide ..... n337
Labor elections illegal ..... n253
To repair cars ..... n631
Penstock bursts during test ..... n501, 634, 640, e758
Periodicals, engineering, getting full value of (P. Thompson) ..... 456
Permanent Internatl. Assn. of Road Congresses, see Highways, Internatl. Assn., etc.
Perry, J. P. H., on engineering education.. 240
Persons in family and dwelling, number of. 777
Petrenko, S. N., on cofferdams for Dnieper River improvement, Russia....*943
Phelps, H. K., on splitting failure in a wooden truss ..... *514, (H. J. Schoenfeld) letter 621
Philadelphia, Asphalt plant, new (H. T. Macfarland) *102
Bonds, municipal, bring premium..... 891
Bridge to Camden, see Bridges, Philadelphia-Camden.
Bridges, to be examined ..... n501
Garbage incinerator, bids asked..... n259
Plan upset ..... n667
Sewage works contract to be completed..n208
South St. Bridge, reconstruction to be readvertised ..... n745
Street cleaning, by contract ends Dec. 31 ..... n123
Full municipal service ..... n298
Phila. Engineers' Club to discuss paving. n424
Phila. Housing Assn. survey..... n292
Phillips, A. E., resignation..... e261, 284, n540
Phipps bill, see Highways, Federal-aid.
Phoenix, Ariz., flood damage ..... n464
Pholas, see Teredos.
Photography in hydraulic measurements in India (S. C. Majumdar) ..... *414
Picketing, decisions on ..... e1009
Pickworth, J. W., on heavy steelwork in N. Y. Stock Exchange ..... e839, *842
Pilgrim, B. H., on heavy narrow-gage locomotives on concrete road work..... *568
Piers (foundation) concrete, fail through rusting of steel (H. H. Brown) letter *827
Test with 1000-ton jack..... *763
Piers (shipping), oranes for, N. Y. City, bids to be readvertised ..... n954
Fires ..... e345, n378, e757, n788
Open deck to resist storms (H. H. Braun) ..... *1055
Pile holes blasted for (H. H. Braun).h*1035

**PILES**

Concrete, bamboo-reinforced, for bridge foundations, China ..... 32
Armored, support wharf, Port Orford, Ore ..... *1061
For concrete trestles over swamps (J. L. Parker) ..... *725
Dragline drives 54 piles in 10 hours (C. H. Efferts) ..... h*120
Driven through wharf roof 90 ft. from tender ..... *25
Footing, cut off 60 ft. below water surface ..... h*1075
Holes blasted, for ocean pier (H. H. Braun) ..... h*1035
Piledriver, pivot with special features (B. E. Torpen) ..... h*377
Pine, successful bids, for Portland, Me..n1042
Universal knuckle for piledriving (M. L. Vaid) ..... h*251
Pine pile prices ..... n877
Pine, Southern see Southern Pine.
Pine stakes, long-lived (J. M. Garrett).... letter 701

**PIPE**

Analysis of stress (J. M. Paris) ..e758, *768
Cast-iron, main-break and material costs in laying (L. G. Hall) ..... 413
Prepared joint ..... n22
Electrolysis in underground systems ..... 891
Galvanized spiral riveted steel pipe, flow of water through (Prof. F. W. Greve).*159

Page

Horizontal, Lure stress coefficients for (J. M. Paris) ..... e758, *768
On pedestal saddles, stresses on (Capt. T. B. Parker)..e303, *306, correction 500
Iron and steel, soil corrosion studied...n833
Rusted, removed from coupling..... h953
Selection of (J. W. Ledoux)..... a556
Submerged, discharging into reservoir, loss of head for (C. O. Wisler) ..... *886
Wood, preferred for tunnel ventilation.. 243
Repair at Norfolk, Va. (J. W. Ledoux)..... e389, *396, (T. F. Wolfe) letter 538, (J. W. Ledoux) letter 621
Wood-stave, stands blast and fire..... 399
Pipe line for oil, see Oil.
Pit River, Cal., project, progress on..... *604
Pitch, elastic viscous deformation expressed by formula ..... 33
Pitot tube, new use in testing pumps (A. L. Collins) ..... *616
Pittsburg, Cal., road tests..... e1045, *1048

**PITTSBURGH**

Allegheny County bond issues defeated..n1001
Bond issue may be lowered..... n586
Bridge,
Concrete to be built ..... n255
Fire, creosoted wood floor responsible ..... n81, n124, *137
Huge program in bond issue ..... n297
Low bids for 16th St. bridge..... n422
Point, to investigate ..... n36
Point, report recommends immediate repairs ..... n668
Liberty Tunnels driven by full-section excavation ..... *178
Side started by heavy rains ..... n125
Penn. R.R. claims damages from city..n337
Planning, see Cities, Planning.
Plants, industrial, enter new fields..... n510
Plumber or sanitary engineer (Old Civil Engineer) letter, with editorial comment 538
Pneumatic caisson, see Caissons.
Pneumatic hammers, see Hammers.
Poisons, use in drainage work (O. C. Kuhlke) ..... 322
Pollutions J. H. on sunken dredge raised by jacking from dry dock pontoons...*1056
Pollock, J. K., on sewage-disposal studies, Flint, Mich. ..... *272
Pollution of navigable waters..... n209, n997
Pontoon bridges, see Bridges, Pontoon.
Population growth expressed by formula.. *889
Port Arthur, Tex., anti-malaria work, cost of (R. Upton) ..... *40
Port Authority, New York, see New York City, Port.
Port Orford, Ore., concrete armored piles in wharf ..... *1061
Portland cement, see Cement ..... n1077
Portland, Ore., exposition, Federal recognition ..... n427
Port, bulk handling plant (G. B. Hegardt) ..... *760
Portland, Ore., Section, Am. Soc. C. E., unconventional society notes ..... n792
Portland-Vancouver bridges makes big profit ..... n707
Portland Cement Assn. engineers meet.... n667

**PORTS AND HARBORS**

Breakwaters of three types in one lake harbor ..... *1069
Calumet Harbor, Chicago, plans ..... n209
Chicago, waterfront bulkhead construction ..... *614, correction 947
Convention of port authorities...n502, n706
Equipment, foreign, barred in New York. ..... e921, n252, 417
Fender logs, maintenance..... 143
Illinois-Indiana, resolution for commission ..... n421
Italy, work under way ..... 180
Lake Michigan-Mississippi interstate harbor..... n166
London, dock improvements..... 31
Milwaukee, city surveys of ..... *508
Waterfront bulkhead construction.... *614, correction 947
National help only to ports encouraging American ships ..... 895
New York, see New York City, Port
Piers—fires, etc., see Piers.
Pollution by oil wastes ..... n208, n997
Portland, Ore., bulk handling plant (G. B. Hegardt) ..... *760
Problems discussed by engineers ..... n461
Russia, British experts to survey..... n122
Trelleborg, Sweden, plans wanted ..... n84
Wharf, Port Orford, Ore., supported by concrete armored piles ..... *1061
Wilmington, Del., bids opened..... n129
Postal distribution, London, rapid..... *1054
Power, see Water Power
Power Commission, Federal, see Water Power.
Power transmission by pulsations in water 30
Pneumatic-tube tram for Baltimore refinery (J. R. Sharp) ..... *1027
Prelini, C., on ancient dams ....556, (N. B. Hunt and C. Prelini) letters 1033
Pressure, earth, see Fills.
Price associations, see Trade Associations.
Price fixing, Federal report soon....n300, correction 343
Prices, see Construction, Materials.
Prices of food retail increase ..... n427
Princeton Engineering Assn. meets..... n745
Princeton Univ. enlarges scope of engineering school ..... n208
Production engineer, Civil Service to appoint ..... n559
Profession, What is a? ..... e1
Subscriber's letter '04 ..... correction 343

Page

Professional fees, limitation ..... e293
Promoter vs. engineer....e674, n692, (R. L. Sackett) letter 824, (C. E. Muhs) letter 867, (C. E. Drayer) letter 950
Proportional representation (Prof. L. J. Johnson) ..... letter 993
Protractor and 18 scales in one..... n*466
Providence, R. I., electricians' union makes wage offer..... n301
Garbage feeding contract ..... n582
Meters and water consumption ..... 250
Rainstorm totals ..... 529
Providence Engineering Soc., fanciful design for clubhouse (W. B. Lewis)..e173 *191, (A Cincinnati Engineer and W. E. Rolfe) letters 333
Public health, see Sanitation.
Public Health Institute program..... n543
*Public Roads* discontinued..... n1079
Public Roads Bureau, see Bureau of Public Roads.
Public utilities, bond market improved ...e923
City has right to take properties, court rules ..... 452
Public works, advance planning proposed.n913
Estimates and costs ..... e131
Gompers urges construction to decrease unemployment ..... n*1
Proposed, total $73,000,000 ....n999, n1036
Urged for unemployed ..... n681
Public Works Dept., see Dept. of Public Works.
Publicity work, Missoula Chapter A. A. E..*353
Publicity, industrial, training course announced ..... n463
Pueblo, Colo., flood, city arranges for study of protection ..... n623
Company donates machine for cleaning city ..... n426
Overflow channel proposed ..... *570
Reservoir sites studied ..... n161
Pulverizing mill for fuel ..... n585

**PUMPS**

And motor specifications, South Africa..n302
Centrifugal:
Baltimore, test of (R. W. Allerton) ..... letter 785
Book review ..... 658
Determining efficiency (A. G. Husted and Prof. A. F. Sherzer)..letters *334
Economics of design (Col. E. J. Dent) ..... e509, *529
Large, wanted by Montreal ..... n583
Engines, triple-expansion, three, wanted by Milwaukee ..... n583
Impellers, open vs. closed, in Brockton, Mass., sewage pumping plant (H. S. Peckett) ..... 854
Reciprocating, at Erie, have lowest cost. n59
Testing new use of pitot tube (A. L. Collins) ..... *616
Valve, automatic double-cushioned check ..... n*426

**Q**

Quayle, L. A., on reservoirs vs. additional pumps ..... *328
Queens Borough, N. Y. C., building..... n547
Queensland, railway work in ..... 690
Queenston-Chippawa power development, canal, sliding form for lining..... *20
Cost ..... 28
Power plant opened ..... n1077

**R**

Racine, Wis., unemployment relief ..... n259
Radio see Wireless Telegraph
Rails, see Railways, Rails.

**RAILWAYS**

Alaska, appropriation for completion ..n877
Nears completion ..... n1078
Susitna River bridge, description ..e90, *92
Alberta & Great Waterways, relocation to eliminate slide ..... *18
Articulated trains, English ..... 933
Ash-handling plant has buckets and crane ..... *310
Ashpit cleaned by steam jets from locomotives ..... *176
Atchison, Topeka and S. F., see Railways, Santa Fe.
Australia, standard gage for ....n705, 910
Better times for ..... e219
Bolivia, F. Lavis retained to advise on..n166
Brake, skid, for gravity switching ....*524
Bridges, see Bridges, Railway.
British, see Railways, Great Britain
Buildings, small cement stucco covering for ..... *852
C. B. & Q., ash-handling plant at Denver *310
Canadian light ..... n399
Rates cut ..... n316
Cars, steel orders ..... n960
Chic., Rock Island & Pacific, tentative valuation ..... n791
Civ growth, railway obstacles to ..e633, *646
Claims settled to extent of $387,000,000. n667
Consolidation of systems, Ripley report on ....e550, n584, see also n505, n986
Crossing made up on job with oxyacetylene torch ....h*162. (L. D. Cornish) letter 334
Curves, true transition for railway problems, article pub. Aug. 26, 1920, correction ..... 343
D. L. & W., see Railways, Lackawanna
Denver & Salt Lake may be junked ....n914
Detroit, Toledo & Ironton, Ford's operation ..... e1, L. J. Carmody) letter 579
Engineers' addresses on railroad as National asset ..... 986


*Illustrated, †editorials, h, hints, n, news-notes, a, abstracts

Page

Economics of Blue Ridge ... [illegible] ... 990
Electrification.
Australian railways ... 1
Chile ... 3
France ... 3
Great Britain ... 861
Lackawanna begins electrification both ways from Scranton ... 667
Lowering railways at Northeast ... 869
Steel plants, electric locomotives at ... 634
Elevated railroads, see Railroads, Elevated
Engineering News-Record, [illegible] ... 61
Engineers, see Engineers, Railway
Erie, [illegible] ... 1014
Equipment, [illegible] ... 1014
Fills, see Fills, Earth
Finances.
Better times for railways ... e219
Increased income [illegible] ... n422
Indebtedness to government to be [illegible] ... n761
Preferred [illegible] ... n795
Relief [illegible] ... 47
War Corporation may resume loans ... n165
Ford's operation ... e345, (L. J. Carmalt) letter 579, 698
Freight classification ... 323
Freight, see Freight
Grade crossings, Michigan, reduced ... n298
Grade line location diagram for final adjustment (S. E. Reed) ... 517
Grand Trunk stocks worthless ... n543
Great Britain:
Articulated trains ... 933
Combined in four groups, government proposal ... 687
Consolidation ... 56
Electrification ... 861
Labor Party's bill ... 76
Longest train run ... 809
Road transport by ... 309
Track tanks for water supply ... 612
Group consolidations, I. C. C. plan .. n505 see also e550, n584
Idaho Central cut-off approved ... n378
Illinois Central small station layout ... *482
India, [illegible] ... n586
Irish, seashore and track protection ... *228
Labor, see Labor, Railways
Lackawanna advertises its engineers ... e509
Plans electrification both ways from Scranton ... n667
Locomotives
American and European effect on bridges (P. H. Chen) ... e49, *58, correction 110, (R. A. Marshall, C. E. Fowler, G. H. Pegram, B. R. Leffler and A. W. Buel) letters 290, (I. F. Stern and A. F. Robinson) letters 858, (J. H. Eblen) letter 866
Cut-off, automatic regulation ... 600
Engine house, rectangular, with interior turntable ... *1061
Fuel oil stations ... *183, (R. L. Holmes) letter, with ed. comment, 618
Lowered through shaft by novel method (E. G. Bailey) ... *902
Scale, track, shows load on each wheel (C. C. Bailey) ... *805
Logging, effect on level work, cost of ... b995
Longest train run, British ... 809
Louisville & Nashville, Gulf Coast bridge renewal held up ... n36
M. K. & T. ... to terminal and improvement in Oklahoma City ... *446
Plan, betterment ... [illegible]
Maintenance costs refused for "labor inefficiency" ... 296
Missouri, Kansas & Texas Ry. to start work on [illegible] ... n711
Motor cars, see Railways, Electric & Salt Lake
Motor car passenger service ... *939
Motor vehicle competition, railways' view of ... (J. H. Mosser) letter, with editorial comment 861
National system not entities, Eastman opinion ... 687 ... also editor ... e550, e584
Ontario to extend new [illegible] ... n586
Operating [illegible] ... n836
Operating income in May ... 795
Passenger trains, first [illegible] 1834 ... 573
Penn. claims damages from city for Pittsburgh slide ... n337
Labor [illegible] ... n233
To repair [illegible] ... n951
Queensland world [illegible] ... 690
Rails:
Australian standard sections and specifications ... *611
Manganese [illegible] ... 2
Rerolled [illegible] ... *2
Research [illegible] ... 2
Rolled [illegible] ... 2
Sag [illegible] ... n795
Specification, new, proposed ... e171, 202
Tests, [illegible] ... 2
Rates on Erie ... [illegible]
Relocation to eliminate sliding hillside ... *18
Reorganization [illegible] ... n147
Roadway [illegible] ... 2
Safety [illegible] ... 1029
Shops [illegible] ... 861
Signaling [illegible] ... *18
Six Flag [illegible] ... 2
Long tunnel built to eliminate operating hazard ... *36

Page

[illegible] ... n710
[illegible] ... n465
Sand [illegible] ... 2
[illegible] ... 2
Station layout, small, Illinois Central ... *482
Street,
Accounting, Wright, book review ... 457
[illegible] ... *264
[illegible] ... e593
[illegible] ... 183
[illegible] ... 611
Tracks paved with grouted concrete ... *532, 681
Strike, see Labor, Strikes.
Subways, [illegible] ... 71
Southern Ry., resurvey after improvement [illegible] ... 761, (C. H. Birdseye) letter 1074.
Swiss, electrification, etc. ... *242
Swing, skid brake for gravity switching ... *524
Tehachapi Pass, Cal., railroad line ... *569
Temiskaming & Northern Ontario to be [illegible] ... n637
Power development ... n705
Ties:
Concrete [illegible] ... 824
[illegible] ... 856
Perforating machine, increased speed on ... 741
Standardization conference ... n748
Track:
Concrete block track supports, Italian railways ... *689
[illegible] ... n542
Falling rocks, protection against ... 602
Machines for work ... 574
Maintenance, book review ... 457
Protection on Irish railway ... *228
Unit costs of work ... 554
Trains, articulated ... 933
Trestles, timber, shearing stresses in stringers (A. M. Van Auken) ... letter 119
Tunnels, see Tunnels.
Turntables, [illegible] ... 653
Interior, in rectangular engine house. *1061
[illegible] ... h*293
Renewal, rapid, at engine terminals .. 933
Valuation:
Chic., Rock Island & Pacific, tentative valuation ... n791
Electric [illegible] ... n38
Florida East Coast and Mobile & Ohio, and others ... n423
I. C. C. closes Chicago office ... n956
I. C. C. issues more supplemental reports ... n38
More [illegible] ... n83
Prompt work not to halt work ... n82
Tentative valuations, additional, n210, n296
Water supply, track tanks ... 612

## RAINFALL AND RUNOFF

Am. Soc. C. E. to discuss subject ... n543
Colorado rainfall records and flood estimate ... *23
Everglades, Fla., tests on run-off from muck soil ... a157
High, from small areas (I. E. Houk) ... *183
High rates, frequency of (A. Hazen) ... *858
New England statistics ... 824
Norfolk, Va., 50-year record (E. B. Noyes) ... *199
Probable frequency of given rates of [illegible] ... *1037
Providence, R. I., [illegible] ... 529
San Antonio flood, extraordinary rainfall due to Mexican storm (C. C. Clark) .. 495
Year 1904, most [illegible] wet ... 987
Raising sunken dredge by jacking from dry [illegible] ... *1056
Raschig, F. L., on Cincinnati rapid-transit [illegible] ... *264
Rand, C. F., British honors ... n82
Randolph, E., obituary ... n379, (P. N. Moore) letter 537
Ransome Concrete Machinery Co. adds to [illegible] ... n751
Rayner, W. H., and J. R. Stubbins, on sand box used in teaching topographic mapping ... *810
Rea, S., elected hon. mem. Am. Soc. C. E. ... e346, (F. I. Winslow) letter 459
Work [illegible] ... n255
Reclamation act, Federal co-operative, favorable report on ... n167
Reclamation Service co-operative investigations ... 199
Redd, S. E., on diagram for final adjustment of [illegible] ... 517
Redwood [illegible] ... 2
530, (J. M. Garrett) letter 701
Refuse disposal, see Garbage.
Regional surveys in relation to city planning ... 201
Registration of engineers, see Engineers, Licensing.
Reinforced concrete, see Concrete, Reinforced.
Research, [illegible] ... e430
[illegible] ... 659
[illegible] ... e673

## RESERVOIRS

Curious structural layout in new British reservoir ... *535, (W. Gore) letter 701
Lecture [illegible] ... n*
Outflow and height computed from inflow and capacity (J. C. Stevens) ... *1031

Page

Underground water storage on Santa Ana cone (H. Forbes) ... *683
Various additional papers for press demands, (L. A. Quasio) ... *328
Residences follow street car lines ... 483
Richards, W. H., retires from New London, Conn., waterworks ... *925
Richardson, C., asphalt specialist, retires. n503
Ridgway, R., and C. M. Holland study city transit in Europe ... n232, n925
On subways for city transportation ... a778
Rimrock dam, height fixed ... n1064
Ripley, Prof. W. Z., report on railway consolidation ... e550, n584 (see also n505 and a986)
River Dee, see Dee.
River and harbor work, small fund for ... n704
Rivers and harbors bill, $27,000,000 asked. n1038

## RIVERS, see also WATER POWER

Bank protection with spur dikes (P. Flitman, W. G. Atwood and H. L. Thackwell) ... letters *78, (Col. C. McD. Townsend) letter 249, (W. C. Hammatt) letter 376
Banks protected by tree retard ... *966
Colorado, one name from source to mouth. n81
Dnieper, Russia, cofferdams for improvement (S. N. Patrouleev) ... *943
Milwaukee, and harbors, city surveys of. *556
Mississippi, emergency levee construction (A. L. Dabney) ... e47, *62
Retards, tree, protect banks ... *966
Santa Ana made to cut new outlet ... *143
Spur dike protection (M. A. Stainer) letter *500
Tidal bore studies, River Dee and estuary, England. (W. Gore) ... *491
Rivets, heating with gas. (L. Ballict) ... e1, 21
Roache, F. L., on underground water supply for Akron rubber plant ... 411
Roadmasters and M. of W. Assn. meeting. n542
Roads, see Highways.
Robinson, E., on jacking up concrete grandstand to allow enlargement ... *818
Robinson, Moncure, biography republished. 990
Roby, H. G., on government engineers' report on St. Lawrence waterway ... e389, 402, with insert
Rochester, N. Y., building inspection. (F. P. Cartwright) ... *197, e219
Engineers and others in conference ... n664
Housing regulations (F. B. Cartwright) ... *318
Sludge disposal at sewage disposal plant. (N. A. Brown) ... a787
Rock Creek Park, see Washington.
Rock crusher repair parts shipped by airplane ... n747
Rock Island Ry., see Chic., Rock Island & Pacific.
Rockskip made from boiler ... n*868
Rollers, highway, see Highways, Rollers.
Rondout Creek, N. Y. bridge, see Bridges, Highway.
Roofs, collapse, Brooklyn theater ... e923, n*954, (E. R. T. Berggren) letter 1072.
Groined arch, between high column and low walls (P. Thompson) ... *515
Large suspended by cables ... *688
Timber trusses, for special conditions ... *246 (E. D. Gilman) letter 418
Rose Polytechnic Institute, new buildings. n502
Rotor, 65-ton, rolled more easily than carried ... *454
Rotterdam dockage, Large ... 105
Rowntree, B. S., studies American industrial relations ... e758, e797
Run-off, see Rainfall and Run-off.
Russell, Col. E., promoted ... n707
Russian, failure of communism ... e219
Harbors to be surveyed by British experts ... n122
Recessional halting. (R. R. Keely) ... a881, 896
Stalled workers number of ... 1055
Rust in reinforcement of concrete, see Concrete, Reinforced.

## S

Sabin, Prof. A. H., on lack of knowledge of paint ... e262, letter 291, (H. A. Gardner) letter 829
Safety, A. R. A. section formed ... n423
Eye protection in electric welding (C. W. Geiger) ... h*120
Salem, Ohio, typhoid outbreak, new legislation caused by ... 846
Salina, Kan., Masonic Temple falls during construction ... n*165, e431, *432
Salt in water supplies allowable ... 899
San Antonio, Tex., 9th construction work under city engineer ... 765
Sand and gravel excavated, stored on building site ... h580
Flooded out approved ... n168
Sand drifts on roads, see Highways, Sand Drifts.
Sand settling tank balanced ... n*915

## SAN FRANCISCO (see also SAN FRANCISCO BAY)

Building situation improves ... n950
Building strike, American plan probable result ... n428
Situation clears ... n427, n711
Engineering building planned ... n745
Industrial Assn. idea spreads ... n427, n711
Market St. subway, survey ordered ... n911
Rincon Hill regrade ... n338
Street signs, new ... *805


*[illegible] ... abstracts

Page

Water supply:
Hetch Hetchy:
Bonds sold ..... n255
$8,520,000 bond sold ..... n914
Dam, excavating foundation ..... *222
Dam, pouring 1,000 cu.yd. per shift ..... n914
Mountain division, funds available n913
Power to be wholesaled ..... n209
Tunnels, equipment assembled ..... 689
Tunnel, progress ..... n123, n161, n626, n833
Water supply:
Rate increased ..... n463, n913

**SAN FRANCISCO BAY**

Army engineer board asked to pass on crossing ..... n337
Bar survey completed ..... n791
Bridge and tunnel projects ..... e2, *16, n83, 248, 268, n463, n627, e714, 739
Cities, reject consolidation ..... n912
Cities, residences follow street car lines. 483
Crossing, War Dept. will approve ..... n1080
Sanitary engineer, or plumber (Old Civil Engineer), letter, with editorial comment 538

**SANITATION**

Amer. Public Health Assn. convention and jubilee, etc ..... n543, 6595
Am. Soc. C. E., conference ..... n790
Anti malaria work, Port Arthur, Tex., cost of ..... *401
Argentina proposes internal loan for sanitation ..... n957
Australia, department created ..... 202
Dividing engineering and sanitation... ..... e1078, n207
Engineering problems and progress ..... a901
Engineers, virgin field for ..... e880
"English Public Health, Story of" (Morris) ..... 823
Health exposition, New York ..... n882
Louisiana engineer on Board of Health urged ..... n792
Malaria control, engineering aspects discussed ..... n1078
New York State, new division in Health Dept. ..... 313
Protection of water supplies (A. Hazen). 496
Public Health Service, engineers ..... e261, n291, n540
Sanitary engineering, fifty years of (G. W. Fuller) ..... a901
Sanitary engineers, Federal. e261, n294, n540
Stream pollution, Connecticut commission ..... n745, e757
Surveys, public health (Horwood), book review ..... 989
Tippecanoe County, Ind., survey ..... n165
Typhoid, see Typhoid.
Water supply legislation in Ohio, new.. 846
San Pablo Dam, see Oakland, Cal
Santa Ana, Cal., cone, underground water storage (H. Forbes) ..... n883
Santa Ana River made to cut new outlet.. *143
Santa Fe R.R. plans industrial extension in Dallas ..... n1039
Saskatchewan Water District may be revived ..... n627
Sault Ste. Marie, Mich., bascule bridge failure ..... n870
Savage, Md., bridge wrecked by auto collision ..... e549, e550, n582
Savage, H. N., on proportioning and making concrete on Barrett dam ..... e673, *695
Saw for stumps, power-operated ..... n545
Scaffold, simple carries floor center on high tower (G. A. Davis) ..... h*953
Scales, 18, and protractor in one ..... *466
Scarifier-grader ..... 257
Schaetzle, T. C., on mine years operation Baltimore sewage works ..... e48, *50, 97
Schenectady, N. Y., sewage works again in use (J. V. Lewis) ..... 1032
Scholer, C. H., on new laboratory abrasion tests for concrete ..... e469, *488, 488
School in New York, credit for designing (E. A. Fraser and E. E. Seelye)..letters 161
Science day of visions ..... e130
Scientific discoveries, waiting for ..... e3
Scientific effort, revival of ..... e673
Scioto River bridge opened ..... n160
Scoop and hammer, pneumatic ..... n*341
Scraper, wheel, new ..... n*106
Searles, W. H., obituary ..... *474
Seashore and track protection on Irish railway ..... *228
Sea wall, preventing undermining of (L. G. Hall) ..... *684

**SEATTLE**

Building increases ..... n712
Citizens only on improvement projects.. ..... n284
City sued by Strauss Bascule Bridge Co.. n421
Columbia River bridge, city raises funds n427
Garbage of restaurants, city's right to take is to be tested ..... n627
City's right to garbage upheld by court ..... n1080
Local improvement orders based on actual property value ..... n907
Pontoon bridge proposed to relieve ferries ..... n507
Skagit project, city votes $5,500,000 more ..... n559
Contract let for tunnel work ..... n760
First unit completed ..... n628
Project favored by A. A. E. chapter ..... n269
Project, progress ..... n918
Water supply, Cedar River reservoir $15,000 for sealing ..... n421
Protest against acceptance of bid bonds ..... n1077
Reservoir is safe, court holds ..... n423
Wharves burn ..... n179
Sections, steel, for anchorin shaft hangers, etc. ..... n793
Securities, tax-exempt ..... e964
Senate filled with engineers, is suggestion ..... n1078
Settlement of building avoided by grouting sewer tunnel cavity by test pits (L. G Hall) ..... h*293

**SEWAGE AND SEWAGE DISPOSAL, see also SEWAGE TREATMENT, SEWERS**

Fort Worth, Tex., delays plant, Dallas investigates ..... n1040
Gas power, from sludge ..... 637
Industrial wastes in relation to water supplies ..... a908
Oxygen consumption in sewage, effect 852
Schenectady, N. Y., again in use (J. V. Lewis) ..... 1032
Sludge disposal at Rochester, N. Y., sewage disposal plant (N. A. Brown)...a781
Small municipalities (J. F. Skinner)...a780
Sugar refinery wastes, handling ..... 178
Stream pollution and sewage disposal..a905
Wastes, oil, pollution of harbors and beaches ..... n208
Sugar refinery, handling ..... 178
Tannery, chlorinated to guard against anthrax ..... 599
Water-gas plant wastes, treating..... 187

**SEWAGE TREATMENT, see also SEWAGE; also SEWERS**

Activated sludge:
Aeration period of sludge (A. G. Husted) ..... *610
"Aggravated sludge" ..... e594
Dewatering, hot sulphur dioxide gas and live steam ..... 947
Dorr Peck tank, reaction ..... a908
In England and U. S. ..... 638
Baltimore works, nine years' operation (T. C. Schaetzle) ..... e48, *50, 97
Milwaukee plant to be largest....e509, n541
Nitrogen, conservation ..... a311
Unusual combination of elements.... 949
Chlorine, liquid, precautions in handling 691
Tannery wastes chlorinated to guard against anthrax ..... 599
Colloidal chemistry in ..... 140
Colloids, removal (W. S. Coulter)..... 571
Filters:
Non-bacterial population of trickling filters (C. R. Cox) ..... 739
Press, plate standardization ..... 949
Imhoff tanks, at Baltimore....50, (C. E. Keefer) e634, 654
Iowa, works not well operated..... 987
Settling tanks, German, with separate sludge digestion (M. B. Tark). ..... *369
Sludge, gas from, utilized as motive power (J. D. Watson) ..... 1062
Unusual combination of elements..... 949

**SEWERS AND SEWAGE WORKS**

Attendant, qualifications of ..... 889
Baltimore, enlargement of (C. E. Keefer) ..... e634, 654
Nine years' operation (T. C. Schaetzle) ..... e48, *50, 97
Brick, concrete blocks hold swelling bottom ..... *80
Construction systematized in soft ground tunnel, Detroit ..... e925, *940
Ejectors, automatic, book review..... 287
Flint, Mich., studies (J. R. Pollock).. *372
Grades and sewage disposal ..... 638
Iowa not well operated ..... 987
Kansas City, Mo., Blue River problem... ....439 (see below Sewers, Turkey Creek)
Milwaukee, new study of ..... e3, 26
Montclair, N. J., commission acts on... n187
Oklahoma City, report on ..... 198
Philadelphia, contract to be completed n208
Pumping plant, Brockton, Mass., open vs closed impellers (H. S Crocker) 854
Tunnels, see Tunnels.
Turkey Creek sewer, Kansas City, Mo., one of largest sewers yet built (A. D. Ludlow) ..... *815
Shadesville, Ohio, bridge may be deferred...n581
Shandaken tunnel, see New York City, Water Supply.
Shannon, W. D., on tunnel lining by pneumatic gun ..... *14, 689
Shapes, concrete, see Concrete Shapes.
Sharp, J. R., on precast stone trim for Baltimore refinery ..... *1027
Sharrow, N. J., on bearing strength of bolts through concrete beam. *413, correction 454
Shelby, J. S., on concrete blocks mark cross walks ..... *203
Sheets F. T. new head Illinois highways n*542
Shepheard, F. H., and E. E. Butterfield, on sand coats treated with steam tubes and cold road oil... 477, e510, (O. F. Wenzel) letter 661
Shipping Board sells villages at auction..n1043
Ships, concrete barges in Austria ..... 111
Concrete ship launched in Germany ..... 520
Lehigh Univ., course in ship building and marine transportation ..... 24
Wooden, Government asks bids for sale n87
Wooden, use for, suggested (F. W. Bowker) ..... letter 161
Sidell, H. G., [illegible] A. A. V. road bonds board ..... n64

**SHOVELS**

Electric, gasoline engine ..... n959
Steam, accident to (C. Dixon) ..... *96
Cost of work in building logging railroads ..... h995
Dies for dragline in hard, stiff material ..... h*743
On rubber-tired wheels ..... h566
Pavement breaker improvised from h*163
Track made of built-up timber sections (C. W. Geiger) ..... h*162
Use air, boiler becomes reservoir....h120
Wearing qualities tested ..... 253
Simplon Tunnel excavation completed..... n503
Second, nears completion ..... 575
Singapore, American-built cement mill... *29
Skagit power, see Seattle.
Skid construction, machinery on track....h336
Skimmer Scoop ..... n*209
Skinner, J. F., on sewage disposal for small municipalities ..... a780
Slide dust for asphalt mixtures ..... 113
Slides, earth, railway relocation to eliminate ..... 18
Slope determination in hopper design, diagram aids in (H. de G. Ardis) ..... *513
Sludge, see Sewage, also Sewage Treatment
Sludge, activated see Sewage Treatment
Smith, E. U., on temporary trusses support columns ..... h*377
Smith, Dr. S., 98 years old, first pres. Pub. Health Assn. ..... n*870
Snare & Triest Co. becomes Fredk. Snare Co. ..... n424
Snow, melted in turntable pits ..... 653
New Jersey plans removal from highways ..... n1079
Problem, discounting ..... e640, n640
Removal, to be discussed ..... n252
Snow, J. B., tunnel experience ..... n254
Snow, W. A., on reinforcement corrosion due to sea water or electrolysis ..... *528
Snyder, T. E., and A. T. Hopkins, on powder-post beetle damage to wood ..... *269
"Social Justice, Unsolved Riddle of" (Leacock) ..... 822
Soc. for Promotion of Engineering Education meeting, report; editorials, letters, etc. ..... e2, n85, e247, 268, 289, 248, 332, 376, 536, 578, 949
Soc. of Automatic Engineers, see Automotive Engineers.

**SOCIETIES**

British, movements ..... e132
Clubhouse, fanciful design, see Societies Providence.
Conference, joint Rochester, Buffalo and Syracuse, N. Y. engineers ..... n664
Convention programs, overloading..... e510
Conventions, conflict of dates and places e963
Foch honored by ..... n997, *1036
Human touch in society affairs (W. B. Lewis) ..... e173, *191, (A Cincinnati Engineer and W. E. Rolfe) letters 333
Papers, time limit for ..... e879
Portland, Ore., Section, unconventional society notes ..... n792
Providence Engineering Soc. fanciful design for club house (W. B. Lewis) ..... e173, *191, (A Cincinnati Engineer and W. E. Rolfe) letters 333
Publicity work, Missoula Chapter, A. A. E. ..... *353
Soil and soil pressure, see Fills, Earth
Soldier preference law, see New York State.
Sounding rods for subsoil (G. E. Horr)... h*539 (G. E. Horr) letter 579, (S. Worthington) letter 909
South Africa, engineers in ..... e89, e303
Pumps and motors specifications..... n302
South America, Bolivian railway, F. Lavis retained to advise on ..... n160
Brazil to provide water storage ..... n301
Chile halts bridge works ..... n1074
Railway electrification ..... 976
South Bend, Ind., Tribune, special design for building ..... *442
South Carolina highways, see Highways, South Carolina.
South Dakota, state cement plant held legal 151
Southern California Edison Co., see Kern River power plant.
So. Pac. Ry. places large rail order..... n795
Lays manganese rail ..... 29
Long tunnel built to eliminate operating hazard ..... *397
Tehachapi tunnels rebuilt ..... n165
Southern Pine, shipments, demand production, etc. ..... n42, n87, n213, n301, n442, n507, n564, n670, n704, n791
Southern Power Co. to build two plants n833
Southern Ry., resurvey after improvement (C. W. White) ..... 761, (C. H. Ensley) letter 1074
Southwest League of, see League of the Southwest
Speedways, one way of diversity ..... 951
Spring Valley Water Co., see San Francisco.
Stadium, comedy aims ..... n*
Water Supply ..... n*
States, [illegible] ..... n*
[illegible] ..... n*
St. John, N. B., sheet-pile cofferdam in 28-ft. tide ..... *
St. John River [illegible] ..... n*


*Illustrated; e editorials; h, hints; n, news notes; a, abstract

ST. LAWRENCE WATERWAY
Arguments presented for ..... n832
Government engineers report on (H. G. Robey) ....e889 102, with insert
Inspecting ..... *155
Is it practicable? ..... e830
National societies to discuss ..... n706
Report made ..... n122
St. Louis Mo. street railway and rapid transit plans ..... 805
Suburban and rapid transit plans ..... 805
Water supply exhibit in municipal library, St. Louis ..... *1066
St. Louis County, Mo., to let $2,000,000 road work ..... n87
St. Marys River (international boundary). see International St. Marys River
St. Marys River, Indiana, pollution by sugar refinery wastes ..... 178
St. Paul Minn. High dam project considered ..... n911
Planning projects ..... *735
To vote on abandoning commission plan 782
Union station work to be shut down..n422
St. Paul-Minneapolis water district opposed.n542
Stadia, see Surveying.
Stadiums, California Univ., planned ..... 8
Campaign gets million dollars ..... n1040
Concrete, traveling forms cut expense. *977
Los Angeles, planned ..... n*957
Ohio State University ..... n*913
Stanford, rapid earth handling ..... 953
Stamm, E. P., on moving a standing 210-ft. tree ..... *230
Standard Oil Building, New York foundation problems (R. H. Chambers) ..... *732
Standard Oil Co. plans work for unemployed ..... n671
Standards, Bureau, see Bureau of Standards.
Standards Committee, see Amer. Engineering Standards Committee.
Standards, explosives and steel ..... n584
Standpipe, wind-induced, repaired (C. E. Carter) ..... *601, (E. N. Fales) letter *950
State Island tunnel, see New York City, Staten Island Tunnel.
Statesmen or business men ..... e594
Stations, railway, see Railways, Stations.
Statistician wanted by I. C. C. ..... n547
"Steam Hoe" ..... n*257
Steam shovel, see Shovels.
Steam trucks, British (G. W. Watson and H. S. Hall) ..... *9
Steamship water supplies certified ..... 767
Stearns, J., on belt conveyor used in placing concrete ..... n*420

STEEL
Bethlehem reduces prices ....n42, e48, n86
Case hardening (book review) ..... 116
Copper bearing in tests ..... 61
Exports recover slightly ..... n794
Freight rates on fabricated steel.....n1005
India, works planned ..... n1005
In roads, see Highways, Concrete.
Prices lower ....n42, e48, n86, (Chemung Iron & Steel Co.) letter 250, (F. O. Lewis) letter 333, n343
Production increases ..... n586
Standards ..... n584
Structural, duty fixed by House ..... n41
Tests
Copper bearing, in tests ..... 61
Medium-carbon, little affected by rolling conditions ..... 194
New impact test ..... *152
Tension, at high temperature ..... 602
U. S. Steel Corp. tonnage grows..... n830
Versus masonry ..... e924 n*954
Steel companies, merger of companies likely ..... n962
Steel construction, see Construction, Steel.
Steel Corporation, cuts prices....n42, e48, n86, (Chemung Iron & Steel Co.) letter 250, (F. O. Lewis) letter 333
Steel frame building, extension of ..... *152
Steel lumber, handbook on ..... n341
Steel plants, electrification of railways... 652, e713
Stevens, J. C., on computing reservoir outflow and height from inflow and capacities ..... *1031
Stones H., on business men or statesmen ..... e594
Stock Exchange, New York, see N. Y. City.
Stockton, Cal., opposition to water meters ....e510, (B. F. Jakobsen) letter, with editorial comment, 720, (G. H. Bragg) letter 909
Stone, building, duty fixed ..... n41
Cast (precast stone trim) for Baltimore ..... *1027
Cutting (J. K. Sharp) ..... *1027
Freight cut approved ..... n408
Carriers supplant cableway ..... *945
Stone crusher, gyratory, improved.....n*1041
Strain, Settlement, see Structure.
Strauss Bascule Bridge Co. sues Seattle ..... n421
Stream pollution and sewage disposal .n905
Commission, etc., Connecticut ..... n745, e757, 5908
Street cleaning, see Cities, Streets.
Streets, see Cities, Streets.
Streetcars in Mexico, iron in early American bridge ..... 819
Strikes, see Labor, Strikes.
Stringers, shearing stresses in (A. M. Van Auken) ..... letter 119, (G. E. Stroebe) letter *419
Wheel guard plate for ..... n*585
Struthers, J. R., and W. H. Rayner, on aerial bay used in teaching topographic mapping ..... *819
Stucco, cement, for small railway buildings ..... n*852
Stump saw, power ..... n*545
Subgrader and finisher ..... *669
Subsoil sounder to determine character (G. E. Horr) ..... b*239, (G. E. Horr) letter 579, (S. Worthington) letter 909
Substructures, see Foundations.
Subway section deep loose-ground, tunneling in (W. C. Bro[illegible] ..... *676, (C. Prelini and W. C. Briggs) letter 867
Subways, see Cities, Transportation.
Sugar refinery waste, handling ..... 178
Suldbach, see Bridges, Suldbach.
Sulphate of aluminum, see Aluminum sulphate.
Superpower, report cities gains.....e757, 783
Surveons' fees, limitations ..... e263

SURVEYING
Assisting Geological Survey, by engineers (C. H. Birdseye) ..... letter 1074
Canadian drainage project surveyed by airplane ..... n870
Government consolidation of mapping work recommended ..... n665
Land lines, field methods in running (F. E. Brackett) ..... *519
Milwaukee, rivers and harbors, city surveys of ..... *558
Railroad, see Railways, Surveys.
Redwood stakes stand 47 years....530, (J. M. Garrett) letter 701
Sand box used in teaching topographic mapping (Rayner and Stubbins)....*810
Stadia system for traverse work (J. A. McDonald) ..... 512
Traverses, simplified method of plotting (H. N. Bradstreet) ..... 160 (E. Low) letter 292, (G. T. Whelton) letter 746
Triangulating under difficulties (H. N. Bradstreet) ..... 899
Tripod, precise-leveling new (J. D. Crichton) ..... n*968
Susitna Bridge, see Bridges, Susitna.
Sutherland, Prof. H., on training engineer for industrial and social service..... 979
Swamps crossed by long concrete trestles (J. L. Parker) ..... *725
Swasey, A., British honors ..... n82
Elected hon. mem. Am. Soc. C. E..... e346 (F. I. Winslow) letter 459
Swift Current, Sask., dismisses city engineer and chief of police ..... e593
Switches, see Railways, Switches.
Switzerland, technical notes from railways, etc. ..... *242
Tunnel construction engineers seek data 285
Sydney, Australia, cantilever bridge for..n542
Syllabus, car ..... 160
Syracuse, N. Y., engineers and others in conference ..... n664

T

Tacoma to protect pipe line ..... n208
Lake Cushman power project report....n300
Still in doubt ..... n1079
Talbot, Prof. A. N., on proportioning concrete by voids in mortar.....e133, a*147
Tamper, power ..... n*669
Tanks, cast-iron, for dry materials.....n*1003
Construction controlled, by Massachusetts law ..... 978
Tannery wastes chlorinated to guard against anthrax ..... 599
Tariff, on cement, stone and steel..... n41
Tarth, M. H., on German sewage settling tanks ..... *369
Tax bill, Federal, six salient features...n1042
Tax relief as business stimulant ..... e509
Taxes, motor vehicle, see Motor vehicles.
Taylorsville Dam, see Miami.
Tehachapi, P. D., Cal., railroad line change..*569
Tehachapi tunnels reconstructed.....n465
Teichman, F., on ground water control, Florida drainage project ..... *406
Teton Dam, see Teton.
Tennessee & Northern Ontario Railway to be extended to provide work....n588, n627
Power development ..... n705
Tennessee, highways, see Highways, Tennessee.
License board appointed, etc. ..... n666, n666, n999
Terminology of mechanics, improvement of (J. H. Gentile) ..... letter 865
Terrazzo layer in sandstone ..... *184
Terra cotta men fined ..... n1043
Terre Haute, Ind., water-works publicity.. 277

TESTS, see also CONCRETE TESTS; STEEL, TESTS, etc.
Aerodynamic and tunnel built by Bureau of Standards ..... n125
Columns, building, fire resistance as shown by test (R. E. Wilson).....e90, *106, 145
Hardness testing device, prize offered.... 15
Machine, large, calibrated ..... 273
Paint, tensile properties of films..... 94
Texas, floods, caused by heavy rainfall.n462, 494
Highways, see Highways, Texas.
Theater roof collapse, Brooklyn, N. Y.....e923, n*954, (E. R. T. Berggren) letter 1072
Thompson, P., on getting full value of engineering periodicals ..... 456
On how to spring a groined arch between high column and low walls..... *515
On weight of forms determined from modulus ..... h*121
Thomson, T. K., on reconstruction of Washington Bldg., New York ..... *774
Thum, E. E., review of books on metallic engineering material ..... 116
Thunderstorm-breeding spots and engineering design ..... 241
Tidal bore studies on River Dee and estuary (W. Gore) ..... *491
Tidewater Oil Co. cuts wages ..... n631
Ties, see Railways, ties.
Tieton Dam, building ..... *890
Height fixed ..... n464
Tile, clay products research begun..... n87
Federal Cement Co. pamphlet..... n341
Manufacturers indicted ..... n467
Still active illegally, is charge..... n1043
Tilton, G. A., Jr., on locating highway grades in side-hill country..... *455
Timber, see Wood; also Lumber.
Timber roof truss, special design....*246, (E. D. Gilman) letter 418.
Timbers, built-up, tests on..... 316
Timiskaming, see Temiskaming.
Tippecanoe County, Ind., health survey...n165
Tires, see Motor vehicles, tires.
Titus, W. J., on concrete girders jacked up to replace settled bridge pier..... *638
TNT for road construction ..... 353
Toledo, Ohio, water, tastes and odors..... 771
Toll bridges, Delaware, abolished ..... n38
Tomlin, R. K., Jr., on motor vehicle legislation, trend of ..... e347, 354, e511, (W. Jackson) letter 1034.
Tools for tunneling with pneumatic hammers ..... h*206
Topographic mapping, etc., see Surveying.
Toronto takes street railways..... 611
Torpen, B. E., on pivot piledriver with special features ..... h*377
Tower, high, floor center carried by simple scaffold (G. A. Davis) ..... h*953
Tower, wireless, 200-ft., moved (Lieut. A. T. Colwell)..... n420, correction 538
Towers, transmission, full-size, high-voltage tests on (E. F. Kriegsman)..... *350
Towns, planning, etc., see Cities.
Townsend bill, see Highways, Federal-aid.
Track, see Railways, track.
Tractors, see Motor vehicles.

TRADE, FOREIGN
August, 1921 ..... 641
Free port zone advocated..... n421
Grain export cities, leading ..... e89
Reports, weekly ..... 659
Road-making equipment, exports, 700, 814, 943
Steel exports recover slightly..... n794
Trade associations endorsed by Hoover.... n911
Federal court decision favors..... n916
Supreme Court decision on "open competition" ..... e1008, n1043, e1046 (See also Trusts)
Traffic, see Highways, traffic and cities, traffic.
Trailers, see Motor vehicles.
Transmission towers, see Towers.
Travel sketches of a mining engineer (book review) ..... 117
Tree, standing, moving of 210-ft. tree (E. P. Stamm) ..... *230
Trelleborg, Sweden, port plans wanted.... n84
Trenching machines and trenches, see Excavation.
Trestles, see also Railways, trestles.
Trestles, long concrete, to cross Southern river swamps (J. L. Parker)..... *725
Triangulation, see Surveys.
Trinity River, Texas, Goethals completes Lake Dallas survey ..... n744
Tripod, see Surveying.
Truckmixer ..... n*299
Trucks, see Motor vehicles.
Truss, steel, largest, used in Chicago mail terminal ..... *1010
Truss, largest steel (150-ft.) erected in Chicago building (W. J. Howard)..... *1058
Trusses, temporary, support columns (E. U. Smith) ..... h*377
Wooden, failure by splitting (H. K. Phelps) ..... *514, (H. J. Schoenfeld) letter 621.
Trusts (see also trade associations):
Hardwood price plan illegal....e1008, n1043
Terra cotta men fined ..... n1043
Tile men still active illegally, is charge.n1043
Tulane Lake, Cal., final words give data for mapping ..... 455
Tulsa, Okla., bonds for water supply voted.n957
water situation ..... 719, n791

TUNNELS
Brick, 30 year old, broken up ..... h910
Clay tunneling winch and hoist..... n629
Full-section excavation, Liberty Tunnels, Pittsburgh ..... *478
Lining, continued beyond portal for protection from slides ..... *247
Placed by pneumatic gun (W. D. Shannon) ..... *14
Machine, new, completes tunnel in one operation ..... *555
New York City, tunnel between Staten Island and Brooklyn, engineers appointed ..... n254
Non-pressure, for water and sewers, tables for designing (J. Hinds)..... 693
Pressure tunnel construction, engineers seek data, Switzerland ..... 285
Railway concrete drainage of..... 113
Railway, long, built to eliminate operating hazard ..... *367


*Illustrated, e, editorials, h, letter, n, news notes; a, abstracts

Page

Relining with concrete, Pacific roads. e131, *134, n465
Timbered fire protection for . . . . . 731
Sewer tunnels, Detroit, dug by draw knife . . . . . h*163
Cavity grouted from test pit to avoid building settlement (L. G. Hall) . . 293
Flooded recovery at Milwaukee . . . e2, *4
20,000-sec. ft. driving, for Turkey Creek sewer . . . . . *882
Simplon excavation completed . . . . . n503
Second, nears completion . . . . . 575
Soft ground, construction systematized. e925, *940
Tehachapi, reconstructed . . . . . n465
Timbered and roof-shield tunneling in deep, loose-ground subway section (W. C. Briggs) . . . *676 (C. Prelini and W. C. Briggs letter 867, (J. F. Fouhy) letter 1033
Tools for tunneling with pneumatic hammers . . . . . h*206
Wood pipe preferred for ventilation . . . . 243
Work, rules for . . . . . n912
Turbimar Hoist . . . . . n*299
Turbines, locomotive, for flood lighting night construction . . . . . h*206
Turkey Creek sewer, see Kansas City, Mo.
Turner, D. L., on engineering education . . . . 241
Plan for controlling New York transit. e1046
Turntable, see Railways, turntable.
Turpentining does not affect lumber value. 482
Typhoid, compensation damages for death, Ohio . . . . . 981
Auto killings more numerous than typhoid deaths . . . . . e1046, 1074
Cumulative case curves . . . . . *170
Monfclair, N. J., freedom from typhoid. n1001
Terre Haute, Ind., decrease . . . . . 277
Water supply legislation in Ohio, new. . . 846

U

Umatilla Rapids, Ore., power development, report on . . . . . 803
Uncompahgre River flood . . . . . 728
Unemployment, see Labor, Unemployment.
Union County, N. J., engineers on park commission . . . . . 21
Park system established . . . . . e864, 978
U. S. Bureau of Public Roads, see Bureau of Public Roads
U. S. Bureau of Standards, see Bureau of Standards.
U. S. Engineer Dept., assistant engineers' salaries standardized . . . . . n379
U. S. Geological Survey, see Geological Survey.
U. S. Reclamation Service, see Reclamation Service.
U. S. Shipping Board, see Shipping Board.
U. S. Steel Corp., tonnage grows . . . . . n630
Universities, see names of universities, as Illinois, University of.
Upton, R. G., on cost of anti-malaria work, Port Arthur, Tex. . . . . *401
Utilities, public, see Public Utilities.

V

Vail, M. L., on universal knuckle for pile-driving . . . . . n*251
Valuation, "Financing Engineering" (Goldman) . . . letters by O. B. Goldman and H. Barker, 114
Valuation, railway, see Railways, Valuation.
Valves, air pressure-seated . . . . . n*545
Automatic double-cushioned check . . . n*426
Stems, see Water Supply, Valve Stems.
Relief, must function . . . . . e758
Valve closing trucks, Detroit water works. *95
Vanderlip, F. A., proposes world reserve bank . . . . . e757, n878
Vermont, water power development, new . . n82
Vermont Society joins Federation . . . . . n624
Vibration effects from subways, negligible
Virginia, water power, Federal permit for. n422
Vision—achievement . . . . . e1045
Visions day of . . . . . e430
Volts, million, tests . . . . . n501

W

Waco, Tex., filtration plant, tuning up . . . . 245
Wage adjustments, etc., see Labor.
Wagon loader on creepers . . . . . n*257
Wait, B. H., on strengthen concrete paving. *192
Wall, sea, see Sea wall.
Wallace & Tiernan new dry feed chemical device . . . . . n87
Walls, brick, to be tested . . . . . 191
War Dept., to encourage military invention. n294
War Finance Corporation may resume railway loans . . . . . n165
Ward, W. on concrete and gunite flumes
King Hill project . . . . . e923, *926, *1014
Warehouse, concrete, 550-ft., without joints 273
Warren bituulithic paving patents status of. e963
Wars, cost of . . . . . 969
Washington, D. C., Phillips, A. E., sanitary engineer of district resigns, praises work . . . . . e281, 284, n540
Power plant history of estimates and cost . . . . . e131
Rock Creek Park to be extended . . . n279
Washington Bldg., N. Y. City, reconstruction. (T. K. Thomson) . . . . . *774
Washington, State, engineers' convention urges public works to aid unemployed n584

Page

Highways, see Highways, Washington State.
Waste in Industry" book review . . . . . 823
Waste-a-building industry report on. e131, n169
In metal trades, committee reports on . . n214
Railroad Division, A. S. M. E., to discuss waste . . . . . n663
Wastes, see Sewage.
Water potable, for steamships, certification of . . . . . 767

WATER POWER

Alabama Power Co., Coosa River project, permit granted . . . . . n84
Big Creek, penstock bursts during tests . . . . . n501, e758
California campaigns for . . . . . n294
Tabulated . . . . . 156
Colorado River discussed . . . . . n1091
Columbia River Umatilla Rapids . . . . . 803
Commission approves over 2,000,000 hp. n747
Deschutes River power and irrigation project . . . . . n501
Federal, progress made . . . . . a313
Federal Commission, St. Paul dam to be considered . . . . . n911
Great Falls, Winnipeg development started . . . . . n666
Idaho, Federal permit for . . . . . n422
Italy, development . . . . . 54
Kern River, Cal., power plant, automatic features . . . . . e430, 453
Lake Cushman, see Tacoma.
New York State map . . . . . 824
Ontario commission against hydro-electric line . . . . . n296
Penstock bursts during tryout of high-head turbine plant . . . . . e634, 640
Pit River, Cal., project, progress on . . . . . *604
Queenston-Chippawa, see Queenston.
Superpower, report cites gains . . . . e757, 783
Transmission towers' full-size, high-voltage, tests on (E. F. Kriegsman) . . *350
Umatilla Rapids, Ore., development, report on . . . . . 803
Vermont development, new . . . . . n82
Virginia, Federal permit for . . . . . n422
Water rights, interstate, settlement by treaties (A. L. Fellows) . . . . . 91
Case to be reargued . . . . . 968
Water storage, underground, on Santa Ana Cone (H. Forbes) . . . . . *68

WATER SUPPLY AND WATER WORKS

And water purification . . . . . a907
Baltimore Montebello filters loss of head as a criterion for washing (J. W. Armstrong) . . . . . *1060
Atlanta, Ga., bids for filters and clear water reservoir invited . . . . . n1079
Brass goods standardization . . . . . 568
Buffalo, N. Y., city votes for filters. . . . n869
Cambridge, Mass., progress and opportunity. (S. A. Johnson) . . . . . e391, 416
Cedar Rapids, Iowa, plan . . . . . 187
Concrete pipe line augments Kansas City supply (F. E. Miller) . . . . . *1029
Controlling water after blowing out 16-in. plug (C. Maffitt) . . . . . 226
Cross-connections, dangerous. . . e390, 409, n464
New Hampshire control . . . . . 396
Rules, Ontario . . . . . 374
Denver, engineer to make survey . . . . . n165
Engineer commission suggested . . . . . n833
Detroit, city gets estimate on Lake Huron supply . . . . . n161
Valve closing trucks . . . . . *95
Distribution system, neglected, overhauling of . . . . . e131, 158
Electrolysis in water pipe systems . . . . . 821
Filters, see Water Treatment, Filters.
Flow of water through galvanized spiral riveted steel pipe. (Prof. F. W. Greve) . *159
Great Britain, drought yields . . . . . 326
Harford, Conn., abolition of double check valves . . . . . 12, e390
Cross-connections . . . . . e390, 409, n464
Indianapolis, opening of new reservoir used to educate public . . . . . n1079
Industrial wastes in relation to water supplies . . . . . a908
Kansas City, Mo., commission elected . . n956
Concrete pipe line augments, (F. E. Miller) . . . . . *1029
Laboratories compared . . . . . 499
London, chemical and bacteriological examinations (Houston), book review. . . 990
Partly shut valves reduce use . . . . . 205
Main, authority to order moving . . . . . 451
Massachusetts, qualities of supplies (Prof. G. C. Whipple) . . . . . 497
Meters, opposition at Stockton, Cal. (510 (B. F. Jakobsen) letter, with editorial comment, 702, (G. H. Teague) letter 909
Providence, R. I., meters and water consumption . . . . . 959
Milwaukee, new story of situation . . . e3, 22, n167
Three triple-expansion pumping engines wanted . . . . . n583
Minneapolis, St. Paul, metropolitan district opposed . . . . . n542
Montclair, N. J., commission acts on Company declines offer . . . . . n165
Montreal, centrifugal pump . . . . . n583
wanted . . . . . n583
City must pay damages for breaks in water main . . . . . n81
New trends, valve closing employed in Detroit . . . . . *95
New England Assn. convention, etc. . . . n581
496, 498, n601

Page

New Hampshire, cross-connection control . . . . . 396
New York City Catskill, method used to prevent turbine Schoharie Creek, auto . . . . . n997
Shandaken tunnel advanced . . . . . n464
Norfolk, Va., wood water conduit repair (J. W. Ledoux) . . . e389, *396 (T. F. Wolfe letter 538, J. W. Ledoux) letter 621
Oakland, Cal., large main laying plans. . . n1040
Oakland, Cal., San Pablo dam completed . . . . . n1078
Ohio, legislation, new . . . . . 846
Oklahoma City, map of water distribution system faulty . . . . . e131, 158
Ontario, cross-connection rules . . . . . 374
Oxygen content, low, causes tastes and odors . . . . . 771
Paterson, N. J., votes to acquire system. n832
Pipe, see Pipe.
Pipe line repair, controlling water after blowing out 16-in. plug (M. Maffitt) . . 226
Pumps, see Pumps.
Reservoirs vs. additional pumps for peak demands (L. A. Quayle) . . . . . *328
Salinity in water, allowable . . . . . 899
San Francisco, see San Francisco
Sanitary protection (A. Hazen) . . . . . 493
School for city employees planned. . . . n1040
Seattle, Cedar River reservoir, $15,000 for sealing . . . . . n421
Protest against acceptance of bid for bonds . . . . . n1077
Reservoir is safe, court holds. . . . . n423
St. Louis, water works exhibit in city library (T. Chivvis) . . . . . *1066
St. Paul-Minneapolis, metropolitan district opposed . . . . . n542
Standpipe, wind-induced repairs to (C. E. Carter . . . . . *601 (E. N. Fales) letter *950
Steamship certification of water . . . . . 767
Tacoma pipe line to be protected from flood . . . . . n208
Terre Haute, Ind., waterworks publicity. 277
Tulsa, Okla. . . . . 719, n791, n957
Tunnels, see Tunnels.
Underground, for Akron, Ohio, rubber plant . . . . . 111
Valve stems, manganese bronze for (W. R. Conard) . . . . . 575, correction 621
Valves, double check, abolition at Hartford, Conn. . . . . 12, e390
Wine from water-works conduits. . . . . 279
Yakima, Wash., authority to order moving of main . . . . . 451

WATER TREATMENT

Alum in Illinois . . . . . 20
Aluminum sulphate solutions, testing and calculating (C. H. Capen, Jr.) . . . . . *573
Bacterial tests, B. Welchii . . . . . e389, e470, 484, correction e509
Chlorine, liquid, precautions in handling. 691
Problems . . . e390, 392, 444 (A. E. Walden and S. T. Powell) letter 579, (J. M. Caudle letter 619, (J. S. Gutzeit) letter 898
Chlorine gas cylinders, Keeping track of . . . . . *1
Filters:
Analytical data essential to run mechanical filters . . . 353 (G. C. Bunker and C. A. Brown) Letters 951
Buffalo, N. Y., to vote on project . . . n167
Buffalo, N. Y., votes for . . . . . n869
Cambridge Mass., mechanical filtration plant being built (G. A. Johnson) . . e391, 416
Loss of head as a criterion for washing filters (J. W. Armstrong) . . . *1060
Milwaukee, filters urged for . . e3, 26, n167
Ohio conference, etc. . . . . n748, n914
Press plates, standardization . . . . . 939
Sand, proper size for rapid sand filters. a907
Waco plant, tuning up after cold years . . . . . 245
Water supply and water purification . . . a907
Gans zeolite softening patents upheld . . . n168
Hydrogen-ion concentration, significance of (H. P. Eddy) . . . . . 494
Iowa plants . . . . . 333
Laboratories compared . . . . . 499
Lime, use of . . . . . 138
Marquette, Mich., elimination of tastes (W. C. Brockway) . . . . . *71
Purification, analytical data necessary to run mechanical filters. . . 353. (G. C. Bunker and C. A. Brown) letters 951
Tests, B. Welchii . . . . . e389, e470, 484, correction e509
Water supply and water purification . . . a907

WATERWAYS

Atlantic to Hudson Assn. meets . . . . . n37
Black, control . . . . . 103
Mississippi Valley Assn. form 11 districts . . . . . n505
St. Lawrence, see St. Lawrence.
Water works, see Water Supply.
Waterless plant wastes treating . . . . . 187
Waterproofing, old method of . . . . . n997
Watson, C. W., and H. S. Hall on brick beam tests . . . . . *9
Watson, J. D., on utilization of power from [illegible] . . . . . [illegible]
Weeks, Claude, M. [illegible] . . . . . [illegible]
Wayne County . . . . . [illegible]
Weir, [illegible] . . . . . [illegible]
Welch, [illegible] . . . . . [illegible]
Roads, [illegible] . . . . . [illegible]
h*162 (L. D. Carvell) letter 2[illegible]


*Illustrated. e, editorials; h, hints; n, news notes; a, abstracts

Page

Wells, Oriental well-drilling rig (E. W. Lane) *685
Streamers and testing devices for concrete for *853
Wenatchee reclamation project to cost $2,500,000 n912
West Coast almost out of lumber n1078
Westinghouse gets Chicago contract e636
Westinghouse Church, Kerr & Co. alumni association formed n1078
Wheaton Congregational College expansion *856
Wheel scraper, new n *466
Whipple, Prof. G. C., on qualities of Massachusetts water supplies 497
White, G. W., in charge of Southern Railway after improvement 764
Whitewash prevents asphalt from running h *351
Whitmer, F. P., book review of "Columns" 822
Whos Who in Engineering (British) 659
Wichita County, Tex., tries lump-sum-fee road contract *607
Wichita Falls Irrigation Project contract awarded n1080
Williams, F. R., on Cleveland reverts to asphalt filler for brick pavements 653
Williams, S. M., not candidate for Highway Commission n295
Williamsburg Bridge, New York, see Bridges, Williamsburg.
Wilmington, Del., finds work for unemployed n961
Port work, bids opened n129
Wilson, R. E., on fire resistance of building columns 90, *106, 145
Wind pressure, standpipe indented (C. E. Carter) *601 (E. N. Fales) letter *950
Wind tunnel, building by Bureau of Standards n125
Window washing tram system for n *545
Winter, cold weather records 887
Water softening plant, recording
Water supply, by n255
Photographic record of work e45, 57
Pumping test of wells 351
Tower concrete design of (K. Shibata) letter 205
Power plant, new, at A. T. Colorado, hydro-electric 518
Water-power development e1045
Waterproofing, see Highways; Wisconsin.
State may prohibit non-fireproof hospitals n1076
Wisconsin Univ., construction course n378
Wisconsin, oil on water found for pipe discharging under water into reservoir *886
Wolf, C. C., on nitrate and chemical analyses of portland cement 650

WOOD, see also WOOD PRESERVATION

Air seasoning, to reduce time 489
Columns to be tested n255
Columns, timber, new tests 1075
Joint plate n *585
Pine pole prices n877
Pine stakes, long-lived (J. M. Garrett) letter 701
Powder-post beetle, damage by (A. D. Hopkins and T. E. Snyder) *269
Preservation above summer water level (C. M. Kurtz) *942
Redwood stakes stand 47 years 530
(J. M. Garrett) letter 701
Safety in service e49
Strength, to be studied n35
Surveying and cruising 447
Tests, column, to be conducted at Madison 580
Virgin and second growth 443

WOOD PRESERVATION, see also WOOD

Bridge floor construction, creosoted, to be studied n1078
Creosoted floor blamed for Pittsburgh bridge fire n124
Highway bridge fire protection under study by Am. Wood Preservers' Assn. 1071
In 1920 932
Powder-post beetle damage by (A. D. Hopkins and T. E. Snyder) *269
Service bureau to be established n295
Tie perforating machine, increased speed on 741
Wooden beams, see Beams
Woods, Col. A., to co-ordinate employment effort n623
Worcester, Mass., puts unemployed on public works n301, n382
Works, public, see Public Works
Wyoming, state makes irrigation investigation with Reclamation Service 199
Wyoming-Colorado water case to be reargued 968

Y

Yakima, Wash., water supply, authority to order main moved 451
Yazoo delta, new river planned for flood protection and drainage *481
Yellow River, China, bridge, bids on n957
Yonts, H. W., on use of equipment reduces concrete gang h *703
Yorkship, N. J., sold at auction n1043

Z

Z R 2, balloon collapse e346
Zeolite water softening patents upheld n168
Zinc chloride, see Wood preservation.
Zoning, see Cities, Zoning.

*Illustrated, e editorials, h hints, n news notes; a, abstracts

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 87 — NEW YORK, JULY 7, 1921 — Number 1

*Engineering News-Record* is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

*Engineering News* was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*," under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

*Engineering Record* was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The staff of *Engineering News-Record* consists of

*New York:* E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., H. H. French and J. W. Shaver.

*Chicago:* W. W. DeBerard, E. E. R. Tratman, C. S. Hill.

*San Francisco:* N. A. Bowers.

## Heating Rivets with Gas

Gas has certain obvious advantages over coke and oil and has replaced these fuels in many industries where there were no special obstacles to the use of gas. In the structural steel field, rivet heating is still done chiefly with oil or coke; gas does not seem to have found favor there. During the war shipyards of the Pacific Coast began to change over their rivet heaters from coke or oil to gas and in some districts gas became the preferred fuel for this service. This change, it appears, was not only for the emergency of war time as gas is continuing in service. The article in this issue by Letson Balliet claims greater economy and better rivets as a result of the conversion to gas in the shipyards of the San Francisco Bay region. Mr. Balliet was instrumental in bringing about this conversion, and it follows that he is an enthusiastic believer in the superiority of gas over oil and coke. While his point of view is to be taken as representative that of the industrial or efficiency engineer of the steel shipyard, the progressive structural engineer would do well to examine with an open mind the claims and reasons advanced, to see what may be worthy of consideration in the structural steel field.

## What Is a Profession?

THERE NEEDS to be a clear definition of what constitutes a profession. Engineers have long regarded themselves as professional men. Now the general contractors style themselves in the same way, and the builders are claiming for themselves a professional status, for the National Association of Builders' Exchanges has just adopted a code of ethics in which it describes its members as being engaged in a profession. Obviously, law, engineering, contracting, and building, if professions, are professions in quite different senses. That the builders are not arrogating to themselves professional distinction without trying to erect standards to which their members should attain, it is worth noting that the code sets forth that the members are engaged in a calling "in which there is a well-defined duty and obligation toward the public and themselves. The profession demands that the members use every honorable means to uphold the dignity and honor of the same, to exalt its standards, and to extend its spirit of usefulness." Of course, a mere declaration of that sort is worthless unless backed up by disciplinary procedure, but certainly, even if one quarrels with the arrogation of the title "profession," one cannot but be gratified that the builders are taking at least the first small step toward raising the standards of their calling. The term "profession," however, certainly needs to be safeguarded, at least to the extent of working out an acceptable definition.

## The Builders' Code

AS MIGHT be expected, the code adopted by the builders has not the finish of the codes of the learned professions. Possibly the character of the new code is best illustrated by the introduction clause which says, "We understand ethics to mean a declaration of principles." With such a beginning one might expect a confused sort of document. And so it is. Ethical considerations are strangely thrown in with mere rules aimed to serve the interests of its members. A professional status—whatever that is—may eventually come to the builder, but the heights are going to be mounted slowly and painfully.

## Engineers and Railroads

APPOINTMENT of a board of six engineers to engage in work "regarded as an important step in the solution of the transportation problems now confronting the country" is a step in the right direction. This appointment has been made by the National Association of Owners of Railroad Securities in constituting the Board of Economics and Engineering. It is recognized that the great problem in transportation now is to reduce railroad operating expenses, and the announcement of the security owners association indicates that the new board will be charged with making recommendations to this end. It is also indicated that the board will study possibilities for effecting economies through the consolidation of railroad properties and the elimination of wasteful competitive practices. This association represents bondholding rather than stockholding interests. The bondholders feel justified in initiating action, believing that their investments are, or will be impaired. It is entirely problematical how far recommendations, however important, emanating from bondholding interests can go in accomplishing direct results until it is established that the bondholders' equities are actually endangered. However, the recommendations of this board of engineers should have weight not only

with the public but also with the railroad managements, since its members have the distinct advantage of being unhampered by individual financial interests. A few weeks ago this journal urged that railroad operating problems heretofore solved merely by rule of thumb should be given over to men equipped to solve them by accurate scientific methods—in other words, engineers. Not only is the appointment of six engineers on this new national board recognition of such a necessity, but it is recognition of the engineers' broader qualifications to deal with the larger phases of the problem. If the railroad managements—that is, the stockholding group—had made such a move, it would be all the more encouraging.

### San Francisco Bay Bridge Schemes

THAT the San Francisco bay region seems now to be in earnest about a transbay bridge or tunnel is evident from the origin and variety of the independent plans reviewed in this issue. The enormous increases of automobile traffic in recent years on California's very extensive highway system has enlisted the powerful support of the ubiquitous motorist and Admiral Jayne's plan, with tentative sanction from Washington, opens up a new field of investigation by implying that the pier-head line need not be kept within the previous limits but that trestles well out into the bay from the Oakland side might be permitted. The plans originally proposed by John G. Little deserve special comment in that they are based on a very broad view of the whole situation. He began with a survey of the probable industrial development around the bay, and located crossings with industrial as well as physical considerations in mind so that the early construction will not be a lost investment when later growth calls for additional harbor or transportation facilities. He says "Some of these crossings may not be built in the next two hundred years; some of them may never be built at all, but several of them will surely be built within the next twenty years and the way should be kept clear for them and nothing should be constructed if avoidable at any of these natural crossing points that will interfere with the location as a bridge site." San Francisco certainly needs—and needs urgently—some form of direct communication with the east bay shore and the time for action in securing a bridge or tunnel seems to have arrived. Not only would this relieve a traffic condition that is now a serious handicap, but it would hasten the much needed union of San Francisco bay cities into a harmonious unit.

### Engineers Prepare Court Case

In court proceedings which involve judgment of engineering evidence, engineers have frequently an educational duty which can well go beyond the stage to which it is usually carried. Unusual perception of this fact is apparent in the methods employed by the engineers of the Milwaukee Sewerage Commission in the damage suit involved in the construction of the sewer tunnels described on page 4. Two purposes were kept in mind by the engineers who prepared the case. One was to instruct the city attorney in the engineering fundamentals of the dispute and the other was to make the technical facts and reasoning plain to judge and jurymen. The methods are described in the article. They emphasize the use of models. The function of these models was to reduce engineering technicalities to terms which the non-technical juryman could readily understand. A vital contention of the contractor was that the soil penetrated by the tunnel was unstable to a degree which endangered the tunnel structure. This claim was supported by descriptive evidence and an exhibition of samples. Rebutting evidence of similar character simply left the jury confused in a maze of poorly comprehended contrary statements. A model of the excavation showing the simple roof-timbering and the enlarging of the invert without, or with only very little, timbering, swept aside all confusion. It was within the comprehension of any juryman that a material which could be as easily managed as the model indicated was not particularly unstable and certainly not a menace to the safety of the tunnel structure. His decision was, therefore, prompt and reckoned little of soil analysis or expert testimony.

### "High-Salaried Engineers"

IN AN appreciation of the late A. G. Batchelder one of the editors of the *American Motorist* remarks that that good-road enthusiast was more pleased at the passage of the first federal-aid road bill than "any one of the highway engineers, who have gained important and high-salaried positions by the creation of the fund." Possibly this is only a hastily considered comment, but it comes with poor grace from one who should know the highway situation thoroughly. Anyone so close to the good-roads movement should know how ridiculously small are the salaries paid the federal highway officials.

## Liberal Courses as a Prerequisite for Engineering

PROFESSOR BURR has given the engineering educators of the country something to think about through his interesting paper at New Haven, in which he challenged the character of the society's activities and maintained that engineering would be accorded its proper place in public esteem only when a liberal education—or at least three years of it—is made prerequisite to an engineering course.

On the past activities of the society we offer but little comment. If the New Haven meeting be typical, we should say that a shaking up is desirable. The meeting was drab; there was little of broad vision, nothing to send the teacher away with new inspiration and enthusiasm. It would suffer much by comparison with the yearly conventions of half a dozen organizations in the civil-engineering field. But decision as to the justice of Prof. Burr's criticism of the activities of the society must be left to those who know it.

His other point is more important. No one will deny that we need a greater number of engineers with a broad outlook, but there will not be agreement that the standard engineering course should be one requiring a liberal education as a prerequisite. Colleges surely should lay out, for those who want them, six-year courses leading to two degrees. In fact, they may well go farther and urge such courses as desirable; there should be enthusiasm for them, and an appreciation of the excellent preparation they give for a rich life work. For the present, though, that is as far as most institutions dare go; nor is the reason solely that their prospective students want to be turned into engi-

neers in four years. There is legitimate reason to question whether the profession does not have places for a great many who are not qualified for six-year courses, but can in four years be excellently trained for their places in the engineering world. If that be the case it would be against the interests of the profession to force all collegiate work in engineering to what would be graduate, or, as Prof. Burr terms it, "professional" grade.

There is another necessary inquiry regarding Prof. Burr's argument. Much that he said depended, consciously or unconsciously, on the thesis that engineering can be made to occupy in public esteem a position equal to that of law and medicine. We doubt that that thesis can be demonstrated as sound. The conditions surrounding law and medicine, on the one hand, and engineering, on the other, are radically different. Only a small minority, less than 10 per cent of the engineering profession (those, namely, in consulting practice) are on a plane comparable with the doctor or the lawyer. It is a precious minority—a very precious one, indeed—but, unfortunately, it is not large enough to give the truly professional color to the whole of engineering practice.

Prof. Burr's paper deserves the consideration not merely of the teachers but of practicing engineers, as well. The latter, let us hope, will jump in and say their say quickly. The teachers—if the action of the convention be strictly interpreted—are not expected to have thoughts thereon until next June.

## Waiting for Scientific Discoveries

SHALL needed public works be held up pending the possible discovery of future scientific improvements of the art? An affirmative answer would effectively stop all impending present-day construction, for there are few lines of engineering today that are not constantly being broadened, extended and changed to take advantage of newly found scientific laws. Illustrative of this point and of the difficulties through which many a city must pass on its way toward obtaining public improvements is the experience of Milwaukee. Politics and engineering, personalities and chemistry, local feeling and high-grade scientific discovery have been important factors for the past several years in the controversy over the relative importance of sewage and water treatment. Rash is the engineer or the scientist who engages in a controversy of this kind without first learning all of the factors in the case in hand, besides taking into account other needs of the city.

Ten years ago Milwaukee called three consulting engineers—H. P. Eddy, G. C. Whipple and John W. Alvord—to report on sewage disposal. These almost went out of their way to say that water filtration was the first line of defense, although advising that both water and sewage treatment were essential. Politically, the city has for some years past been divided between socialists and non-partisans, as the opposition to the socialists is called. The non-partisans advocated sewage treatment and the socialists sponsored water filtration. For two years nothing was done. Then the non-partisans, being in power, obtained the passage of a bill in the State legislature creating the present Sewage Commission for the definite purpose of building sewage-works but no provision was made for water filtration. No doubt the sustaining force behind the sewage movement was the conviction on the part of the general public that sewage treatment would solve the water problem, at least for a number of years. Then ensued the long line of sewage experiments to produce non-polluting effluent. A change in administration, and an unusual pollution of the water by phenol by-products, rendering the water almost unusable if safely chlorinated, brought water treatment again to the front at a time when its political supporters were in power. A technical report by J. W. Ellms, consulting engineer, based on investigations for a year, indicated that the water, even after treatment of the sawage, would not be safe. He recommended immediate filtration.

When plans were well started questions arose as to cost. Then came a report from a committee of the local section of the American Chemical Society. In effect it says that filtration should not be started because present-day filtration methods are in all probability antiquated and because within a few years, by taking advantage of new discoveries in colloidal chemistry and adjusting the hydrogen-ion concentration, vastly improved filtration methods will be developed. Politically some say, and scientifically others aver, this report by the chemists was not pleasing to the socialists. However that may be, Harrison P. Eddy, who for several years has been employed by the Milwaukee Sewerage Commission as consulting engineer, was called in to advise on water treatment. His report, abstracted elsewhere, may be considered the last word on the subject. As noted, he counsels an immediate start on plans for water treatment and simultaneously further experiments along the lines suggested by the chemists. He is not optimistic of the attainment of the far-reaching results the chemists predict. In his opinion any change in design suggested by further chemical studies will not be material and can be made quickly.

A decidedly new angle is presented in this argument of the chemists for deferment—an argument, if accepted as valid, that would be perfectly effective in stopping work on any filtration project in the country. Such an argument for a halting policy has rarely if ever been brought forward seriously in an important engineering matter. Because of its nature and because of its being brought forward by men without experience in water treatment, it must inevitably arouse decided objections on the part of sanitary engineers, men who have given their whole careers to the study of the very subjects into which the chemists lightly leap. How lightly the Milwaukee chemists took this leap is illustrated by their apparent oversight or at least ignoring of the fact that Mr. Ellms is himself a chemist of many years' standing, having been, after and besides other engagements, continuously connected with water treatment at Cincinnati, Cleveland and elsewhere for the past 23 years, serving at Cincinnati successively as assistant chemist, chemist, and superintendent of filtration. Moreover, Mr. Ellms, as already mentioned, directed water-treatment experiments at Milwaukee, on the very water in question, during which chemical and bacterial studies were conducted under his direction. Thus in their haste or zeal to promote chemical service, the Milwaukee chemists seem to have overreached.

Finally, although Mr. Eddy's conclusions seem to offer a practical and harmonious way out of the Milwaukee complication, yet in another case involving inter-professional claims the solution might not be so happy.

# Recovery of Flooded Sewer Tunnels at Milwaukee

**Settling Shafts Carried Down Adjacent Lining, Opened Construction Joints and Flooded Tunnels—Contractual Difficulties Lead to Court Adjudication of Case**

AN EVENTFUL engineering operation, which normally should have been without incident, has been concluded by the completion of two sewer tunnels under the harbor entrance at Milwaukee, Wis. The natural difficulties were not unusual and the tunnels were not large. However, the work failed when near completion, and had to be recovered and restored, and finally it came before the Federal Court for review and adjudication. Questions of construction methods, engineering design, default of agreement, damages and contractual responsibilities came up for consideration and decision.

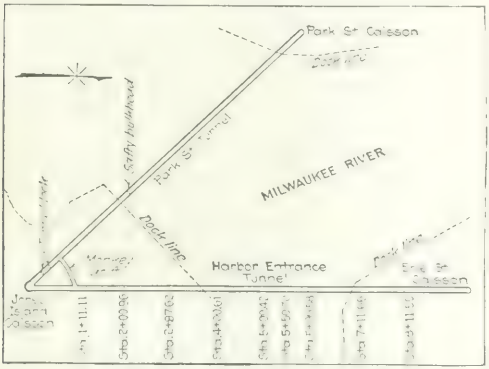



FIG. 1. CONSTRUCTION PLAN OF SHAFTS AND TUNNELS

Two subaqueous tunnels form the connecting link between the new intercepting sewer system on the mainland and the sewage works being constructed on Jones Island at Milwaukee. They constitute two reinforced-concrete inverted siphons, with separate drop shafts on the city shore (see the location plan, Fig. 1) and a common riser shaft on Jones Island. Both the shafts and the tunnels are of two-compartment construction as indicated by the drawings (see Fig. 5 and Fig. 9). Briefly, the Park St. siphon is 797.85 ft. long and 8 ft. in diameter inside, while the Harbor Entrance siphon is 937.42 ft. long and 8 ft. 9 in. in diameter. Originally the tunnels were designed circular, the anticipation being that they would be constructed by shields. The outside form was changed to that shown by Fig. 5, at the request of the contractor, when he decided to use timbering methods.

## Original Construction and Failure

The general plan of construction adopted by the contractor was to sink the Jones Island shaft and from it to drive both tunnels toward the drop shafts, which meanwhile would be sunk ready for the junction. Broadly, separate operations of shaft sinking and of tunnel driving were planned.

*Shaft Construction*—All shafts were constructed as open caissons. In each case an excavation a few feet deep was made, at the bottom of which a cutting edge of the required diameter was started. The earth was then excavated inside this cutting edge with a clamshell, the caisson sinking of its own or under added loading. As soon as water began to come into the caisson, pumps were installed and the water was lowered from time to time, with the idea that the reduction in buoyancy would increase the effective weight of the caisson and that a current of water would be created downward outside the shell which would reduce the skin friction and would also erode the earth under the cutting edge and so assist the sinking. From time to time sections were cast on top until full depth was reached; then the water was allowed to come to its level and the bottom was closed with concrete placed under water.

As indicated by the sinking charts Figs. 2 to 4, the operation was reasonably rapid and regular except in the case of the Park St. shaft. Here a double caisson was employed, the idea being to obtain a caisson structure corresponding more closely than a single shell to the planned shape of the drop shaft. As indicated by Fig. 3, sinking proceeded normally with the outer caisson, until July 25, when the structure ceased to settle. Various means to induce movement, including undermining, water jets, loading and hammering, were tried. Finally a superimposed load in excess of 35 tons started the caisson on Aug. 18 and it settled about 3 ft.

Preparations were made to start the second caisson. Until it reached elevation —40 the small caisson settled normally but then the outer caisson began also to settle. The cause, it was thought, was that material was boiling in at the bottom, and to stop this action the inner caisson was loaded in an attempt to drive the cutting edge far enough below the excavation to provide a seal. This effect was not realized and the inner caisson proceeded, pulling the outer caisson with it, until grade was reached. Then the bottom of the inner caisson was plugged with concrete, the water was pumped down and the seal between the two caissons was constructed.

*Sealing the Shafts*—In plugging the caissons the bottoms of the pits were as the clamshell left them. At Jones Island and Park St. an open-top bottom-dump bucket was used to place the concrete, care being taken to lower the bucket through the water and well to the bottom before the concrete was dumped. When the caissons were unwatered the seals were found reasonably solid and tight. At the Erie St. caisson less care was taken. The concrete was placed with a clamshell, wide at the top, very shallow compared with a bucket, and also permitting excessive leakage. Also, it is stated, frequent batches were dumped well above the bottom so that the concrete fell through water.

As shown by the charts, the caissons were completed at different dates. The Jones Island caisson was unwatered on July 31, 1916, shortly after completion, to permit the tunnel headings to be started. Neither of the other caissons was intended to be unwatered until the tunnels were completed to junctions with them. The Erie St. caisson was the first to be laid dry, on Sept. 4, 1917. Then the tunnels had been completed, the monkey drift (Fig. 1) sealed and the air pressure removed. Cutting of the Jones Island shaft-eye into the Harbor Entrance tunnel was in progress. The Erie St. caisson had been laid dry to cut that shaft-eye into

the tunnel. On the date stated, at 1 p.m., while the bottom was being cleaned, a leak appeared, followed by others which drove the men out of the shaft. Soon afterward the shaft was flooded and the men were called out of the tunnels. By 4:30 p.m., shafts and tunnels were flooded. Measurements showed that the caisson had sunk 6 in., cracks appeared in the ground around the caisson and adjacent structures had settled. About 60 ft. of the adjacent tunnel had been carried down by the sinking caisson and this settlement had opened cracks in the linings, as described later, through which the water had entered to flood the tunnels.

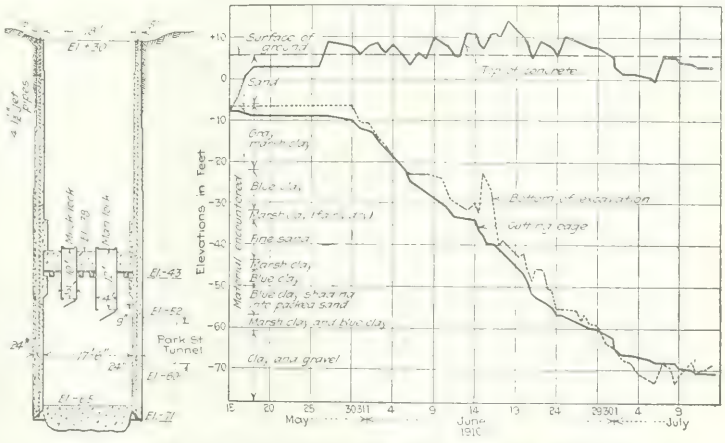



FIG. 2. JONES ISLAND CAISSON AND SINKING CHART

*Tunnel Construction*—Tunnel construction up to the time of the flooding involved comparatively few real difficulties. In general, the plan was to drive the Park St. tunnel about 100 ft. ahead from the Jones Island shafts, remove the shaft locks and place a tunnel lock, then drive a cross- or monkey-drift to the Harbor Entrance tunnel, and then proceed with both tunnels simultaneously. Until the tunnel lock could be built, air locks, as indicated by Fig. 2, were placed in the caisson. These shaft locks were removed as soon as the tunnel lock was in operation. A timbering method as indicated by Fig. 5 was adopted. Briefly, a top heading held by batter posts and crown plank was driven 10 to 12 ft. The face was then lagged, if the ground was soft, and the invert cut was made and concreted in 6-ft. sections, the concrete being placed as quickly as possible after the excavation was ready. On top of the invert steel forms were set up, and the roof arch was concreted in 6-ft. lengths. The partition slab was concreted separately after the lining proper was completed.

As stated, no particular difficulties were experienced. At places running soil required close watching, but it was always held by ordinary methods. Never was the general method of procedure, which required a fairly stable soil, abandoned. There were faults in workmanship, slight irregularities in line and grade, porous spots and poor construction joints, but these faults were not vital. They were most common in the Harbor Entrance tunnel. Nowhere did they show up particularly until the air pressure was removed. The sequence of work was somewhat erratic but generally the progress was rapid. With tunneling started late in August, 1916, both tunnels were holed through and lined, and arrangements were being made to remove the air pressure by May 31, 1917.

With the gradual release of the air pressure, leaks

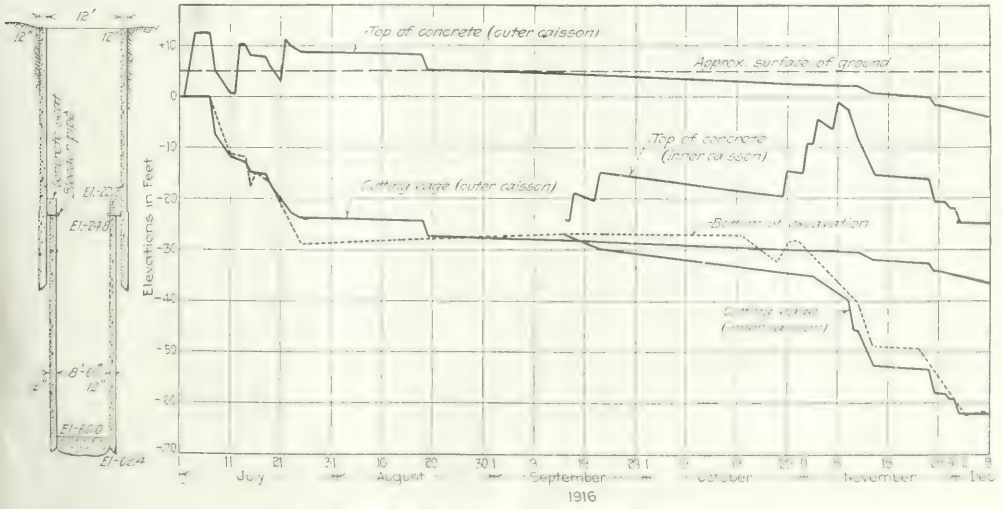



FIG. 3. PARK ST. CAISSON AND SINKING CHART

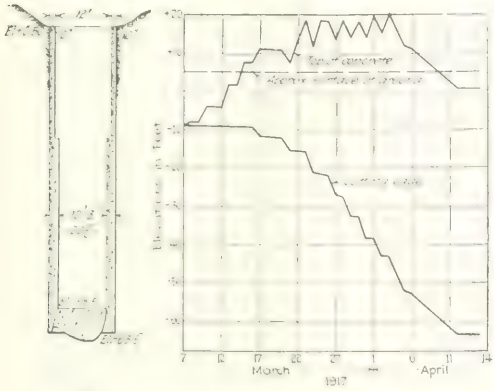



FIG. 4. ERIE ST. CAISSON AND SINKING CHART

appeared. These were insignificant in the Park St. tunnel and will not be considered further. In the Harbor Entrance tunnel, however, on June 2, with the air pressure at 13 lb. (it ran from 20 to 32 lb. during construction), several construction joints were leaking a spray like a shower bath, and at station 1 + 50 (see Fig. 1) there was a ¼ x 1½-in. stream. On June 3, with the pressure at zero, so much water was entering the tunnel that air pressure was restored. With the tunnel freed of water an examination on June 6 showed a ⅛-in. roof crack at station 6 + 85 and several smaller roof cracks, all at construction joints. There was a slab crack at 7 + 33 and a bottom crack at 7 + 36, both open about ⅛ in.

There followed a period of delay and marking time. Work was not discontinued but no thoroughgoing effort was made to make the tunnel watertight, the position of the contractor being that this should be requisitioned as extra work, which the engineers of the sewerage commission declined to consider. Some of the cracks were chiseled out for filling, but they were not filled. Some porous spots were plastered, and home-made grout pads were tried out in a few places. One crack at the junction of the lining with the Erie St. caisson was thoroughly grouted. Meanwhile the contractor made surveys inside the tunnel and took samples of the concrete and of the ground behind the lining, in preparation, apparently, to substantiate his indicated claim that the lining defects were due to settlement because of inadequate design.

With the conditions about as indicated the contractor began on Aug. 8 to reduce the air pressure, which was at 24 lb. On Aug. 15 the pressure was zero. As the pressure was removed, leaking appeared, increasing as the pressure decreased. No sand came into the tunnel, and two 2-in. Cameron pumps handled the water. With the tunnel in free air, removal of the locks and delayed slab construction proceeded, and construction of the shaft-eyes was begun as previously described, when, on Sept. 4, the Erie St. shaft settled and the works were flooded. On Oct. 3, after due notice, the work was taken out of the contractor's hands by the sewerage commission and Oct. 24, 1917, a new contract was let for its recovery and completion.

In general the plan of recovering the work was to place air decks in the caissons; restore the air pressure and clear the work of water and earth; restore the defective structure to as nearly as possible the planned construction; close the leaks, and complete the structures as planned.

Reconstruction was begun at the Erie St. shaft. The caisson contained a layer of earth which had flowed in at the time of the accident. On this earth fill, 6 ft. of lean concrete was deposited through the water and then about 19 ft. of earth. Upon starting the pumps it was found that very little water entered through the plug, so the water was pumped down and the air deck placed. This air deck was provided with locks and loaded to resist upward air pressures.

With the air pressure on, the material in the caisson was excavated. Below the lean concrete there was about 6 to 8 ft. of mud which represented the material which had come into the caisson at the time of the accident. When this mud was cleared away the original concrete plug was found intact and hard. There were, however,

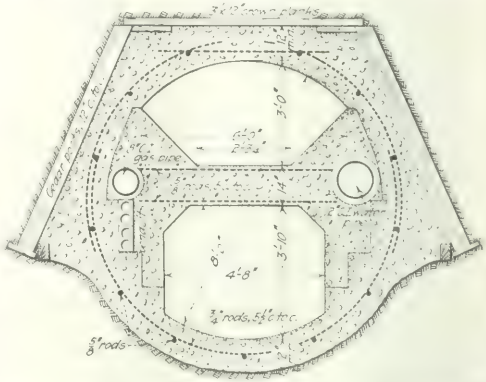


FIG. 5. SECTION OF PARK ST. TUNNEL AND TIMBERING

two places near the wall through which a bar could be thrust into soft ground, and when the air pressure was reduced slightly water came in at these places, showing conclusively that it was here that the water and earth entered. In cutting down the concrete it was found that the openings increased. The condition is indicated by the drawings of Fig. 6. Apparently, in excavating with the clamshell, the ground had been cupped out and the concrete did not fully seal the caisson. The concrete was cut down to about the level *AA* in Fig. 6 and a reinforced concrete floor 2 ft. thick was constructed. The Jones Island caisson was recovered by a similar procedure. Fig. 7 indicates clearly the methods, the original construction being indicated in this illustration by the cross-hatched sections. With the Erie St. and Jones Island caissons recovered the tunnels could be put under air pressure and cleared of water.

The condition of the Harbor Entrance tunnel on recovery is shown by Fig. 6. There were about 237 cu.yd. of material in the tunnel. About 259 cu.yd., including the amount of dirt in the Erie St. caisson, was estimated to represent earth displaced from around the tunnel and shaft. The removal of this earth was accomplished by ordinary methods.

Examination of the tunnel shell showed it to be intact from Jones Island to Sta. 8 + 59, or 75 ft. from the Erie St. shaft. From 8 + 59 to 9 + 04.5 there was a crack at each construction joint, varying from a hair crack to ⅛-in. width. At 9 + 04.5, 30 ft. from the

Erie St. shaft, the crack was 3 in. wide at the top of the arch and there was a vertical slip of about ¾ in. At the junction with the Erie St. caisson the arch was crushed as if by compression parallel to the tunnel. Elevations showed no settlement to Sta. 8 + 85, but thence to the caisson, 49 ft., the shell had tilted down so that at the caisson it was 16 in. lower than originally constructed. There were no longitudinal cracks and no signs of crushing other than indicated.

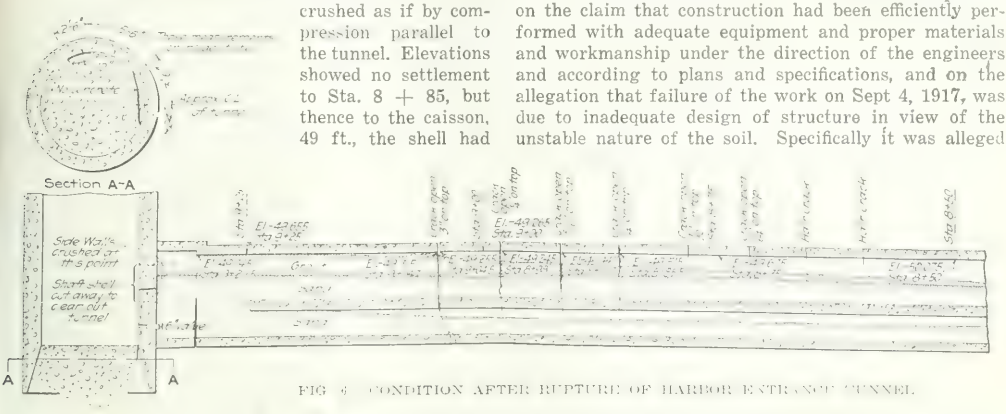



FIG. 6. CONDITION AFTER RUPTURE OF HARBOR ENTRANCE TUNNEL

The drawing, Fig. 6, shows the various conditions described; Fig. 8 is a view of the large roof crack at Sta. 9 + 04.5.

The method of restoring the damaged section is indicated by Fig. 9. The settled bottom was filled up to grade and the slab was removed and built at the planned level. The roof was not changed. This construction restored the bottom conduit to its planned dimensions but constricted the top conduit for a short distance, which was considered less objectionable than risking the danger and expense of rebuilding the roof. As the settled section was reconstructed the cracks were closed by grouting. Following the restoration of the Harbor Entrance tunnel, the recovery of the Park St. shaft and the completion of shafts and tunnels involved no unusual methods. All work was performed with great caution but no unexpected difficulties were encountered. The cost of recovery and reconstruction is given in Table I. Since its completion in 1918 the structure has stood unimpaired.

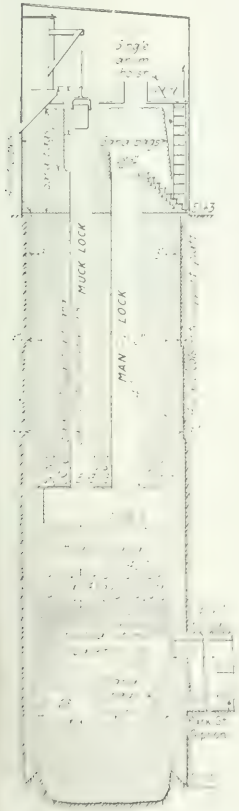



FIG. 7.
METHOD OF RECOVERING JONES ISLAND SHAFT

*Tunnel Models Win Law Suit.*—In March, 1918, suit was brought by the original contractors to recover $111,274, this being the balance of $239,689 expended on the work less payments received. The demand was made on the claim that construction had been efficiently performed with adequate equipment and proper materials and workmanship under the direction of the engineers and according to plans and specifications, and on the allegation that failure of the work on Sept 4, 1917, was due to inadequate design of structure in view of the unstable nature of the soil. Specifically it was alleged "that said plans and specifications did not provide for sufficient or proper bearing areas, sufficient quantity of concrete, proper mixture of concrete or sufficient or proper reinforcing."

In reply the sewerage commission denied both claim and allegation of the contractor and brought counterclaim for delay damages, and cost of completing the work in excess of the contract prices, on the allegation that the contractor "used faulty inadequate methods in the construction of the so-called Erie St. shaft, causing great damage and subsequent loss of the entire work."

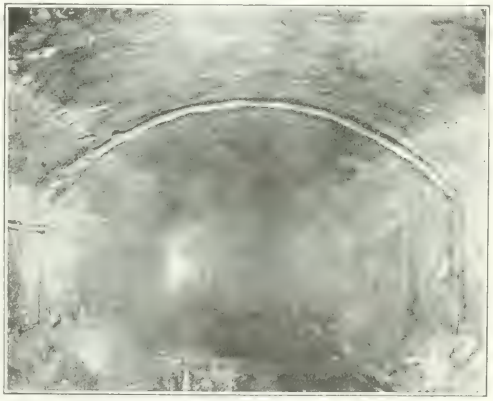


FIG. 8. VIEW OF LARGE CRACK IN TUNNEL ROOF

The verdict of the jury under instructions was in favor of the commission; the commission was awarded damages of $10,000, which, with the retained percentage, made a judgment of about $85,000 in its favor. Broadly the decision required was between (1) the contention of the contractor that inherent weakness of design caused the tunnel structure to settle, producing incidentally the settlement of the Erie St. shaft, and (2) the contention of the commission that improper methods of constructing the Erie St. shaft caused it to settle and carry with it an adjacent section of the tunnel structure.

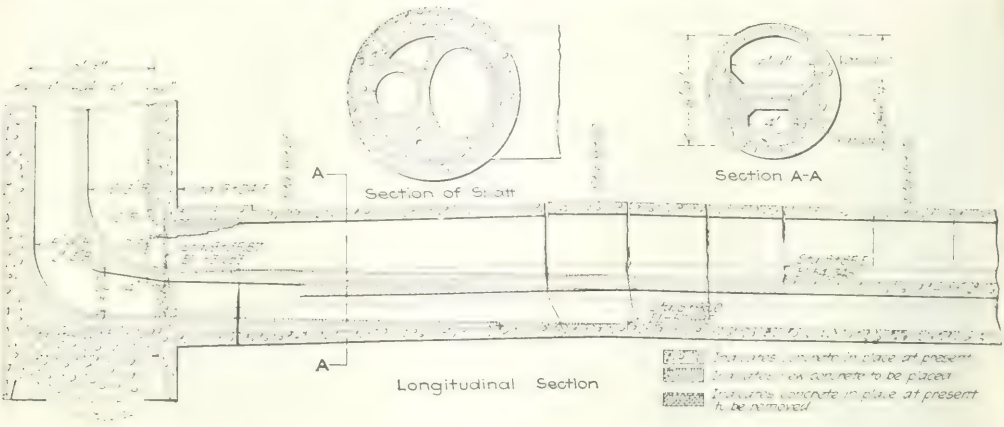



FIG. 1. RECONSTRUCTION OF DISPLACED PORTION OF HARBOR ENTRANCE TUNNEL

Both contentions involved the difficult task of making clear to a jury of laymen numerous unfamiliar technical facts and their significance under complex conditions. In this respect the preparation of the case for the city attorney by the engineers of the commission was the outstanding and suggestive feature of the court proceedings.

First a descriptive history of the work was prepared by the division engineer in direct charge. This included the original plans and contract, allowed changes in plans, progress charts and all facts of plant, methods and workmanship and all records of the loss and recovery of the work. It was indexed, and included precise reference to all original records of proof.

TABLE I ANALYSIS OF COST OF WORK ON CONTRACT 25 FROM FIGURES AVAILABLE OCT. 22, 1918

| | Recovery | Repairs | Completion | Total Cost |
|---|---|---|---|---|
| Erie St. Shaft: | | | | |
| Labor | $8,027 56 | $738 01 | $6,105 58 | $14,871 15 |
| Plant rental | 1,402 18 | 156 03 | 855 82 | 2,414 03 |
| Material | 6,382 90 | 40 43 | 3,171 41 | 9,594 74 |
| Total | $15,812 64 | $934 47 | $10,132 81 | $26,879 92 |
| Jane Elizabeth Shaft: | | | | |
| Labor | 11,035 15 | 4 05 | 5,679 91 | 16,719 11 |
| Plant rental | 765 80 | 14 | 711 20 | 1,477 14 |
| Material | 8,691 94 | 22 | 2,389 34 | 11,081 50 |
| Total | $20,492 89 | $4 41 | $8,780 45 | $29,277 75 |
| Park St. Shaft: | | | | |
| Labor | | | 7,018 21 | 7,018 21 |
| Plant rental | | | 867 51 | 867 51 |
| Material | | | 6,073 28 | 6,073 28 |
| Total | | | $13,959 00 | $13,959 00 |
| Harbor Entrance Tunnel: | | | | |
| Labor | 9,429 80 | 2,743 23 | 1,624 29 | 13,797 32 |
| Plant rental | 1,991 77 | 568 78 | 379 18 | 2,939 73 |
| Material | 2,623 32 | 220 49 | 875 93 | 3,719 74 |
| Total | $14,044 89 | $3,532 50 | $2,879 40 | $20,456 79 |
| Pier at Tunnel: | | | | |
| Labor | 1,092 10 | | $2,627 49 | $3,719 59 |
| Plant rental | 126 17 | | 332 17 | 458 34 |
| Material | 351 32 | | 555 82 | 907 14 |
| Total | $1,569 59 | | $3,515 48 | $5,079 07 |
| Valve Chamber: | | | | |
| Labor | 421 70 | 742 63 | 3,946 84 | 5,111 17 |
| Plant rental | 51 52 | 45 35 | 220 30 | 317 17 |
| Material | 196 88 | 35 03 | 2,057 69 | 2,278 60 |
| Total | $670 10 | $843 01 | $6,224 83 | $7,707 03 |
| Caissons: | | | | |
| Labor | $30,006 40 | $4,227 92 | $27,002 32 | $61,236 64 |
| Plant rental | 4,331 44 | 720 30 | 3,366 18 | 8,467 92 |
| Material | 18,215 | 66 67 | 15,123 47 | 33,655 00 |
| Total | $52,552 84 | $5,314 39 | $45,491 97 | $103,359 56 |

Models were then constructed. A model to scale of the Erie St. shaft and adjacent Harbor Entrance tunnel was the largest, about 10 ft. long. It represented the structure divided at construction joints, with details of forms, timbering and all structural parts to scale, and could be opened up to show all interior parts. It was so supported that the shaft could be dropped vertically to indicate the settlement of the Erie St. shaft and its action on the tunnel structure. A separate larger scale model represented the excavation methods and timbering. Even the excavating action of a clamshell working inside a caisson was represented by a model. Supporting these models were photographs of the failure and construction plant and operations.

With the history and models, the city's attorney was instructed in the technicalities of the case, including probable controverting evidence, until he had the facts at his command. At the trial the model was exhibited and used by the attorney and his witnesses to present the evidence to the jury. With the models in evidence no attempt to confuse the facts before the jury could be successful. Its members could visualize the facts and follow the technical evidence with unusual understanding. Indeed it is frankly asserted by those conducting the trial, that the models virtually won the suit for the commission.

*Engineers and Contractors*—The work described was performed for the Milwaukee Sewerage Commission, T. Chalkley Hatton, chief engineer, James L. Ferebee, principal assistant engineer, and George R. Young, division engineer. The contractor for the original construction was the Western Foundation Co., St. Paul, Minn., and the contractor for the recovery and completion was the John F. Casey Co., Pittsburgh, Pa.

## Large Bowl Planned for California Athletes

The University of California board of regents has given approval to the plan of the student body and alumni for organizing a campaign to finance the building of a stadium that will cost between $800,000 and $1,000,000. The plan for raising funds with which to construct the large bowl contemplates taking popular subscriptions of $50, in return for which the subscriber will receive a 5-year season ticket.

# Why Steam Trucks Are Popular in Great Britain

## Influence of Legislation on Vehicle Types—Running Costs—Types Employed Include Both Tractor and Load-Carrying Truck of 5 or 6-Ton Capacity

By George W. Watson
President-Elect, Institution of Automobile Engineers
and H. Scott Hall
Member, Institution of Automobile Engineers

THE design of British mechanically propelled road vehicles is largely governed by the somewhat intricate laws relating to their use on the highway. These legal restrictions are likely to undergo considerable modification in the immediate future and we will not, therefore, waste any time discussing them here. It is necessary, however, to indicate the extent to which they have affected design. They are responsible, for example, for the wide gap between the road locomotive or traction engine, weighing 12 to 14 [long] tons and which has its prototype in the United States, and the steam tractor and motor wagon, which must not exceed a weight of 5 tons unladen, i.e., without fuel or water. It will be the latter class of vehicle—those

UNDER-TYPE OF STEAM TIPPING WAGON

which, in England, come under what are called the heavy motor car acts—with which we are concerned in this article.

The steam wagon is popular in the British Islands to an extent unrealized and unequaled elsewhere. This is due to a variety of causes but probably, in the first instance, to the fact that mechanical transport has been used in these islands for upward of 60 years, during most of which time it was entirely carried out by steam road locomotives. These were, and still are, very popular with showmen who travel from town to town with fairs, circuses and the like. Their engines weighed upward of 12 tons each. Their use and the spread of mechanical transport in Great Britain may be traced through the laws which have been enacted concerning them.

The principal acts were passed in 1861 and 1878, and these heavy locomotives were run under the latter act, which is still in force, one of the provisions being that they should not travel at more than 4 miles an hour, and that they should be preceded by a man on foot with a red flag. When the present type of motor car began to be introduced into, or manufactured in, the British Islands they too were governed by this act and we then had the extraordinary situation that a motor car capable of traveling 20 to 25 miles an hour was not supposed to pass along the road unless preceded by a man walking and waving a red flag. It was to remedy this state of affairs that another act was passed in 1896. This last-named act provided for a new class, a road locomotive which must be under 3 tons in weight, and for vehicles within this limit the absurd restrictions as to speed, etc., were withdrawn. This limitation of weight was subsequently increased to 5 tons unladen, and it was in conformity with that act that the steam tractor began to be made.

Simultaneously makers of steam tractors, seeing the headway which was being made by motor cars, turned their attention to the production of light goods-carrying vehicles which would also comply with the acts. The result was that when the first important trial of commercial motor vehicles was held in 1898 out of eleven machines which took part, only two were gasoline lorries, the remainder being steam wagons. It will thus be seen that the steamer had a start in this country such as it never received elsewhere. It has never relinquished its position, and at the present moment is actually improving it by comparison with the gasoline machine.

### Early Vehicles Maintained by Steam Engineers

Another factor which helped the steam wagon was this: The first users of heavy motor vehicles were largely mill owners in the northern industrial districts. They had to have machines which were particularly robust in order not only that they should be able to carry the heavy loads offered but also that they might successfully negotiate the rough roads which were at that time and still are to a certain extent characteristic of Lancashire and Yorkshire, the two main counties concerned. The gasoline motor lorry at that time was anything but robust. Again the steam wagon got a good start.

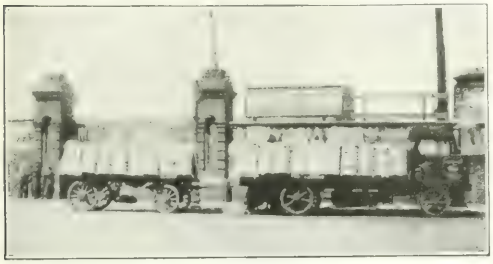
The mill owners had in their employment engineers accustomed to the steam engine, men who understood how to keep boilers in order and how to keep a steam engine in good running repair. They naturally chose for their transport machines which they could handle and repair in their own establishments and by the aid of their own staffs. It was this combination of circumstances which placed the steam wagon in a good position when heavy motor vehicles commenced to be used to any extent in Great Britain. They have never receded; at the present day it is an acknowledged fact that the steam wagon will stand much more rough usage than its competitor and it is invariably the favorite choice when heavy loads have to be moved. Apart from that, it is pre-eminently the vehicle for drawing a trailer, for only in the steam wagon is there that reserve of power and strength which is necessary for the haulage of a trailer up hill and down dale in all weathers.

Finally, and as if to clinch the argument where any doubt arises as to the advantages of this form of transport, the cost of running a steam wagon is less than that of a gasoline vehicle. The following tables are taken from a recent article contributed by one of the present authors to *The Commercial Motor*, the leading British journal dealing with heavy motor vehicles. The table shows side by side the running costs of steam wagons and of gasoline vehicles.

TOTAL WORKING COST (PENCE PER MILE) OF 3-TON AND 5-TON STEAM AND GASOLINE WAGONS, CALCULATED FOR VARIOUS WEEKLY MILEAGES

| Miles per Week | 3-Ton Steam | 3-Ton Gasoline | 5-Ton Steam | 5-Ton Gasoline |
|---|---|---|---|---|
| 200 | 19 71 | 20 12 | 22 57 | 25 22 |
| 300 | 16 35 | 17 68 | 19 15 | 22 57 |
| 400 | 14 67 | 16 46 | 17 44 | 21 24 |
| 500 | 13 66 | 15. 73 | 16 41 | 20 45 |
| 600 | 12 95 | 15 24 | 15 73 | 19 92 |

The fact that steam wagons consume coal or coke, the national fuels in Great Britain, has also contributed



STEAM LORRY AND TRAILER AT THE MERSEY FERRY, LIVERPOOL.

largely to their extended use. Generally speaking, also, a steam vehicle will give ample warning of the need for repairs, as it may be kept working, without entailing any risk of accident or sudden breakdown, long after the first signs of trouble have become apparent. This is in strong contrast to the sudden troubles which often overtake gasoline trucks. When faults do occur with the steam wagons their cause is at once obvious and their repair simple and quickly effected.

### Types Employed

British steam-propelled machines are divided into two distinct classes: One a tractor pure and simple which carries no load and is used for hauling a trailer; the other a wagon which actually carries a load and may also draw a trailer. The former type of machine is of great value to contractors engaged on building construction or civil engineering work where much of the transport consists in moving loads over comparatively short distances between two terminal points. For such work three or more trailers are employed, one of these being loaded while a second one is being unloaded and the third is in transit. These steam tractors are made by about half a dozen manufacturers, and, except as regards minor detail, they are all alike.

In general design they resemble the traction engine or road locomotive, their dimensions and power being such as to enable them to be constructed within the legal weight limit. They are designed to haul a trailer which may weigh about 30 cwt., and carry a net useful load of 5 or 6 tons. The boiler is invariably of the well-known locomotive type. The working steam pressure is usually 200 lb. per square inch and the heating surface varies from 60 to 70 sq.ft., of which from 14 to 18 sq.ft. are in the firebox. The engine is mounted on a saddle-plate on the top of the boiler, the cylinders being toward the smoke box end, and the crankshaft is disposed transversely. The power developed at normal running speed is usually about 20 hp. at a speed of about 300 r.p.m. Compound steam engines are used, as a rule, having high-pressure cylinders 4¼ to 4¾ in. in diameter and low-pressure cylinders of from 6½ to 7 in., with a stroke of 7 to 8 in.

Transmission is by a double train of gears to a large spur wheel bolted to a differential case on what is known as a traction-engine type of live rear axle. Provision is made, as a rule, for two changes of gear ratio, the change being effected by sliding one pair of wheels out of engagement, subsequently sliding another pair into mesh. These gears are generally placed in full view of the driver, and in order to effect a change he must stop the wagon. Where, in exceptional circumstances, extra power is required for short periods provision is made whereby high-pressure steam can be admitted direct into the low-pressure cylinder as well as to the high-pressure cylinder. At the same time the exhaust from the high-pressure cylinder is diverted direct to the atmosphere, up the funnel.

Reference has been made to the traction-engine type rear axle. In this a solid, one-piece axle runs from wheel to wheel, one wheel being keyed thereon. The other road wheel is keyed on a sleeve which is mounted on this axle and is free to rotate thereon. The sun wheels of the differential gear are secured, one to the solid axle the other to the sleeve.

### General Dimensions of Tractors

These tractors are of short wheelbase, generally about 8 ft., and the track of the front wheels is narrow, usually in the neighborhood of 4 to 4 ft. 6 in., while that of the rear wheels is from 5 to 6 ft. The front axle is centrally pivoted on a bracket beneath the boiler, and is sprung by means of a single transverse spring. The front wheels, in order to allow a good lock to this type of axle, are necessarily small in diameter, varying from 2 ft. 9 in. to 3 ft. 6 in. by 5 in. wide.

The steering is generally effected by means of a chain which, at its ends, is secured to the front axle, one end of the chain near each wheel. The chain is wound on a transverse drum which is rotated by the steering wheel through the medium of a worm and wheel gear. Generally the connection between chain and axle is made flexible by the interposition of extensible springs. The rear wheels are generally about 5 ft. in diameter and 12 in. wide.

As a rule the front wheels are tired with plain steel bands, and the rear ones by alternating diagonal strakes of steel and wood. During the past few years, however, both manufacturers and users have begun to realize the advantages of rubber tires for this class of work, and solid band tires of a size approximating to that given for the steel wheels are gradually coming into favor.

There is, of course, much bigger scope for use of the load-carrying steam wagon, as distinct from the tractor. This is made in capacities varying from 3

to 6 tons, and in one or two exceptional cases, such as for dock use in Liverpool, where the authorities permit the use of a heavier wagon than is legal on the highway, for 8 tons. The steam wagon of this type is also largely used for hauling a trailer carrying 3 to 4 tons, as well as carrying its own superimposed load. Steam wagons compete on level terms with gasoline trucks. Where there is much to be gained by hauling a trailer the steam wagon has distinctly the advantage.

Owing to the greater scope for its use much more thought and ingenuity have been spent on the design of the steam wagon than on that of the tractor, and the result is that although broadly there are only two main types, with a strong line of demarcation between them, there are also one or two manufacturers whose machines exhibit unusual features. The two types are known as the "over-type" and "under-type," the designation implying the position of the engine, which on the one is, as described in connection with steam tractors, above the boiler, and in the other is below the chassis. Whichever type is made there is generally very little to distinguish to the outward eye between the various models and capacities made by different makers, except in the case of special machines, such as the 8-tonners. Generally both boiler capacity and engine size are standardized for loads of from 3 to 6 tons, the difference being in the strength of the frame and size of the wheels, together with alterations in gear ratio.

### The "Over-Type" and The "Under-Type"

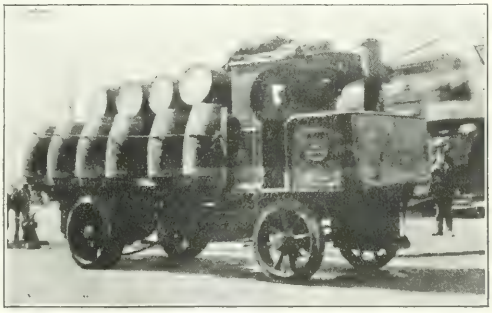
The "over-type" is constructed on very much the same lines as the tractor, already described. Let the reader imagine that the boiler, engine, and essential components of the tractor are made particularly compact, but that the frame, which is usually of rolled steel channel, although of late pressed steel has come into favor, is extended rearward until it is of a length sufficient to accommodate the usual bodywork. The final gear transmission of the tractor is replaced in the wagon by a long single roller chain. The boiler capacity differs very little from that of the tractor. The pressure, however, is a little higher, being usually 220 to 230 lb. per square inch. The engine is generally of the compound type, with cylinders 4 and 7 in. in diameter, and 7 in. stroke.

The transmission gear is similar to that of a tractor, with the exception of the final chain drive, and the arrangement for effecting the change of gear is also the same. The steering gear is similar, but the wheel diameters are naturally not quite the same. The front wheels are generally about 2 ft. 9 in. and the rear wheels 3 ft. 4 in. in diameter. The track of the front wheels is from 3 ft. 6 in. to 4 ft. and that of the rear wheels from 5 ft. 9 in. to 6 ft. 6 in. The wheel base varies from 12 to 14 ft., according to requirements.

At one time it was the general practice to fit wagons with steel tires only, but rubber tires began to be fitted about 1911 to 1912, first to 3-tonners, then to larger sizes, until at the present time there are few steam wagons being made which are not fitted with solid rubber tires. We have not yet, however, reached the stage when anyone has seriously considered the fitting of giant pneumatics to this type of vehicle.

The under-type steam wagon is as different from the other as is possible. In this type the vertical type of boiler is preferred; it has a cylindrical firebox within a cylindrical boiler shell, the firebox being crossed by a number of nearly horizontal water tubes, which traverse the fire space. The heating surface of these boilers is generally a little less than the loco type, but they are remarkably efficient. The working pressure varies from 200 to 250 lb. The boiler is fitted at the extreme forward end of the wagon; the driver sits immediately behind it and stokes either through a hole in the top of the boiler, down a vertical chute, or through a hole in the floor of his cabin, down a diagonal chute, to the grate.

The engine is located below the chassis, being hung from the side members, and is disposed just behind the driver's cab. It is horizontal and of the twin high-



LOADED STEAM LORRY, LIVERPOOL

pressure type, not compound. Its running speed is about 200 r.p.m. and has cylinder dimensions of 6¾-in. bore and 10-in. stroke. There is no change-speed gear, the drive being transmitted from a sprocket pinion on the end of the crankshaft by roller chain to a sprocket wheel on the differential gear of the rear axle, which is usually of the traction-engine type. In this type of steam wagon the steering gear is generally similar to that of the motor car, and is known in Great Britain as the Ackermann type. This type of wagon is growing in favor, though this is largely because of the fact that owing to the boiler not occupying so much space longitudinally there is more space behind the driver's cab, and more weight can be imposed upon the front axle, thus keeping the rear axle weight, when the wagon is fully loaded, within the legal limits of 6 tons for a wagon which may travel at 12 miles per hour, or 8 tons for a wagon which may travel 8 miles per hour.

Superheated steam is not greatly favored for over-type steam wagons, and on these engines the plain D-shape slide valves or piston valves are adopted, and wherever superheat of appreciable degree has been employed a certain amount of trouble has resulted in connection with the lubrication of these valves. With the under-type, however, superheated steam is invariably used, and in the engines of these machines poppet or ball valves are generally incorporated. As has been indicated in the foregoing, these wagons are built in all sizes from a minimum of 3 tons upward. The most popular type, however, is undoubtedly the 5-tonner in the case of the over-type, or the 6-tonner in regard to the under-type, the difference in capacity of the two types being largely due to what has been pointed out in respect of the legal limits and the capacity of the under-type for taking a bigger load without exceeding the limit of rear axle weight.

# Abolition of Double Check Valves on Hartford Water-Works

ACTING on a report and recommendations by its manager and chief engineer, Caleb M. Saville, the Board of Water Commissioners of Hartford, Conn., voted late in 1920 to require the abolition of all connections between the public water-supply of that city and other sources of supply, including those protected by double check valves. The resolution of the Board is given in full, as of possible use elsewhere:

1. That the report of the manager and chief engineer on "Use of Double Check Valves," dated Oct. 18, 1920, be accepted and that the recommendations therein be adopted, and

2. That all persons, firms and corporations now having or maintaining any connection between the city water-supply and a source of water supply taken from any other source, whether or not such connections are controlled by automatic devices such as check valves or by hand operated mechanisms such as gate valves or stop cocks which may or may not be sealed, be notified by the secretary of the board to discontinue and physically separate all such connections forthwith and that hereafter all connections of similar character are prohibited and enjoined, and

3. That failure on the part of persons, firms and corporations to discontinue the use of any and all connections between the city water supply system and any source not supplied from such system and to physically separate such connections within thirty days from the date of notice to disconnect or to make any such connections hereafter will be sufficient cause for the Board of Water Commissioners on notification from the manager to order discontinuance of city water service to the premises on which the connection exists, until such separation is accomplished, except

4. That in the case of persons, firms and corporations now having connections governed by the double check valve mechanism of the so-called Factory Mutual type, the time of discontinuance of the same be extended until Sept. 1, 1921, provided these valves are subjected to such inspection as the board deems proper, the expense of which will be borne by the person, firm or corporation now having such connections, and

5. That the manager be and hereby is directed to carry out the provisions of this vote.

### Engineer's Report

Mr. Saville's report is given below nearly in full, with the omission of his final recommendation, which was substantially the same as the resolution of the Board:

As a matter of strict sanitary regulation of a water supply used for domestic purposes every reasonable precaution should be taken to exclude all known sources of pollution. This may be accomplished by elimination, by filtration, by sterilization, and to some extent by storage. In the opinion of sanitary engineers and practical water-supply operators, connections controlled either by automatic devices, as check valves, or by hand operated mechanism, as gate valves, which may or may not be sealed, are not included in any of the approved methods at present in vogue for the protection of a safe and clean water supply against contamination from one which is polluted and dirty.

It is well recognized by all fire insurance interests that proper fire protection to important factory or industrial works requires a secondary supply of water from a source independent of the primary supply. To accomplish this purpose, however, there are safe and approved methods which may be substituted for connections with a polluted source. Such methods of secondary supply, as from tanks and cisterns, are authorized and satisfactory to the majority of engineers versed in fire protection engineering.

The matter of danger of dual connections was brought to the attention of the board Sept. 20, 1919, because of indication of serious pollution in the city water supply in the center of the city. The source of this pollution was traced to a connection in a store building where the city system was interconnected with a supply from driven wells. At that time the board passed a vote discontinuing and prohibiting the use of auxiliary connections but later stayed its execution to obtain further information relating to fire protection supplies.

It is perhaps necessary to state that many serious epidemics of typhoid fever elsewhere have been traced without question to dual connections existing between city water-supply systems and an auxiliary source of supply which was more or less protected by automatic or hand-operated devices. These are matters of record and to cavil at details is merely to dodge the issue.

### Danger to Health

In every case where the matter of connections between a city water supply and a polluted source have been considered, including those protected by the so-called "F. M." system of double checks, danger to health of consumers has been recognized. In some places on account of this fact all such connections are prohibited, as in Stamford, Conn., Providence, R. I., Springfield and Lowell, Mass., St. Paul, Minn., Cleveland, Ohio, Terre Haute, Ind., and others. The Minnesota State Board of Health absolutely prohibits such connections and has ordered out existing ones. The State Board of Health of Illinois "sanctions no such physical union in the installation of new factory fire supplies."

From a water-supply standpoint a principle is involved which is of practical application and not theoretical discussion. From the very nature of the case no argument can be successfully defended that there is no danger to health through these connections. On the other hand, from a fire protection standpoint, other approved means are at hand to accomplish the result.

No automatic device can be relied upon for absolutely perfect working at all times and even if tight there is no assurance that at any time unknown to factory officials an ignorant or careless workman may not make connection inside the building which will serve to bypass the polluted water around the check valve and into the city system.

The expert called by the manufacturers particularly spoke of the danger of pipe moss getting under the clapper of the valve and keeping it open. Similar danger exists from wads of joint packing and sometimes even pieces of wood. No flap valve, no matter how perfectly constructed, can be made proof against such conditions.

### Experience in Hartford

The courts have recognized the responsibility of water-supply companies both public and private to take every known means to protect the health of consumers from water-borne diseases. In Hartford, since the installation of these valves in 1919, there have been 61 instances of leakage through one of the two check valves on these connections, and on six occasions both valves were found leaking at the same time, although in all cases the valves were left tight on previous inspection. Water systems elsewhere report similar experiences of leakage except that of both valves leaking at the same time and this may be due to less thorough methods of inspection.

When installed, the present check valves were sponsored by the Manufacturers Mutual Fire Insurance Co. as a substitute for complete separation, yet after a comparatively short time the design was changed to remedy defective action. At the present time even this design is roundly scored and condemned by the expert sanitary engineer representing those who would retain the dual connections.

As to the relative danger to health with their retention and that alleged from fire with their discontinuance, there seems little necessity for debate.

The question here, however, is not what degree of safety to health can be had with proper fire protection because fire protection adequate in the opinion of all fire insurance engineers except those of the Factories Mutual

can be had by other methods which require no connection between the city water supply and a polluted source.

In spite of all the arguments which are brought forward in favor of the retention of these connections, the condition of accountability of those in charge of the city water-supply stands out strong and clear. Remote as may be the chance of pollution through these connections, on one, not even the sanitary expert speaking in favor of them, has been willing to deny that a chance of pollution does exist. If pollution of the public water-supply should obtain and an epidemic of typhoid fever ensue, the responsibility for death, disease and impairment of health must rest squarely on the shoulders of those officials who are in charge.

By vote of the people, it was decided some years ago to seek a water supply at a distance rather than filter the water of the Connecticut River. This choice entailed much greater expense than if the river water had been taken, although the latter could have been made unquestionably safe. In other words, the people of Hartford wanted not only a safe water but one which would be above suspicion.

The present auxiliary connections join together city pipes which in a short time will be carrying carefully filtered water with pipes into which may be forced water flowing in the Park River which is dirty and foul with sewage and waste. Under certain combinations of circumstances this water may be injected into the pipes carrying water for the domestic use of the citizens.

# Cost Keeping on Asphalt Paving

By Henry C. Browne
Division Engineer, Lane Construction Corporation, Meriden, Conn.

*Extract from "Suggestions for Asphalt Paving Contractors" to be published by the Asphalt Association, New York, N. Y.*

PLANNING and co-ordination of work are of extreme importance in highway construction. When the methods to be used have been determined, a progress plan of the work should be made. The need of plant and materials necessary for the work should be anticipated far enough in advance so that no delays will occur for lack of them. A well-defined plan of progress will enable the contractor to keep the work more closely co-ordinated.

A daily report of progress may be made on a form similar to the one shown. The report should show each day the total of the work performed to date. By comparing these reports with the progress anticipated, the work can be speeded up where necessary, or the original plan modified to suit the conditions which prevail. Another valuable feature of this report is the listing by car number of the material imported by rail. Material which is slow in arriving can be traced and rushed and one only has to look at the last report to learn the whole situation. Careful planning will prevent having too many laborers who cannot work to advantage because some other part of the work is held up for a cause that could have easily been foreseen.

| Contract Headings | Headings for Cost Classification |
|---|---|
| 28,500 sq.yd. grading | Grading |
| 28,500 sq.yd. 2-in. Topeka | 2-in. Topeka<br>Plant repair<br>Asphalt<br>Filler<br>Sand<br>Stone<br>Mix<br>Haul mix<br>Roll mix<br>Lay mix<br>Coal and oil |
| 1,375 cu.yd. sand filler | Sand filler |
| 5,652 tons trap rock | Trap rock<br>Stone at car<br>Load<br>Haul<br>Spread<br>Roll<br>Coal and oil |

Many of the items of work on a highway contract are difficult of exact measurement until the final survey is made. The daily expense on the job should be kept and classified into at least as many subdivisions as there are items in the contract and sometimes it is advisable to make further subdivision. To illustrate, the foregoing list is given which shows on the left side the contract quantities and on the right side the subdivisions that might be made in classifying the costs.

## DAILY REPORT

### THE LANE CONSTRUCTION CORPORATION,

MERIDEN, CONN.

Name of Contract ____ Date ____

Work entirely stopped ____ hours. Due to ____

| Road bed grade completed. | | Sub base completed. | |
|---|---|---|---|
| Sta. | to Sta. | Sta. | to Sta. |
| Sta. | to Sta. | Sta. | to Sta. |
| Sta. | to Sta. | Sta. | to Sta. |
| Lost time | hrs. due to | Lost time | hrs. due to |
| **Concrete base completed.** | | **Surface completed.** | |
| Sta. | to Sta. | Sta. | to Sta. |
| Sta. | to Sta. | Sta. | to Sta. |
| Sta. | to Sta. | Sta. | to Sta. |
| Lost time | hrs. due to | Lost time | hrs. due to |
| **Shoulders completed.** | | Local Stone, Total to date on Road | Tons |
| Sta. | to Sta. | Car Stone, Total to date on Road | Tons |
| Sta. | to Sta. | Car Sand, Total to date on Road | Tons |
| Sta. | to Sta. | **Concrete Culverts.** | |
| Lost time | hrs. due to | Yardage required | Yardage laid |

Total Cement received ____ bags. Cement Used ____ bags.

Bituminous Material Received ____ gals. / ____ tons. Used ____ gals / ____ tons.

| Corrugated Pipe | | Vitrified Pipe | | Iron Pipe | |
|---|---|---|---|---|---|
| Received | Feet. | Received | Feet. | Received | Feet. |
| Laid | Feet. | Laid | Feet. | Laid | Feet. |

| | Cars | | | Cars | | |
|---|---|---|---|---|---|---|
| | On Track | In Transit | On Demurrage | On Track | In Transit | On Demurrage |
| CEMENT. | | | | SAND | | |
| STONE | | | | BIT. MAT. | | |

*Give Car Numbers.

In urgent need of following material which has been ordered but not received.

Signed ____ Approved ____ Supt.

DAILY REPORT FORM FOR ASPHALT ROAD CONSTRUCTIONS

A superintendent can roughly estimate the daily output on the different parts of the work and from his classified expense arrive at the unit costs of the work. The frequency with which the daily classified costs should be sent to the office is optional with the contractor. While some prefer to know the total expended each day, others do not require the classification costs to be submitted except with the payroll which may be once a week or once in two weeks. A superintendent should approximate his unit costs from day to day. The need for checking up the cost of work oftener than every one or two weeks is not so essential in the case of superintendents in whose ability the contractor has the utmost confidence, as it is in the case of superintendents whose knowledge of work is not so proficient. An analysis of costs will sometimes show where expensive but avoidable mistakes are being made.

If a contractor has certain rules or methods which he wishes followed in conjunction with the work, it is advisable that he prepare a set of instructions covering them and put it in the hands of each superintendent. Much confusion will be avoided by doing this and there should be no excuse on the part of the superintendent for his failure to comply with the written instructions. Written reports of superintendents, if made on printed report forms furnished by the office, will facilitate the recording work of the office.

# Tunnel Concrete Lining Placed by Pneumatic Gun

## Nearly Two Miles of 10-Ft. Pressure Tunnel at Caribou Hydro-Electric Plant in California Placed by Novel Machine

By W. D. Shannon
General Superintendent, Stone & Webster, Inc., Belden, Cal.

THE success of placing concrete lining in tunnels by the pneumatic method has recently been well demonstrated on the tunnels of the Caribou hydro-electric development for the Great Western Power Co. of California. Tunnel No. 2 of this project is 9,213 ft. long, and 10 ft. finished diameter, and the concrete arch lining for the entire length was placed pneumatically. This tunnel is a part of the hydraulic system of the Caribou plant, and is used to convey the water from Butt Creek to the head of the penstocks.

Fig. 1 is a profile of this tunnel showing the two adits and upraise, from which all the work of concreting was carried on. That portion of the tunnel between the intake and adit No. 1 was handled from a concrete plant located at the upraise, the plant being on the ground surface and the concrete sent by gravity to cars in the tunnel. A 12-in. wrought iron pipe was used to convey the concrete from the mixer to the tunnel. From the bottom of the upraise the concrete was distributed to the heading in trains of three cars each, and delivered to the concrete guns; one machine working from adit No. 1, and a second machine working from the intake, each traveling toward the upraise. In the first operations only one crew was used, working the concrete guns alternately, while the form builders worked in the opposite heading. This plan was carried out during the placing of the arch between the intake and adit No. 1, and an average of 70 ft. per day was maintained.

That portion of the tunnel between adit No. 1 and adit No. 2 was handled somewhat differently. The two concrete guns were started at approximately the midway point between the two adits, and worked toward their respective adit. A plan was therefore worked out to build forms while placing the concrete. By this method a maximum of 156 lin.ft. of arch was placed in 24 hours, and an average of 105 lin.ft. per 24 hours was maintained over a period of 25 days. The invert thickness is 12 in. and that of the arch 9 in. Only the arch was placed by the gun.

The concrete gun or "pneumatic concrete ram," as it is called by its makers, is shown in the drawing in Fig. 3 and the view in Fig. 5. It differs from other machines used for the same purpose in that the concrete charge is started through the delivery pipe by means of a piston. This "gun" requires that the mixed concrete be delivered to it and deposited in the concrete chamber, the air pressure being used for delivery only on the last 200 ft. of the distance from the mixer to the heading. The machine is mounted on trucks and as shown moved along the invert as the lining progresses. It has a capacity of 18 cu.ft. and works under normal air pressure of 90 to 100 lb. per square inch. The main diameter is 36 in. The device is patented and manufactured by Webb & Coxe of Los Angeles.

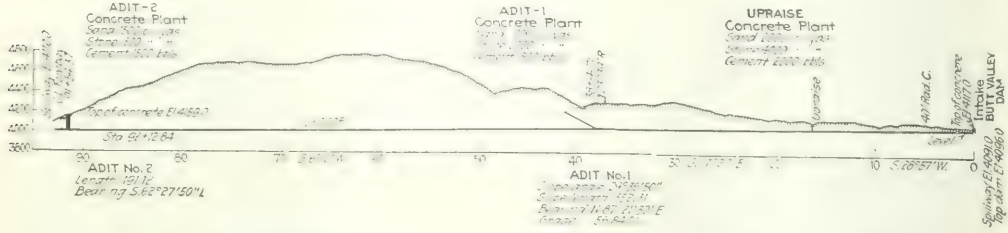



FIG. 1. PROFILE TUNNEL NO. 2, CARIBOU HYDRO-ELECTRIC DEVELOPMENT IN CALIFORNIA

Fig. 2 shows the concrete gun in place, the direction of travel being toward the right. The gun was moved forward on the invert the required distance, and the air connections made, after which the overhead track was lowered and the discharge pipe hung to the roof of the tunnel timbers. The arch forms were then constructed, the key forms at the top of the arch being

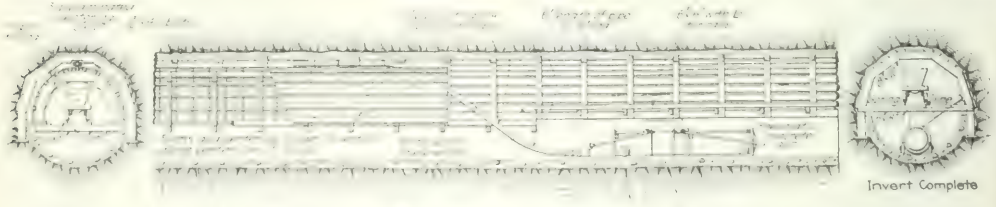



FIG. 2. SHOWING METHOD OF PNEUMATIC CONCRETING OF CARIBOU TUNNEL

omitted, to be put in place in 5-ft. sections as the concrete discharge pipe was removed.

Cars of 24-in. gage and 20 cu.ft. capacity were used to handle the concrete from the plant to the concrete gun. The entire load was dumped into the barrel of the gun and "shot" in one charge with an air pressure at the nozzle of 100 lb. Smaller air pressures were sufficient to force the charge into the delivery pipe, but the best results were obtained with the above pressure. About one minute was required to "shoot" a batch of concrete under the above conditions. An important feature of the air supply was a receiver of not less

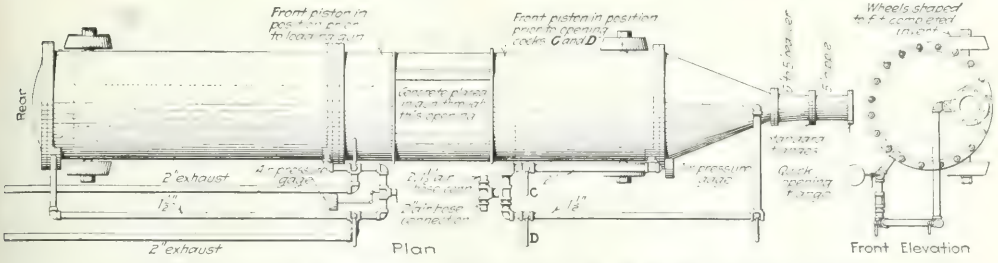


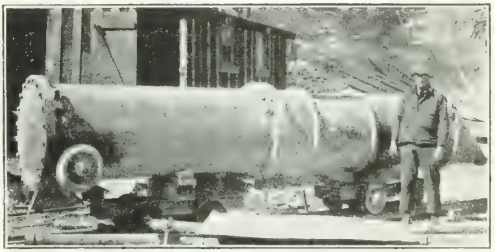

FIG. 3. DETAILS OF CONCRETE PNEUMATIC GUN USED ON CARIBOU TUNNEL LINING

than 200 cu.ft. capacity, located as close to the nozzle as possible, but with a 3½-in. air line it was found satisfactory to have the receiver at the adit mouth, and maintain 105 lb. of pressure. The quantity of air used depended largely on the length of concrete discharge pipe and the condition of the concrete. A dry mix was found to require nearly twice as much air as a wet mix, but a compressor handling 500 cu.ft. of free air per minute will supply the gun under average conditions.

Another very important feature was the long bends in the 5-in. concrete discharge line used in lifting the concrete from the gun to the arch, and in carrying the concrete over horizontal angles. It was found after experiment, that pipe bent on a 10-ft. radius gave the best results with the least wear to the metal. Good sharp river sand was used in mixing the concrete, but experiment showed that river gravel passing a 1½-in. screen, or slightly smaller, gave good results with minimum wear of the pipe. Crushed rock of the same size could be "shot" as easily as the river gravel, but the pipe bends would cut out in a few hours.

Replacement of worn out pipe sections and the removal of end sections as concreting progressed, was made easy by special flanged connections shown in Fig. 3. These flanges were screwed to the sections before going to the tunnel. To take down a joint simply required the loosening of two bolts which swung out of place when the nut was slightly turned. A round rubber gasket specially designed to stay in place made the joint air-tight. The pipe sections were cut into 5-ft. lengths. This length was easily handled, and enabled the workmen to keep the discharge end of the pipe within a short distance of the placed concrete. Best results were obtained when the pipe was kept not more than 7-ft. distant from the concrete.

An improvement in the gun itself over what was originally provided was the substitution of cast-iron piston rings in the piston driving the concrete into the nozzle. The hydraulic packing used at first required daily replacing, while the cast-iron rings with daily cleaning and oiling lasted several weeks.



PNEUMATIC CONCRETE GUN OUTSIDE THE TUNNEL

At no time during the concreting of the arch was the gun placed more than 200 ft. away from the forms, as it was found by experiment that the pipe plugged too easily if shooting was done at a greater distance. This plugging was reduced to a minimum only after experienced operators who could handle the gun were found. An operator could tell by the air gages, and by the sound of the concrete traveling in the pipe the exact condition of the charge, and could regulate his piston travel and air accordingly. As the work progressed in the various headings, the operators became more experienced and fewer plugs in the discharge line occurred.

The work of lining the arch of the tunnel was begun Nov. 15, 1920, and completed March 25, 1921. The entire Caribou development, including the tunnel, was constructed by Stone & Webster, Inc., of which S. L. Shuffleton is western manager, and the writer general superintendent.

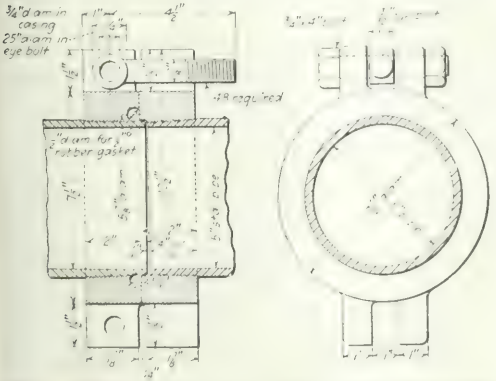



FIG. 4. DETAIL OF FLANGE JOINT IN CONCRETING PIPE

## Prize Offered for Hardness-Testing Device

A prize has been offered by Sir Robert Hadfield, under the auspices of the Institution of Civil Engineers (Great Britain), for the best design of apparatus for measuring the hardness of materials, especially under such conditions and in such locations as are not suitable for the use of present devices. A fund of about £150 is available. Communications, accompanied by drawings or models, should be submitted to the Institution before Dec. 1, 1921.

# San Francisco Bay Bridge Project Revived by New Plans

## Schemes for Tying City by Bridge or Tunnel to Mainland—One Comprehensive Study for Years to Come

THE plan of bridging or tunneling San Francisco Bay to do away with the ferry between the city and the east shore is again up for consideration. Last fall three independent bridge or tunnel projects, all apparently based on more or less engineering study, were brought forward within a few weeks. As a result of the interest thus aroused, cities on both sides of the bay appointed committees to consider the matter and compile data relating to trans-bay traffic, conditions of the bay bottom, and costs of bridge and tunnel construction. More recently, as stated in the news pages of *Engineering News-Record*, June 16, 1921, page 1053, a private enterprise has announced that funds were available for the construction of a trans-bay bridge according to plans prepared by Gustav Lindenthal of New York. A campaign is now being carried on by the motor truck dealers' association of San Francisco, which is using a series of full page advertisements in the daily newspapers and otherwise endeavoring to build up a popular realization of the need for better access to the city. In view of these various activities space is devoted to a résumé of the situation and some of the suggestions already made.

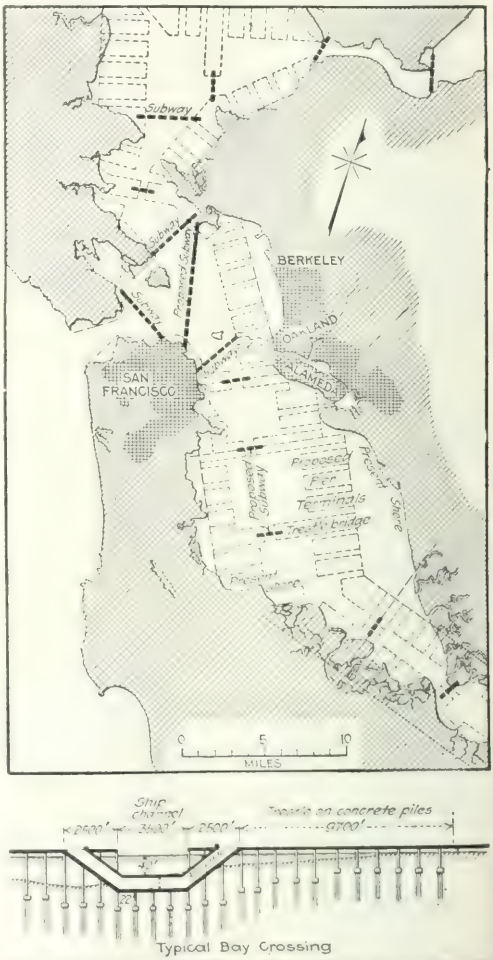
### Ferry Service Inadequate

Except for the trains that come up the peninsula over the Southern Pacific coast line, all steam line passengers coming to San Francisco are obliged to cross the bay by ferry, using the same boats that carry the local traffic. The ferry service is inadequate both on automobile and passenger lines. In the evening rush hour the ferries are so over-crowded that the boats go out with passengers standing tightly packed on the outside of both upper and lower decks fore and aft. The automobile boat service is in still worse condition. These boats have to make a 5-mile, 45-minute trip as against the 2¾-mile, 20-minute trip on the passenger ferries because the nearest city street landing on the east shore is well inland. As no more than a limited number of machines (about 100) can be taken on each boat, and despite the fact that present conditions doubtless discourage much trans-bay auto travel, it is not unusual for long lines of machines to wait hours to get across when the ordinary week-end or holiday rush is on.

*Admiral Jayne's Plan.*—Rear-Admiral Joseph L. Jayne, U. S. N., when commandant of the twelfth naval district last fall, proposed that the present Key Route trestle from the Oakland shore be extended to Yerba Buena Island, which would be converted into a union terminal, and that a ferry and later a tube be provided to connect the island with the foot at Market St. Admiral Jayne is quoted as saying that this plan "has been the subject of correspondence between the district commandant and the Navy Department and, while no decision has been reached in regard to it, I have received the authority of the Secretary of the Navy to take up the question with local interests."

Announcement of the Jayne plan and the tentative approval by the Navy came as a surprise, not only because the island has long been owned by the federal government and used as a naval training station, but also because it has been believed by engineers that the Navy would never look with favor upon the closing of the channel between this island and the east bay shore. Opposition at once appeared in the shape of protests that if the channel to the east of the island is closed, shipping would have to go around the island to get from the western waterfront to the inner harbor—this making it necessary, too, the dredging and maintaining of a channel through the shoals north of the island.

*Goethals Plan.*—Howe & Peters, consulting engineers of San Francisco, have been working for nearly two







Typical Bay Crossing

IDEAL DEVELOPMENT OF SAN FRANCISCO HARBOR AND LOCATIONS OF BRIDGE AND SUBWAY CROSSINGS (LITTLE)

years as Pacific Coast representatives of George W. Goethals, in getting together data on the construction of a subway for both vehicular and rail traffic, which would connect the foot of Market St. with Oakland Mole. Tentative plans on this project, made public some months ago, call for a shield-driven concrete tube, similar to the type General Goethals recommended for the

New York-New Jersey tube under the Hudson River.

Provision would be made for two decks, the upper for use of motor vehicles and the lower for electric trains. The upper roadway would permit of two traffic streams, one going each way, with ample room in the center for lighter cars to pass trucks and other slow-moving vehicles. Tracks on the lower deck would accommodate all classes of railroad traffic. The gradient would be kept below 3 per cent so freight could be handled easily. The depth of water along the route the tube would follow does not exceed 65 ft. and soundings taken at various points indicate that its entire length would be in blue mud. Not only would mud facilitate driving by the shield method, it is pointed out, but it would constitute a cushion to safeguard the tube from possible disalignment due to earthquake shocks.

The opinions thus far submitted on this plan are only of a very general character and recommendation is made for a thorough preliminary investigation such as would cost about $25,000. If the results of such a survey confirm the rough estimates, it is suggested that the construction of the entire 3.5-mi. concrete tube would be between $40,000,000 and $50,000,000.

### Goethals Favors Tunnel

In commenting on this project General Goethals is quoted as saying, "as between a bridge and a tunnel connecting San Francisco and Oakland shores, the tunnel would be the more satisfactory construction, particularly in view of possible and even probable objection by the war department to a bridge. The depths are not excessive and there would be no difficulty other than might be created by the character of the material encountered in construction."

By way of indicating the amount of investment that might be warranted in such a tube, Howe & Peters have tabulated the following traffic data: In 1912 the ferries serving three steam railroads and one electrical line carried across the bay a total of 33,000,000 passengers; in 1918 the Key Route and the Southern Pacific carried a total of 39,165,000; and in 1919 the same lines carried 41,961,000 passengers; in 1919 some 2,253,500 motor vehicles were taken across the bay by ferry. Based on the rate of increase shown up to 1919, it is estimated that by 1940 more than 100,000,000 passengers and between 10,000,000 and 15,000,00 motor vehicles will cross the bay annually.

*Little Plan.*—A comprehensive study of the future bridge requirements of the entire San Francisco Bay district, made several years ago by John G. Little, begins with the assumption that ultimately there will be dense population distributed more or less uniformly from one end of the bay to the other, with the financial center still about where it is now but with the industrial centers shifted to outlying points. On this basis he prepared maps indicating the location of some eighteen crossings at various points on the bay which would ultimately be required, the idea being to have in mind the ultimate program when the first units are constructed.

Of these several crossings a combined trestle and tube suggested for immediate construction about 1½ miles south of the Ferry Building, Mr. Little says, is "cheaper than any scheme for crossing the bay which has yet been proposed, will meet all of the requirements for safety and convenience, and will eventually add to, rather than detract from the shipping facilities of the harbor." This structure would begin on the San Francisco side at the intersection of Sixteenth and Kentucky Sts. and end on the east shore at the intersection of Lincoln and Adeline Sts. (the latter projected), a distance of 4¾ miles. The water depth along this route nowhere exceeds 60 ft. The construction recommended is a concrete trestle or viaduct at the elevation of the present docks and having a depressed section or tube at the point most desirable for an unobstructed ship channel. The viaduct could, when future growth warranted it, be skirted on each side by piers projecting at right angles to the viaduct.

The office of the Chief of Engineers, U. S. A., is definitely on record as opposed to any low-level bridge north of San Mateo and has expressed the opinion that a tunnel is preferable to any bridge, but at the same time it made the statement that "a modification of the plan presented by John G. Little might prove workable."

In preparing estimates for the San Francisco Chamber of Commerce based on prices as of October, 1920, Mr. Little compiled the following cost estimates.

(1) For a wood trestle built out from each shore leaving a central ship channel of, say, 3,500 ft. clear width, and using ferry boats across this channel, pending the construction of a subway:

| | |
|---|---|
| 25,000 lin.ft. 21-ft. highway on creosoted pile trestle | $1,410,000 |
| 2 ferry houses on creosoted piles | 90,000 |
| Approaches | 100,000 |
| 2 ferry boats | 1,000,000 |
| Promotion | 400,000 |
| Total cost, trestle and ferries | $3,000,000 |

(2) For a concrete highway supported on concrete piling and planning the immediate construction of a tube in place of the ferry:

| | |
|---|---|
| 25,000 lin.ft. 21-ft. highway (concrete) | $3,250,000 |
| 2,000 ft. concrete tube, giving a 40-ft. clear channel | 5,000,000 |
| Approaches | 750,000 |
| Promotion | 1,000,000 |
| Total cost, highway and tube | $9,000,000 |

In connection with this plan, Mr. Little recommended the construction of a tube under the estuary to the Sixteenth St. station in Oakland and a second tube at the foot of Broadway, Oakland.

A later modification of the Little plan, made by C. H. Snyder of San Francisco, provides for the same general construction but places the ship channel at the San Francisco end, thus building inshore one of the inclines down to the tube and putting the entrance to the shore incline on Fourth St. between Channel and Kentucky Sts. Mr. Snyder proposes the use of pre-cast concrete tube sections 24 ft. long floated to place and sunk onto accurately placed concrete piles. J. Vipond Davies of New York is quoted as having approved this plan.

*Other Plans.*—Some years ago plans were brought forward for a high-level bridge from the top of Telegraph hill to Yerba Buena Island. Objections to this were the very high cost and the climb necessary to reach the San Francisco end.

A means of relief for the automobile congestion that would be inexpensive and could be speedily completed is the proposed Dumbarton cutoff highway. This would call for the use of the present railroad bridge or a new bascule bridge across the south end of the bay at point Dumbarton. Here government restrictions are not believed to require a clear channel of more than 125 ft. and good concrete boulevards have already been built down both sides of the bay. Plans and estimates have been made on this proposal showing total costs as low as $600,000. The great drawback, however, is that the crossing would be 25 miles south of the Ferry Building.

# Railway Relocation to Eliminate Sliding Hillside

## Operation Stopped by Shifting and Subsidence of Banks, Trestles and Cuts—Advice for Location on Wet Sidehills

RECONSTRUCTION of a portion of the Alberta & Great Waterways Ry., in Canada, has been made necessary in order to put the line on stable ground and to eliminate a 9-mile stretch which has been wrecked by the movement of a hillside. This movement was started by the excavation for the original roadbed, with the disastrous results shown in Figs. 1 and 2. The northern part of the line was abandoned and is out of operation until the new connection can be completed. This railway was acquired by the government of the province of Alberta in 1920, and the improvement and relocation have been under the direction of H. A. Warner, chief engineer and superintendent. The route is approximately northeast from Edmonton for about 300 miles to Fort McMurray, at the junction of the Clearwater and Athabasca rivers, in north latitude 56 deg. 40 min. This is said to be the most northern point thus far reached by the railway system of North America, with the exception of the isolated lines in Alaska and the Yukon district.

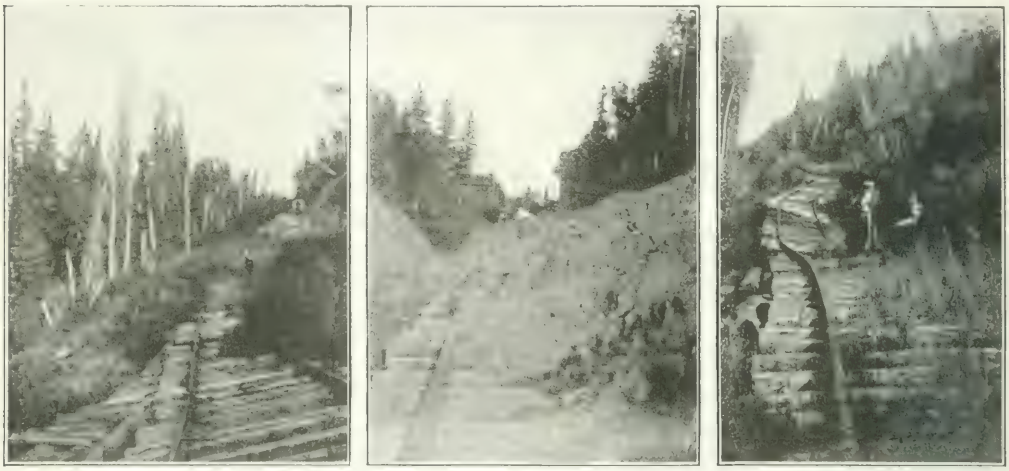


FIG. 1. SLIDING HILLSIDE PUTS NORTHERN CANADIAN RAILWAY OUT OF OPERATION

As built originally the railway approaches Fort McMurray along the south banks of the Clearwater and Athabasca rivers, as shown in Fig. 3, and it is here that the sliding has occurred. The two valleys are about 400 ft. deep, with side slopes averaging 12 deg., and are cut through limestone overlaid with bituminous sands of varying thickness (McMurray tar sands) which show outcrops on the slopes and are exposed occasionally in the railway cuts. Overlying the tar sands and forming the face of the slopes where the sand outcrops do not occur is a much thicker bed of alluvium of glacial origin, containing a large percentage of boulders.

At Mile 274.5 the line begins to descend into the valley of the Christina River and it reaches the flats of the Clearwater River at Mile 283.5. This is the distance affected by the slides, nine miles, with a fall of 460 ft. from El. 1,280 on the plateau to El. 820 on the flats. The grade is 1 per cent compensated for curvature and fitted to the topography with 10 deg. curves, the roadbed being 14 ft. wide on fills and 22 ft. in cuts. The quantities are fairly well balanced, so that the characteristics of the profile are through cuts and medium fills, with a comparatively small amount of trestling. The earthwork per mile averaged 24,200 cu.yd. in cuts and 23,700 cu.yd. in fills. Culverts are of native timber, without floor, paving or riprap protection.

### Topographic Conditions

An extensive swamp occupies the plateau forming the summit of the divide between the Clearwater River and Deep Creek, and as the bulk of the water precipitated is unable to penetrate the tar sands it percolates through the subsoil and appears on the Clearwater side as seepage. The sidehill is clothed with a dense forest of spruce, and as it has a northerly aspect it receives but little sunshine in these high latitudes, so that evaporation of the seepage is retarded and the growth of moss is encouraged. This moss, in combination with rotten logs and other forest debris, covers the ground to depths approaching in some places 5 or 6 ft., not only retarding the natural evaporation but also obstructing the surface drainage. When undisturbed, therefore, the soil is held in a constant state of saturation and yields up its moisture slowly, but when it is opened up by a cut, the groundwater of this natural reservoir is tapped and percolates more or less rapidly through the sides of the cut, causing destructive scour and slides.

When the alluvium is saturated it becomes practically viscid and its tendency to slide is increased by the presence of boulders in the moss covering. Although considerable damage had been occasioned by sliding cuts, the fills gave the most trouble, the ground on which they rested being too soft to bear their weight, so that they would either move bodily downhill or subside into the soil, often leaving no trace of their previous existence. Over the worst section of four miles about every fill has been displaced, the characteristic

condition being that from the mouth of every cut the track deflects sharply downhill, while also sagging deeply in the vertical plane. Some fills have cracked longitudinally, the downhill half sliding away from the uphill half. Where fills have disappeared and been replaced by trestles most of the trestles have also suffered both lateral and vertical dislocation, the piles having either subsided and pulled away from the caps or having been pushed down hill by the movement of the ground in which they were driven.

Among other factors noted by Mr. Warner as being prejudical to the stability of earthwork on these alluvial sidehills is that of wind action in trees standing above the disturbed ground. He says that any engineer who, on a windy day, has looked through a transit set up in a spruce or tamarack swamp and tried to set a hub will appreciate the extent of ground movement induced by the wind in the trees, magnified by the leverage of the trunks and acting through the shallow spreading root system. With trees on a sidehill the movement is not so perceptible because of the greater firmness of the soil. But the leverage exists and where the continuity of the surface is broken by a railway cut within a certain distance of the trees there comes a time when a wedge of earth, waterlogged and lubricated by continuous rains, will yield to the influence of the swaying trees and slide bodily downhill into the cut. For this reason, and apart from other considerations, he suggests that it is desirable that the right-of-way should be cleared from the edge of cuts on the uphill side for a distance equal to one or two times the depth of the cut.

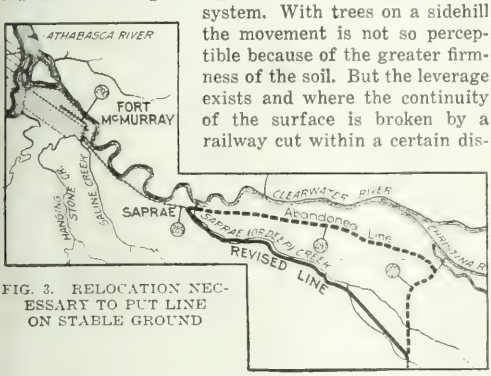



FIG. 3. RELOCATION NECESSARY TO PUT LINE ON STABLE GROUND

Large stumps left standing close to the edges of cuts were also found to be prejudicial, having slid into cuts during or after prolonged spells of wet weather. It is probable that with the cutting down and killing of the tree and consequent shrinkage of the stump and roots from the surrounding soil, in combination with the removal of the surface vegetation, water would penetrate the fissures thereby created. The distance from the face of the cut to these fissures being relatively small, percolation and scour would rapidly increase until the soil supporting the stump becomes practically a lubricated wedge which will slide into the cut under the weight of the stump. For this reason stumps near the uphill edges of cuts should be removed, the holes being backfilled with good material or the slopes of the cut trimmed back sufficiently to eliminate them.

### Construction and Relocation

This line was originally graded in 1915, but rails were not laid till the winter of 1917-1918. Considerable sliding and subsidence which had occurred in the meantime had to be remedied before the track could be laid.

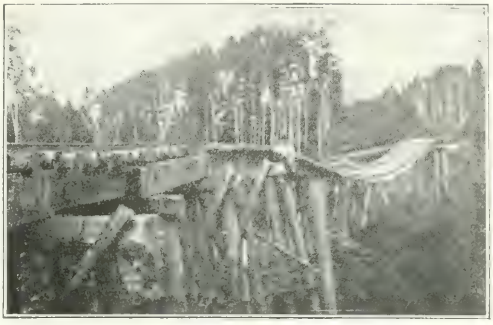


FIG. 2. TRESTLE WRECKED BY MOVEMENT OF HILLSIDE

During 1918, while the line was in operation, sliding still continued, and extensive works of trestling and grading were undertaken. The slides had to be removed by hand, as it was impossible to hold a steam shovel on the track. All this work, however, was without avail, the disturbance of the ground which it involved seeming only to aggravate the condition. All further work on the hill was therefore abandoned.

When the railway came into the possession of the provincial government, in July, 1920, a thorough investigation was made, the problem being to maintain a line on a sidehill composed of what was virtually a plastic material and which was furthermore subjected to rapid and destructive scour when exposed to the action of running water. This study led to the conclusion that it would have been much easier to cope with such conditions when building the line originally, but that as so many points of weakness and instability had developed in the hillside as a consequence of the presence of the existing works it would be cheaper to rebuild the line on a new location than to reconstruct the existing line. This conclusion was supported by the fact that the railway was a pioneer line of relatively cheap construction, unballasted and but half finished, running through an unsettled country where land was practically of no value and the cost of right-of-way not an item for serious consideration. Therefore the line could be diverted without detriment to any existing settlement and without any expense other than that of new construction.

A location was accordingly run down Deep Creek, which crosses the existing line at Mile 273 and flows into the Clearwater River at Mile 284 (see Fig. 3). The banks of Deep Creek for the first four miles are low and gently sloping, of good material and lightly timbered with poplar and spruce. For the remainder of its course, however, its valley deepens rapidly and its topography and materials are more like those prevailing on the Clearwater. But as it is possible to lay the line all the way in the valley bottom the character of the banks is not an important factor. As the material is not disturbed it is not likely to slide down on the track, and as the track is on a sidehill it cannot slide laterally.

The distance by the diversion is 2.8 miles shorter than by the old route, but a heavier grade had to be adopted in order to keep the line in the valley bottom. For the first 6½ miles the grade is a slack 1 per cent, the next three miles having a 2 per cent grade and being figured as a pusher grade on a 1 per cent line. For the present density of traffic, however, this latter section will be more economically operated by doubling the hill.

Experience on this line emphasizes the desirability of avoiding sidehill location on rivers in alluvial country wherever possible. Mr. Warner suggests, however, that the following precautions should be taken when a water level route by a subsidiary stream cannot be secured or when development cannot be avoided by a high crossing, so that a sidehill location becomes essential.

1. Where there is a choice of two banks, choose the bank with the sunniest aspect.

2. Fit the grade line to the ground so as to have daylight in all cuts, as far as possible. Put trestles in all sags, so as to avoid any but low embankments.

3. Clear the right-of-way to such a width as will let in ample sunlight and air.

4. Clear away all moss and old debris on right-of-way, sowing grass seed if necessary to protect surface from denudation.

5. Clear out all buried or obstructed channels.

6. Remove all stumps from edges of cuts and all trees near enough to cuts to induce sliding.

7. Provide ample culvert capacity for drainage and do not attempt to divert the natural drainage except where absolutely necessary.

8. Make culverts of metal or masonry, with ends protected by rip-rap or wing walls. If timber culverts are used they should be paved or floored to prevent scour.

9. Maintain the velocity of the drainage water through cuts and along the upper side of fills within such a limit as not to scour the material. In cuts, this way requires the use of track boxes to get the water away from the ditch in intermediate points. For fills, the remedy is to use sufficient culvert openings. Where it is impossible or economically undesirable to increase the number of relief openings, so that the velocity is liable to exceed the safe limit, the ditch should be paved throughout the portion affected by such increased velocity.

10. Thoroughly drain all pot holes and water reservoirs above and below the track to the limit of the maximum sphere of influence.

11. Above all things, watch carefully at all times for scour in drainage channels, and take steps immediately to counteract such scour.

## Brick Paving Filler in Ohio

Records compiled by the National Paving Brick Manufacturers Association of contracts awarded for brick pavement construction, since Jan. 1, by the Ohio Highway Department and by the counties and municipalities of that and neighboring states, give information as to the trend of engineering preferences in design on a state-wide scale. For every 10 miles of brick-paved state highway 6.4 miles will be asphalt-filled and 3.6 miles cement-filled; 2.9 miles will be laid on rolled bases, 4.2 miles on the regulation concrete, and 2.9 miles on green concrete bases. All municipal construction for which contracts are so far awarded will be asphalt-filled on concrete bases.

Summarizing all state, county and municipal contracts, the percentages are:

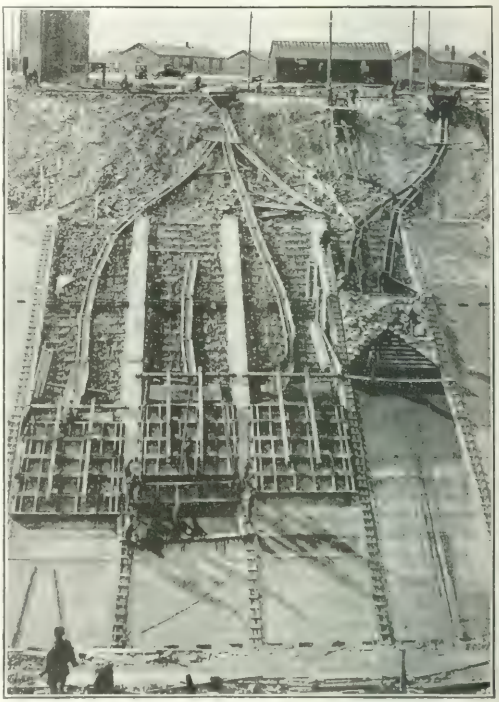
| | | |
|---|---|---|
| FILLER | Asphalt | 68.2 per cent |
| | Cement | 31.8 per cent |
| BASES | Rolled | 28.5 per cent |
| | Concrete | 71.5 per cent |

Six miles out of 10 among the county contracts will be asphalt-filled and the same proportion holds true in respect to the amount of brick upon rolled bases.

## Sliding Form for Lining Chippawa Power Canal

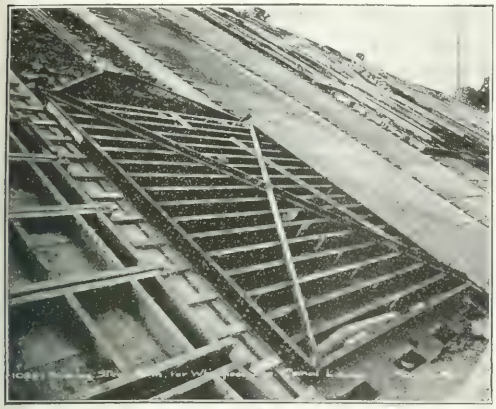
THE power canal for the new Queenston-Chippawa development around the Canadian side of Niagara Falls is being lined with concrete throughout its length of about nine miles. In that part nearest the Whirlpool, where the canal is trapezoidal, 54 ft. deep and with side slopes of 1 on 1½, the lining is now being placed behind a movable form of steel plating which is pulled up the slope so that the concreting is continuous for a given vertical strip.

In this section the concrete is placed up the slope for a distance of 83 ft. from the bottom. At the beginning the method adopted was first to place by ordinary methods 3 ft. strips of concrete up the slope at 18 ft. centers, and to fill the space between these strips by using wooden panels, 3 ft. wide by 16 ft. long, attached to the panels by anchor bolts. The left-hand three panels in the view show this system in operation.



LINING THE WHIRLPOOL SECTION OF THE QUEENSTON-CHIPPAWA POWER CANAL

To get away from the carpenter work entailed by these forms, the steel screed was later devised. This screed or sliding form is 16 ft. long by 17 ft. wide, and is made up of one thickness of ¼-in. steel plate, with a 9-in. channel around the outside and reinforced with 9-in. channels placed horizontally across the plate at 9 in. centers. The drawbar is a continuation of the side channels brought together about 6 ft. ahead of the form. A hand winch was placed at the top of the slope and from this a five-part line of ⅜-in. steel cable, was attached to the form by 2 five-sheave steel blocks.



STEEL SLIDING FORM IN PLACE ON CANAL SLOPE

In use, approximately 20 ft. from the bottom is poured in each panel behind the regular forms and allowed to set. The steel form is then placed on this and commenced moving slowly up the slope, the concrete placed being kept almost even with the top. In warm weather and with the concrete kept reasonably dry, it has been possible to pour a distance of 55 ft. up the slope in 10 hours. By the time the plate has passed over the concrete, it will be set sufficiently to stay in place. The result is a much more uniform face than with wood forms and a better chance to finish, as finishers can get on so much sooner, and work on green concrete.

The opposite view shows a general view of the work with one of these steel forms in operation. In this picture the green concrete behind the form can be plainly seen in contrast to the fully set concrete placed by the wood panel forms. The finisher can also be seen following the form as it goes up, only one man being required for all the finishing work necessary. The view above shows a close-up of the form. It also shows two completed pours where the superior finish of the work done with the steel form is plainly evident. The lower portions of these pours was placed with wood forms and the picture shows the off-sets at the panel joints which do not appear at all in the upper section where the steel form was used.

This method of handling the work was originally proposed by James Leith, the foreman in charge, and the idea was perfected and put in successful operation by George Angell, general superintendent. The canal and power plant is being built under the direction of H. G. Acres, hydraulic engineer of the Hydro-Electric Power Commission of Ontario, which is carrying out the development.

### Engineers on Union County Park Commission

A temporary park commission for Union County, N. J., has been created to make a survey and report on a park system for the county, to be voted on next November. Two of the members of the commission are engineers—these two, residing in Cranford and Summit, respectively, are Charles Hansel, consulting engineer, New York City, and Caxton Brown, of the Weston Electrical Instrument Co., Newark, N. J., Appointments were made by a judge of the State Supreme Court.

# Experience With Gas Rivet Heating in the Pacific Coast

## Shipyard Results Show Better Rivets and Saving of Time and Cost—Possibilities for Structural Work

By Letson Balliet
Consulting Engineer, San Francisco

During the war, shipyards of the Pacific Coast, particularly in the San Francisco Bay district, substituted gas for oil and coke as fuel for rivet heating. When the yards became accustomed to gas, it was applied in a very economical way and the men learned to like it better than other fuels. The practice spread to other fields, and now there are numerous instances of gas rivet heating in structural steel shops. It is even being suggested, and with good reason, that there would be economy in heating rivets with gas in the erection of steel frames of large buildings, using a single gas-pipe riser with taps serving manifolds for flexible hose at the desired levels.

Considering the chemical process of combustion, the accurate control of air supply possible with gas makes the ideal conditions much more nearly attainable than in the case of other fuels. Full efficiency in air control has never been attained with oil, coke or coal, and in practice about 20 per cent excess air is common, and 50 or even 100 per cent excess is often found. Hot spots in the fire and burnt rivets result, and much heat is lost. With fuel oil, the usual method of spraying the oil into the combustion chamber with compressed air generally gives a severe oxidizing fire, of low efficiency; proper combustion chambers are rare, any brick-lined box in which the fuel can be burned being accepted as satisfactory.

### The Air Supply

With solid and liquid fuels as ordinarily used the cost of delivering the compressed air may be more than the cost of the fuel. Largely on this account, while a dollar's worth of gas does not contain as many heat units as there are in other fuels yet it supplies more utilizable units for a given over-all expense.

The gas mixing machine is to the gas rivet heater what the compressor is to the oil rivet heater. The mixing machine is connected to the gas feed pipe and operated by a small motor. Once set up it requires no more attention than an electrically driven air compressor. It automatically governs its gas and air intakes to suit the demand, and if no gas is being used the gas meter does not move.

Simple and inexpensive mixing machines were brought out during the war as a means to greater efficiency in shipyards and other industries where gas was used extensively. These mixers are equipped with a rotary fan blower or compressor, having two intake ports, one drawing in air and one taking gas, adjustable to admit the proper relative quantities. In one type the primary mixture is made only partly combustible, and a bunsen burner with an adjustable throat of venturi-tube design supplies the required secondary air with great accuracy. This is the less expensive type. The other makes a complete mixture at the start and has back-fire arresters at the burners.

Rivets are not heated by gas as rapidly as with oil fuel, but allowance can be made for this by putting a

few extra rivets in the box when maximum speed is required. Three types of gas forges are common. The more popular type weighs about 120 lb. and has a firebox of plate steel lined with firebrick and served by gas through a ¾-in. hose. In this forge the hot rivets are turned out at the rate of three ¾ x 2½-in. rivets per minute, when using 244 cu.ft. of gas per hour. With a forge of this sort there is very little loss from burnt rivets. In fact when gas was installed at the plant of the Moore Shipbuilding Co. at Oakland, Cal., and oil- and gas-fired forges were worked side by side, the piles of rivets rejected on account of pitting or burning showed about 4 to 1 in favor of gas.

The quality of gas-heated rivets is much superior to those fired with other fuels because they are subjected to a soaking heat in a reducing fire and are soft throughout. They drive easier, fill the hole better and permit a riveter to drive more rivets in 8 hours. Tests made at the Moore yard show that gas-heated rivets have 2 to 6 per cent greater tensile strength than rivets heated by other fuels. The gas burner is always ready. It can be lighted with a match without wood kindling, is free from smoke, fumes and waste, and saves the time lost in starting or cleaning fires. There is no annoyance in keeping watch of the supply of fuel on hand and ordering more in time to avoid delay. Supply, storage, and delivery problems are all solved at once and there is no surplus to be hauled away when the job is finished. Another advantage in the shipyard is that a gas torch can be operated from the same supply line that serves the forge, with which to heat an angle or bracket that must be "flanged" or "knuckled" to fit closely in a corner.

In the plants converted to gas rivet heating, if the compressor equipment was previously sufficient to supply oil burners, when gas was adopted enough compressor capacity was released to double the number of riveting guns. Conversely, a smaller compressor is required upon the job which uses gas, and of course a correspondingly smaller energy charge or steam requirement.

COMPARATIVE RIVET HEATING COST, USING THREE FUELS

| For Each Rivet Pot per Eight Hours | Oil | Coke | Gas |
|---|---|---|---|
| Cost of fuel delivered on job | $0 96 | $1 43 | $1.20 |
| Distribution of fuel to forge from storage | .62 | .81 | ..... |
| Truck, wagon hauling in yard to hull | .20 | .36 | ..... |
| Motor power compressed air at 1c. per hp-hr | .80 | .64 | ..... |
| Air overhead yard leakage and operation | .80 | .64 | ..... |
| Coke boxes, upkeep, delivery, etc. | ..... | .15 | ..... |
| Clean up, oil, ashes, burnt rivets, etc. | 2.10 | .52 | .03 |
| Supply and delivery of kindling for fires | ..... | .30 | ..... |
| Rivet gangs lost time, starting, adjusting fires | .64 | 1 28 | .32 |
| Rivets burnt (or lost in ashes) at 7c. lb. | 3 50 | 2 10 | .14 |
| Destroyed coke—not burnt out or lost | ..... | .30 | ..... |
| Operation gas mixers, power, etc. | ..... | ..... | .08 |
| Auto truck—hauling gas tanks to dump | ..... | .06 | ..... |
| Time of hip riveter handling coke and coke trays | ..... | .07 | ..... |
| Time of hip riveter handling empty and full ash bbl | ..... | .09 | ..... |
| Laborer time passing bolt and rivet from fire | ..... | .05 | ..... |
| Lost bolts, nuts, rivets in ashes | ..... | ..... | ..... |
| Paint barrels—tar barrels—brake | ..... | .03 | ..... |
| Lost time cleaning fires and rekindling | ..... | .64 | ..... |
| | $9 62 | $9 47 | $1 77 |

The accompanying tabulation of expense incidental to rivet heating, from one of the shipyards of the San Francisco Bay district, gives an excellent comparison of fuel costs. Oil is figured at 6c. per gallon, coke at $26 per ton, gas at $1 per 1,000 cu.ft. and 16 gal. of oil is taken as the equivalent of 110 lb. of coke or 1,200 cu.ft. of gas per 8-hour shift. In the gas cost no piping charge is included, as this item has a high salvage value and was not charged against each job in the shipyard.

The plant at which this table was compiled was operating 14 large compressors when the gas forges were installed. Seven of these compressors using 3,300-hp. motor capacity were dismantled and sold when 300 gas forges replaced that many oil and coke forges, the amount realized on this sale being enough to pay the cost of the gas installation. The power bill was reduced between $4,000 and $5,000 a month, which practically offset the gas bill. Thus the yard made a net saving equal to the entire cost of coke and oil used in rivet heaters.

Gas is now being used for rivet heating in a number of structural-steel fabrication shops on the Pacific Coast. Its use in the erection of large steel-frame buildings has been proposed but not yet tried. On construction jobs, a 2-in. riser could be carried up the elevator shaft or up any convenient post with manifolds vcut in to serve flexible hoses supplying forges at the several levels. The derrick or elevator would be relieved from the necessity for hoisting fuel and lowering ashes and this time-saving for the hoisting equipment could be measured in terms of more structural material handled.

## Elastic Viscous Deformation Expressed By an Exponential Formula

Shearing experiments on pitches, asphalts and similar materials by P. G. Nutting of the Bureau of Standards have led him to establishing an exponential formula including both force applied and time of action as factors of the resulting deformation. As reported by him at the recent annual meeting of the American Society for Testing Materials, the formula is,

$$s = at^n F^m$$

in which $s$ is the deformation, $t$ is the time during which the shearing force $F$ acts, and $a$, $n$ and $m$ are constants. Ordinary viscous deformation would have $n = 1$ and $m = 1$, but for pitch and asphalt of various kinds these exponents were found to have different values. Purely elastic deformation corresponds to $n = 0$, $m = 1$, and the author therefore suggests that the formula may prove to be so general in form as tc be applicable to most kinds of stress = strain relation.

For a particular hard stearine pitch the exponents were determined as $n = 0.56$, $m = 2.0$. The range found in testing various pitches, tars and asphalts was $n = 0.40$ to $0.91$; $m = 0.74$ to $2.0$, the time exponent being less than unity in every case. A high value of $m$ was interpreted as showing a rubbery texture, and a value less than unity a texture resembling quicksand, the deformation increasing less rapidly than the applied load.

For determining the constants of the formula a steel tongue 50 × 100 mm. was inclosed in the material to be tested, held between parallel steel plates 2 mm. distant from either face of the tongue, and the tongue was pulled out of the material by the action of a weight. With careful control of temperature, measurements could be made to within one per cent, and results could be duplicated very closely.

### Truck Operation Costs on Grades

Record of the cost of operating passenger automobiles of large capacity, running out of Los Angeles, show that for a given car and load, averaged over long periods, the entire cost of operation over paved roads on fairly steep grades is very close to 33 per cent more than the cost of operation on the level. While the same holds true for other similar runs, records of the bus companies show that the Bakersfield and San Diego runs illustrate this cost relation very well. The former involves a climb of about 5,000 ft. while the latter is practically level.

# Colorado Rainfall Records and Flood Estimate

## Intense Local Precipitations East of Mountains and Succession of Local Floods Reported by Officials

RECORDS of the Colorado rainstorm of the first week of June have been collected by J. M. Sherier, meteorologist of the U. S. Weather Bureau at Denver, and through his courtesy are made available herewith. On the map Fig. 1 are given the total precipitations for June 1-4 and June 1-7 inclusive. They indicate that an extremely heavy rainfall was localized in the region east of the Continental Divide and, in fact, east of the Front Range. The total precipitation over the larger part of the region was 2 in. to a maximum of 11.44 in., the latter being recorded at Colorado Springs. The following discussion of this rainfall is given in Mr. Sherier's own words.

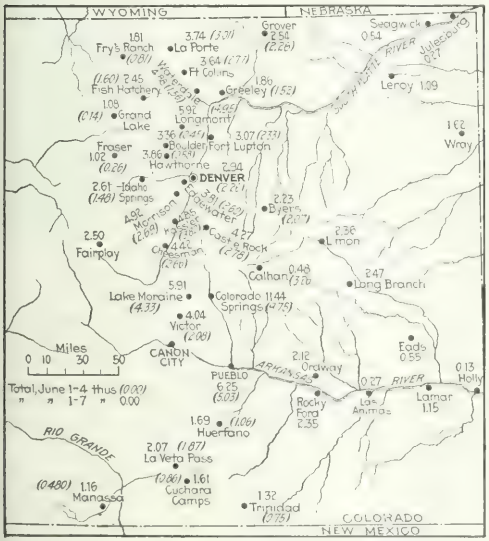



FIG. 1. RAINFALL MAP OF CENTRAL COLORADO

"While the precipitation was everywhere heavy near the mountains, no very unusual amounts occurred in the eastern portion of the state. This is also true of the western slope. The flood at Pueblo was due not so much to a heavy general rainfall as to terrific downpours over limited areas, some idea of the intensity of which is indicated by the record from Colorado Springs, where it appears that 9.40 in. of rain fell between 3:30 p.m. of the 3rd and 2 a.m. of the 4th. This opinion is supported by every local engineer with whom the matter has been discussed.

"Although such a rain as occurred at Colorado Springs would alone have caused a serious flood if it had extended over any considerable area, the disaster at Pueblo was due principally to a so-called cloudburst at Swallows, about 12 miles west of Pueblo, on the evening of the 3rd, of which there is no exact record. The river rose rapidly from a stage of 5.6 ft. on the morning of the 3rd to a crest at 1 a.m. of the 4th that has been fixed by the state engineer at 24.66 ft. After the passing of the crest, the stream fell rapidly and is reliably reported to have been at a stage of approximately 14 ft. at 4:30 a.m.

"Unfortunately no rainfall data has been received as yet from Canyon City. The highest river stage reported from that place, however, was 9.0 ft., or 1 ft. below the flood stage, and it was assumed excessive precipitation did not extend so far westward."

### State Engineer's Study of River Flow

An investigation of flood phenomena by the state engineer's office is still in progress. On account of the great demand for information, however, a preliminary report has been made by R. G. Hosea, deputy state engineer, to A. J. McCune, state engineer, which brings together essential flood-stage and river-flow data concerning the Arkansas River and Fountain Creek. In connection with his report Mr. Hosea emphasizes that the flood was not caused by the failure of any reservoir dam, and that the Schaeffer reservoir dam failed about 10 o'clock Sunday morning, June 5, while the peak of the flood at Pueblo occurred about 1:30 a.m., June 4, more than 30 hr. previously.

COLORADO RAINFALL RECORD FOR JUNE 1-6, 1921
(Daily Precipitation in Inches)

| | June 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Grover | ..... | 0.34 | 0.62 | 1.30 | 0.16 | T |
| Fry's Ranch | | | 0.67 | 0.14 | 0.20 | 0.10 |
| Laporte | | 0.06 | 0.47 | 1.88 | 0.47 | 0.26 |
| Ft. Collins | ..... | 0.24 | 1.07 | 1.46 | 0.25 | 0.02 |
| Greeley | | | 0.90 | 0.62 | ..... | 0.30 |
| Waterdale | | 0.07 | 1.56 | ..... | 0.52 | 0.24 |
| Fish Hatchery | ..... | 0.20 | 0.28 | 1.12 | 0.45 | 0.20 |
| Grand Lake | ..... | 0.14 | T | T | 0.10 | 0.60 |
| Longmont | 0.10 | | 4.40 | 0.45 | 0.44 | 0.48 |
| Fort Lupton | ..... | 0.02 | 1.36 | 0.95 | 0.35 | 0.04 |
| Boulder | | | 0.31 | 0.14 | ..... | 0.71 |
| Hawthorne | | 0.58 | ..... | ..... | 2.10 | 0.71 |
| Fraser | ..... | ..... | 0.09 | 0.17 | 0.08 | 0.41 |
| Idaho Springs | ..... | 0.14 | 0.20 | 1.16 | 0.59 | 0.32 |
| Edgewater | 0.08 | ..... | 2.15 | 0.45 | 0.48 | 0.60 |
| Denver | T | 0.10 | 0.75 | 1.41 | 0.37 | ..... |
| Morrison | ..... | 0.23 | 0.40 | 1.98 | 1.60 | 0.40 |
| Kassler | ..... | 0.14 | 0.17 | 3.51 | 0.52 | 0.36 |
| Byers | ..... | 0.35 | 1.38 | 0.34 | 0.10 | 0.06 |
| Castle Rock | 0.06 | | 2.78 | ..... | 0.50 | 0.18 |
| Cheesman | ..... | 0.34 | 0.10 | 2.22 | 1.07 | 0.49 |
| Calhan | ..... | ..... | ..... | 3.26 | 0.83 | 0.39 |
| Colorado Springs | ..... | 0.35 | 5.00 | 4.40 | 1.26 | 0.42 |
| Lake Moraine | ..... | ..... | 0.65 | 3.68 | 1.40 | 0.18 |
| Victor | ..... | ..... | ..... | 2.08 | 1.55 | 0.37 |
| Pueblo | ..... | 1.94 | 1.64 | 1.45 | 1.12 | 0.09 |
| Huerfano | ..... | ..... | ..... | 1.06 | 0.56 | 0.04 |
| La Veta Pass | ..... | ..... | 0.98 | 0.89 | ..... | 0.20 |
| Cuchara Camps | ..... | ..... | ..... | 0.86 | 0.21 | 0.12 |
| Manassa | ..... | ..... | ..... | 0.48 | 0.36 | 0.13 |
| Trinidad | ..... | 0.20 | 0.55 | 0.30 | ..... | T |

The drainage areas of the two rivers and their principal tributaries are marked out on the accompanying map, Fig. 2, which forms part of the report mentioned. The territory shown contributed practically the entire amount of flood water which passed Pueblo, according to the conclusions reached. The following flood facts are taken from the report.

*Flood Stages at Pueblo*—The flood rise of the Arkansas at Pueblo began about 11:30 p.m., June 2, when the river rose from a flow of 8,100 sec.-ft. to 28,500 sec.-ft., corresponding to a gage height of 13.7 at 2 a.m., June 3, but by 8 a.m. the water had receded to 5.5 ft., with a 3,500 sec.-ft. discharge, and dropped considerably more by noon. A sharp rise began at 5 p.m. raising the stage 6.2 ft. to 11.2 ft. in little over an hour, with 18,000 sec.-ft. discharge, and after con-

tinuing slow rise of the stage the peak flood rise began at 7:40. An hour later the stream overflowed the stone coping of the levees (18.14 ft.), and quickly flooded the city. Despite the increase in flow area, the river continued to rise, to about 24.66 ft., or 6 ft. over the sidewalk of the Main St. Bridge. The water then receded, and by daylight, 4:30 a.m., was just below the levee top. A flood in Fountain Creek also developed during the night of June 3, of sufficient violence to tear out nearly every bridge below Colorado Springs; its maximum probably did not reach Pueblo until the morning of June 4, after the crest of the Arkansas flood had passed by.

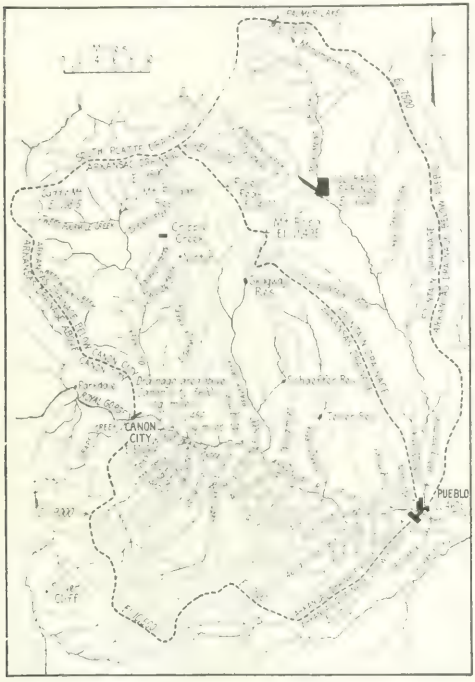



FIG. 2. DRAINAGE-AREA MAP OF PUEBLO REGION

The Arkansas rose again, a lesser amount, in the afternoon of Sunday, June 5, due to the flow of the discharge of the Schaeffer reservoir failure. The dam, an earth structure, gave way about 10:30 a.m., discharging its entire storage volume of 3,100 acre-ft. The gage height reached at Pueblo in this wave is not recorded, but it was far below the Saturday peak.

Gagings were made by H. D. Amsley and G. C. Price, state hydrographers at Pueblo, in the morning of June 2 and the afternoon of June 3, which gave a check on the discharges corresponding to low and ordinary flood stages. Discharges at other stages were estimated from these, and were checked by the Chezy formula with coefficient calculated from the Kutter formula for the slope of 13½ ft. per mile and roughness factor 0.0225.

Mr. Hosea estimates the capacity of the channel under the floor of Main St. bridge (16.85 ft.) with 2,300 sq.ft. waterway, at 41,000 to 45,000 sec.-ft. This flow could be carried only if the stream were free from debris; the floorbeams of the bridge go down to 14.67, which stage corresponds normally to about 33,000 sec.-ft. discharge. At 13 ft., allowing some 20 in. clearance under the floorbeams, the channel is estimated to have only 25,000 sec.-ft. capacity. The peak flow of the night of June 3-4 is estimated at 100,000 sec.-ft. (believed to be a liberal estimate).

The peak flow of Fountain Creek is estimated at 50,000 sec.-ft. (for channel 400 ft. wide by 10 ft. deep, slope 30 ft. per mile between Colorado Springs and Pueblo, velocity 12 ft. per sec.). The estimated maximum for La Junta is 172,000 sec.-ft., corresponding closely to a flow of 170,000 measured at the Amity dam, some 30 miles farther downstream. The crest of the flood reached La Junta at 3:15 p.m., June 4, 13¾ hr. after the Pueblo peak. This gives a figure of about 5 miles per hour for the movement of the flood wave downstream.

The total quantity of water discharged through the Pueblo streets (i.e. outside the river channel) is estimated at 20,000 acre-ft.

Canyon City reports indicate a maximum flow of only 4,200 sec.-ft. at 9 a.m., Saturday, June 4 (this is after the peak passed Pueblo) and it is stated that the storm did not extend 3 miles west of Canyon City. In the afternoon of June 3 there was a very heavy storm in the drainage area between Canyon City and Pueblo, and this same storm covered the upper Fountain Creek area, with 5.00 in. fall at Colorado Springs, followed by 4.20 in. more between 2 a.m. and 6 a.m. of June 4. The storm was very heavy to the south, and it was from the Siloam and Boggs Flat country that Pueblo was first warned of the coming of a flood. The St. Charles River carried a very large flood but the Huerfano was not unusually high. These facts indicate clearly the local storm nature of the Pueblo flood.

On the north side the Teller reservoir stored practically all the flow of Turkey Creek, which showed no signs of unusually high water at its mouth. The Schaeffer reservoir also held back the flood of Beaver Creek until after the Pueblo peak.

Mr. Hosea makes the following preliminary estimate of flood peaks:

| Stream | Sec. Ft. Peak Discharge |
|---|---|
| Arkansas River at Pueblo | 100,000 |
| Fountain Creek at Pueblo | 50,000 |
| Salt Creek | 1,000 |
| Chico | 2,000 |
| St. Charles | 10,000 |
| Huerfano | 2,000 |
| Apishapa | 1,000 |
| Timpas | 1,000 |

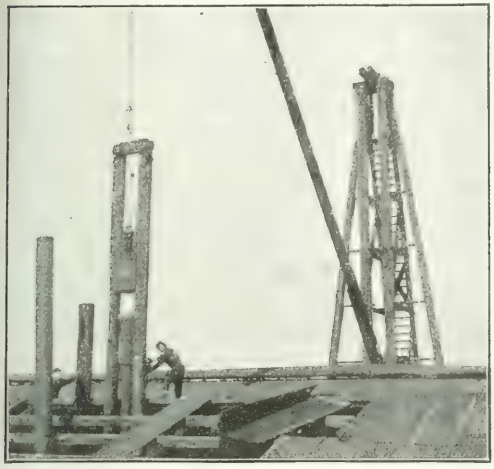
Slope measurements are to be made to give a further check on the computed discharges. Extensive damage done to irrigation structures, particularly due to shifting of the river channels, is to be reported upon later.

## Lehigh Has Course in Ship Construction and Marine Transportation

A course to prepare men for the field of ship construction, marine transportation, and foreign trade is offered by Lehigh University, Bethlehem, Pa. In addition to studies in engineering, shipbuilding, and naval architecture, the course includes a considerable amount of study in business and economics, such as finance, accounting, business law, foreign exchange, marine insurance, economic geography and foreign trade. One of the requirements for graduation is that students spend a summer at sea following their junior year.

# Piles Driven Through Wharf Roof 90-Ft. From Fender

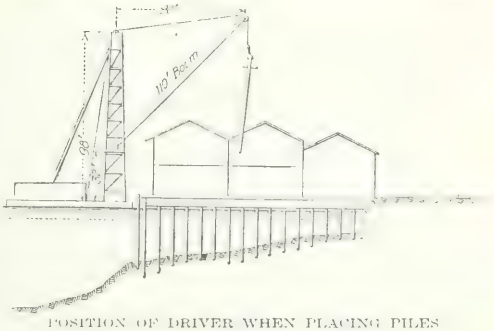
THE destructive action of marine borers recently made it necessary to replace with creosoted piles about 3,000 untreated piles in a wharf at Port Costa, Cal., some of the replacements being as far as 90 ft. from the fender line. This wharf is built parallel with the shore line. The driving had to be done with floating equipment for three reasons; (1) the wharf has a superstructure upon it, (2) piles of considerable length were required, and (3) it was desired to carry out the work without interfering with the storing and moving of freight on the wharf. The piles were driven though openings made in the roof and in the floor for this purpose, using a scow piledriver with a 110-ft. boom set in the tower. The boom was used first to place the piles and then to support a hammer and pair of leads for driving them.



DRIVING THROUGH ROOF WITH SUSPENDED LEADS

Work was done on only a small section at a time. A space about 32 x 40 ft. in area was cleared of freight on both main and second floors and roofing and flooring was opened up in this section to make way for the new piles. The driver used has a tower 98 ft. above the deck of the barge. At a point 32 ft. above the deck it has a step in which a boom can be set when desired. For use on this work a pair of 15-ft. leads with a 4,400-lb. hammer were suspended from the end of the boom, the hammer being operated by a line running through a sheave at the boom end to the head block and thence to the winch drum. The usual procedure was to set about 25 piles with the boom and then to suspend the hammer and leads from its end and begin the work of driving. This process was repeated, moving such freight as was necessary, until the work was finished.

Piles 55 to 85 ft. long were used and were driven to refusal. They were placed on 8-ft. centers in bents spaced 12 ft. apart, the allowable load being taken as 22 tons per pile. For convenience in shifting to a new hold on the pile when this was necessary after it was lowered through the roof, an 8-ft., 6 x 8-in. timber was chained to the pile as a crossarm near is upper end.




POSITION OF DRIVER WHEN PLACING PILES

The piles were driven as close to the cap as possible and after driving were cut off on a slight bevel at the exact level desired and pulled under the caps where they were wedged tightly into place and fastened by drift bolts driven through the cap. With this rig the rate of progress was about 10 completed piles per 8 hours.

The contract on the work was held by the Healy-Tibbitts Construction Co. of San Francisco. Information from which the foregoing was compiled was supplied by B. C. Gerwick, engineer for the contractor.

# Standard Specifications Helpful to the Municipal Engineer

*From the presidential address of George S. Webster before the American Society for Testing Materials, read at Asbury Park on June 21 under the title "The Influence of the Work of the American Society for Testing Materials Upon the Execution of Public Works."*

The adoption of standard specifications has proved to be beneficial to the consumer in that it has enabled him to secure a more uniform and higher grade of material at a lower cost than would otherwise be possible. The standard has been evolved as a result of the collective work of the leading experts on the subject and it is common experience that the composite work of many experts is far more valuable than that of a single expert.

The ability to obtain materials of a specified quality has reduced the cost of construction because in the use of the material by reason of the better knowledge of its properties, economies can be effected which would not otherwise be possible. The producer, by reason of uniform standards, can operate his plant uniformly in turning out a standard product, and thereby effect economies in the cost of production.

### Politics Eliminated and Test Methods Fixed

Probably no consumer of building materials has benefited to a greater extent as the result of the adoption of standard specifications than has the municipality. In the construction of public works there are many influences which render such work difficult, not the least of which is the political influence. The adoption of the standard specifications of this society eliminates a great deal of undesirable controversies and undesirable competition and results in a greater efficiency in the expenditure of public funds. Where standard specifications are formulated in the manner as are those of this society, all producers are aware of the fact and can offer less objection to the specifications than would be the case if the specifications, no matter how meritorious, were prepared by the employees of the municipality.

As I review my experience in passing upon materials, I am impressed by the fact that nearly all the controversies that occurred over materials that had to be rejected, related to the methods used in testing the materials. With

the establishment of recognized standard methods these controveries have decreased and with the growing respect for the specifications used there has been less attempt to secure the acceptance of inferior materials, and this has resulted in a marked improvement in the work.

It would be impossible for a municipality to undertake to carry on the research necessary for the development of specifications as is possible through such an organization as the American Society for Testing Materials. Through the membership of its employees in this society and on its committees, the municipality can have the advantage of the experience of the many experts serving on these committees and participating in the general discussions at the annual meetings. The inevitable result of these meetings is the broadening and an ever-widening experience of those who attend with a consequent increased service to the municipality. It has been my practice to encourage assistants connected with the work under my charge to become identified with the society and to participate in its work.

RULE-OF-THUMB SELECTION

In the early days of engineering in this country, materials of construction were for the most part passed upon by the engineer by rule-of-thumb methods and later experience has shown how very deceptive such methods are as an indication of quality. For example, it was formerly a practice to test the quality of cement by placing the mortar between two bricks and the quickness with which the bricks would adhere together was an indication of the quality. It was usual years ago in sewer construction to use natural cement in laying the bricks and this quick-setting material showed a rather superior quality in this respect to portland cement, which set much more slowly. Sand was tested by rubbing it in the hands to see whether it was dirty, and determining whether it was otherwise suitable by visual methods. Those who are experienced in testing know how utterly inefficient and aburd such methods are.

The advantages to the municipality through the adoption of the standards of the American Society for Testing Materials may be briefly stated as follows: (1) Ease in specifying the quality of the material required, (2) ease in testing materials delivered under the specifications through the use of standard methods, (3) ease in obtaining standard products, (4) an effective means for minimizing controversies over purchases of materials, and (5) a feeling of security that the materials used are satisfactory, as a result of the knowledge of how the standard specifications are formulated and that they reflect the latest knowledge and experience.

## Mole Hole Drains Without Tiles

Drainage of wet agricultural lands by means of mole holes or mole drains, as practiced in England, consists in forming drains in the soil, without the use of pipe or tile, the process being limited to soils in which the holes or drains will retain their shape. For making the drains, there is a machine consisting of a frame slung below the axle of a pair of large wagon wheels and carrying a steel plate or colter which extends down into the soil. To the bottom of the colter is attached a cylindrical steel mandril or plug, behind which is a similar but slightly larger plub to compress and smooth the walls of the hole formed by the plug. The depth at which the drain is formed can be regulated by an attachment for raising and lowering the colter. This machine is hauled across the land by a cable and hoist, the soil at once closing in to fill the narrow slot cut by the colter. A very similar process used in this country has the important advantage of placing tile in the hole by means of a carrier following the colter, so that the system is applicable to various kinds of soil (see *Engineering News*, March 30, 1916, p. 615.)

# A New Study of the Milwaukee Water-Supply Situation

### Low Typhoid But High Child Mortality—Sewage-Works Will Reduce Average Load on Water Filters But Flood Overflows Menace

AS A result of a new investigation of the water situation from the standpoint of whether filters are needed or not, Harrison P. Eddy, consulting engineer, Boston, has returned a decidedly affirmative answer. Nor is he favorable to further delays in starting the design—delays to see what effect the proposed sewage-works will have on the lake water. As nearly a year will be required to perfect the designs, further experimental work along the lines of colloidal chemistry proposed in a report by a special committee of the local section of the American Chemical Society can be carried on simultaneously. If anything of value is found which will modify the design, and Mr. Eddy is not especially optimistic, the plans can quickly be modified to care for the new methods of operation proposed. Following are Mr. Eddy's conclusions and a part of his discussion of the need for a further investigation of the sedimentation, filtration and chlorination of the supply.

*Health Indices*—Vital statistics indicate that the health conditions in Milwaukee compare favorably with those of other American cities where the health standards are reasonably high.

Typhoid fever, which was high in the earlier years, has been reduced materially by improvements in the water supply. Mortality among young children is somewhat higher than would be expected if the city were provided with an absolutely uncontaminated water supply. Notwithstanding the vigilance of the water department officials in protecting the water supply and the painstaking work of the health department, both of which have had so beneficial an effect as to place the city in an enviable position with respect to the general public health, there are indications that the quality of the water supply is such as to affect somewhat unfavorably, although much less so than formerly, the health of the city, particularly as regards intestinal diseases.

The change of intake, December, 1912, resulted in a distinct improvement in the sanitary quality of the raw water.

ALL SEWAGE CANNOT BE TREATED

Because of rapid changes resulting from wind currents and the flushing of sewage into the lake, the quality of the raw water is such that its purification requires the utmost vigilance in order to prevent infectious matter reaching the consumers. In addition to the pollution derived from the sewage of the city, there is opportunity for pollution from bathing beaches, lake traffic and industrial wastes, these sources of pollution being of relatively minor importance, although by no means to be neglected, as compared with the city's sewage.

The proposed treatment of the sewage, aside from practically eliminating the present exceedingly objectionable foul condition of the rivers and shore waters, will, under normal dry weather conditions, materially reduce the amount of sewage contamination reaching the intake. Notwithstanding the excellent results of sewage treatment which are assured, there will continue to be bacterial contamination of the waters of the bay by the treated sewage, but this contamination can be so controlled as not to exceed that caused by the discharge of the untreated sewage of a population of one-tenth that of the city.

*Flood Menace*—In times of substantial rain or melting snow untreated sewage will be discharged from the intercepting sewers into the rivers and from the sewage-works directly into the lake. The quantity of such storm over-

flows will vary from small to great volumes according to the intensity and duration of the storms, but in all cases the waters discharged will contain not only the filth washed from the streets and other surfaces but also a portion of the sewage of the city. The frequency of such overflows will depend upon the number of storms causing them. It is reasonable to expect upwards of 60 occasions per year or an average of five per month. The quantity of untreated sewage so discharged will vary according to the intensity and duration of the storms and the contributing population. On the average in 1925 it may amount to 4.4 per cent of the entire normal sewage flow for the duration of the storm. At times of intense storm it may be as great as 90 per cent or over, of the entire sewage flow. Storm overflows will frequently be of short duration, although on some occasions the discharge may continue for many hours.

### Filters Needed for Worst Condition

Even after the sewage-works shall have been put in operation, the continued though greatly reduced contamination of the lake water will be a menace to the sanitary quality of the water supply. The treatment of the sewage will assure a raw water generally well within the accepted safe limit of contamination for purification in a thoroughly effective dependable water purification plant. Nevertheless, the relative change in conditions which the water purification plant will be called upon to meet apparently will be practically as great although much less frequent than before sewage treatment.

*Filters vs. Chlorine*—Chlorination alone has undoubtedly been of marked benefit in reducing typhoid fever and other intestinal diseases in Milwaukee, and so long as such chlorination is carried on effectively and uninterruptedly there should be no recurrence of excessive typhoid, although a few cases may occur now and then, resulting from a small amount of infection escaping the chlorination process. A filtration plant built and operated according to present generally accepted good practice is more dependable and a greater safeguard to the health of water consumers than chlorination alone.

Filtration followed by chlorination will afford even greater protection than either process alone and is fully justified at Milwaukee. Filtration will give a clear, physically attractive water and one of relatively uniform quality for disinfection, thus assuring satisfactory bacterial removal even with materially reduced amounts of chlorine and therefore with less probability of objectionable tastes and odors.

*Colloidal Chemistry* — Notwithstanding the great advancement which has been made during the past twenty-five years in the purification of contaminated municipal water supplies, it is possible that further substantial improvements may be accomplished by the application of the principles of colloidal chemistry. The more delicate control of the hydrongen-ion concentration, which may be popularly called acidity of the water, appears theoretically to offer some adantages. Such control, however, is clearly in the experimental stage of development and must be very thoroughly investigated and tried upon a relatively large scale before its adoption can be justified. The promise of advantage from application of the principles of colloidal chemistry is sufficient to justify Milwaukee in forthwith making preliminary laboratory investigations, and if these indicate material advantage the city is fully warranted in making investigations upon a relatively large scale to demonstrate the practicability of the new methods. If it should prove practicable to utilize the new methods, it is possible that greater filter efficiency would result and that permissible higher rates of filtration would warrant a material reduction in the size of the filter plant.

### What Colloid Study Might Show

The committee of chemists was of the opinion that the practical application of the principles of colloidal chemistry to the problems of sedimentation and filtration will have an important influence on the treatment preparatory to filtration. To take advantage of the hydrogen-ion concentration in the operation of filters it will be necessary to control the chemical treatment in several steps: (1) Quantity of alum required for successful treatment must be determined. (2) The $P_H$ value must be ascertained. (3) The amount and kinds of chemicals must be learned to produce the isoelectric point. Since water varies as to bacterial content, organic matter, micro-organisms, turbidity, and temperature as well as $P_H$ value, such control involves extreme care, particularly as the variations are sometimes frequent and sudden.

Five advantages appear possible from $P_H$ control: (1) Prevention of after-deposits; (2) elimination of corrosive action; (3) control of small plant and animal life; (4) possible reduction in plant size due to speedier filtration of water containing a floc formed at the isoelectric plant; (5) possible increase in efficiency.

If it be assumed that all of the advantages can be secured—a very improbable assumption—it does not appear likely that any material change will be required in the design of a plant to be operated in this way, as compared with a plant designed to operate according to the older and well-established methods, except that some reduction may be possible in the size of coagulation basins and in the extent of filter area. Such other changes as may be necessary would appear to be of a minor nature, such as in chemical tanks, pipe lines and dosing apparatus.

## Status of Federal-Aid Roads

OF THE 22,030 miles of federal-aid roads which have been built or were under construction March 1, 1921, more than two-thirds are earth roads, sand clay, or gravel, according to a recent statement by the chief of the U. S. Bureau of Public Roads. These have cost less than one-third of the total amount expended, as compared with nearly 50 per cent of the estimated cost applied to 4,890 miles of hard surfaced roads.

For the 22,030 miles of highway, extending into every state, the total estimated cost is $361,946,868. The percentage of this total estimated cost which will be incurred for each type and the mileage of each type based upon the records of plans approved, are shown herewith.

| | Per Cent of Total Estimated Cost | Mileage |
|---|---|---|
| Type 1, including earth, sand, clay and gravel | 32 2 | 15,300 |
| Type 2, including water bound and bituminous macadam | 9 0 | 1,530 |
| Type 3, including brick, bituminous concrete, Portland cement concrete | 48 8 | 4,890 |
| Miscellaneous | 4 0 | 310 |
| Bridges | 6 0 | |
| | 100.0 | 22,030 |

Many times the question has been asked the bureau, What type of road is best? The answer is always the same: There is no one best kind or type of road surface. A recent statement issued by the officials of the bureau expresses this thought in the following language: "It is the policy of this bureau to consider the conditions on each individual federal-aid project, as there are elements such as subgrade, drainage and present and prospective traffic, which vitally affect the determination of the standards of construction to be used."

There have been occasional attempts to write into state laws or the governing conditions of bond issues a requirement as to the type or kind of roads to be constructed. To follow such a course the bureau believes, would be most unfortunate. This principle was recently expressed to a chamber of commerce asking for information, in the following language: "Types of highways should not be specified by law. This is a matter to be decided by the state highway department in which should be lodged full authority both to construct and to maintain. Competition between different types of material should be maintained and selection made to fit traffic requirements in each case.

# Methods of Checking Erosion of Farm Lands in Iowa

## Brush Dams and Tile Drains Reduce Destructive Flow After Rains and Promote Filling of Gullies by Sediment

AS heavy rainfalls cause extensive gullying of soft surface soils in rough and rolling country, means of preventing such erosion and restoring the surface have been studied by the Iowa State College, with results as outlined in the following abstract of a report by M. H. Hoffman, formerly extension professor of agricultural engineering.

Overfalls or vertical falls of water which work back through the land are the cause of 90 per cent of the gullying, the remainder occurring where cattle tramp in the mud of overcrowded pastures or where sidehill ditches are washed in cultivated land. Some of these gullies are 40 to 50 ft. deep and of equal width. Most of them carry water only during rains. Their annual progress is from 30 to 300 ft., depending on the slope and rainfall, but they stop on reaching a point where the flow is so small that the current does not dislodge the grass. Meantime, side ditches have developed and form a special trouble, for while land may be farmed on both sides of the main ditch, the others cut it into small, irregular pieces.

### Methods for Filling Gullies

The loose soil which is 15 to 30 ft. deep along the Missouri River thins out as it extends across Iowa, and erosion is at its worst where only a few feet of this soil covers the glacial drift. In the southern section this soil has somewhat greater tenacity, but there is trouble from erosion in the 10 to 12 ft. of alluvial soil in the valley land. A single rain has developed a crack 12 in. wide, 6 ft. deep and 240 ft. long, which later rains in the same season enlarged to 8 ft. in width and depth and more than 480 ft. in length. Approximately 1,100 cu.yd. of soil were lost from this ditch in one month.

For filling a gully, the work should begin both at the upper end to check the overfall and at the lower end to catch the soil that comes down. The former usually is not difficult or expensive if immediate repair is made after rains. A satisfactory method is to set posts in the ditch about 2 ft. from the overfall, these being spaced 2½ to 3 ft. apart and sloped downstream. Straw is packed on the bottom and up against the bank, being kept in place by a layer of green brush intertwined between the posts and held down by crosstimbers spiked to them. The obstruction should not be higher than the banks as it would then turn the stream around to the sides, forming more overfalls. Good results have been obtained by stretching a wire fence across the ditch 6 or 8 ft. below the fall and packing the space above it with bundles of cornstalks set on end. In some cases the steep fall of the valley and hillsides makes it desirable to install plank, concrete or stone chutes.

After checking the overfall, the ditch is to be filled to such a level that it can be crossed by teams and farm implements, leaving a shallow rounded channel in order to prevent new gulleys. A tile drain is the first and most important step, for where water flows it is impossible to get root growth established firmly enough to hold the soil. In eight years a rough ditch that had been tiled was filled from 5 to 7 ft. and could be crossed with farm implements. The drain should be placed below the bottom of the ditch, not alongside it, and should follow the general course but smoothing out the sharp turns. As tiles 1½ to 2 ft. below the ditch may be washed out by a heavy rain coming before the fill has compacted, it is advisable to secure them by X-braces of stakes against which straw is packed before the trench is filled.

After the drain is established, low obstructions should be built in the ditch bottom. For Iowa conditions the most successful have been those from 1 to 2 ft. high and spaced 30 to 90 ft. apart. A common method is to set posts in the form of a V with the vertex downstream, straw being then packed on the bottom and against the sides. On this is laid brush with butts upstream held down by boards nailed to the posts. Old woven wire fencing packed with straw may be used where brush is not obtainable. The top of the obstruction is made concave to keep the current in the middle in times of high water. When a fill of 12 or 18 in. is formed new obstructions should be placed half way between the old ones. If the obstructions are too high at first there is danger of undercutting and sidecutting by the water impounded. Planting willows is not advisable as they do not form sufficient obstruction and their roots are likely to clog the drain.

Dams of plank, concrete and stone have been unsuccessful, the water usually washing out one end and so getting underneath. A dam would stand if built with a footing several feet below the bottom of the ditch, its ends well into the banks, the middle considerably lower than the ends and with a downstream curvature of about 120 deg. The Iowa Highway Commission has a design for use where the culvert must be low to take the tile water but where erosion will result unless flood water is held back. Surface washing on hillsides has carried away large quantities of soil, but except for the bluff land along the rivers it is a question whether the use of terracing is advisable.

Sink holes occur in the extreme northeast part of Iowa. Usually a crevice in the underlying limestone allows earth to drop through and be carried away by the underground stream, until the surface soil falls in, forming a cavity 5 to 15 ft. deep and 20 ft. or more in width. There is usually a hole at the bottom through which soil disappears in time of rain and in which livestock is occasionally lost. If such sinks are filled with logs and brush the earth keeps sliding in. Plugging with stone and concrete stops drainage and causes mud holes. A successful method is to cement a tile into the hole in the rock and build a vertical drain of tile with loose joints. In heavy rains the water first flows over the top of the tile, leaving the dirt behind, and as the pools lowers the water escapes through the pipe joints. Some of the larger drains need to be provided with a manhole grate, but many can be capped 2 ft. below the surface and then covered with soil.

## Cost of Canadian-Niagara Hydro-Electric Power

In an address before the Toronto Board of Trade, visiting the Queenston-Chippawa power development around Niagara Falls, Sir Adam Beck, the chairman of the Hydro-Electric Power Commission of Ontario, made a statement last week regarding the probable cost of power in the new development. He said the estimated cost of the Chippawa development, based upon cost of labor and materials in 1920 and 1921, was $60,000,000, and the plant would have a capacity of 500,000 hp. When this development is finished the total amount of the investment in the whole "Hydro" system would be not less than $210,000,000. The total electrical energy purchased and generated by the commission is 440,000 hp. The capital cost per horsepower at the Ontario Power Co.'s and Electrical Development Co.'s plants at Niagara is $135, whereas the capital cost of Chippawa power on the above basis would be $125. This means $12 per horsepower delivered compared with the cost of steam generated power, which is between $60 and $70 per horsepower. Sir Adam suggested a reciprocal arrangement should be made between the United States and Canada under which, pending the completion of the Chippawa canal, Ontario would borrow unused power developed in the American plants and after the canal had been put into operation, "Hydro" could turn over some of its Chippawa power to American users on short-term leases, which, he said, would ease the burden on the Ontario municipalities.

## First Portland Cement Mill in Straits Settlements American Built

AN AMERICAN equipped cement mill at Singapore is the first to produce portland cement in the Straits Settlements. It is known as the Ho-Hong Portland Cement Works and was designed and constructed by James C. Muir, M. Am. Soc. C. E., who is engineering representative of the Robertson-Cole Co. and general manager of the works. The photograph of the mill reproduced herewith has been furnished by C. A. Wilson, Cambridge, Mass., who has been traveling in the Far East.

AMERICAN EQUIPPED CEMENT MILL AT SINGAPORE, STRAITS SETTLEMENTS

The mill was built by coolie labor, under the direction of Mr. Muir, in the midst of a swampy jungle with the tide overflowing all the grounds and nine miles away from the unloading of heavy machinery. It has an output of 1,100 bbl. per day and it is expected to increase the capacity to 5,000 bbl. to meet a growing export demand, according to Mr. Wilson. All of the machinery for the mill, clay digging, and pulverizing coal for the kilns came from the United States. American machinery is also used in a barrel factory run in connection with the mill.

It is stated by Mr. Wilson that throughout the Far East there is a growing attempt to supply the naturally large demands for cement construction. He believes that American machinery should be in great demand. Both India and Ceylon are making portland cement.

### Southern Pacific Lays Manganese Rail

The first shipment of 15 per cent manganese rails on an order placed by the Southern Pacific Railroad for 3,000 tons, has been laid on the Tehachepi grade in California. Rail wear over this pass has been very rapid because a large portion of the grade is on sharp curves, the ruling curve of 10 per cent being frequently used. Under these conditions 90-lb. A. R. A. standard rails on the inside of curves have to be renewed on an average of every 18 months. The decision to use manganese rails was made in an endeavor to minimize interruptions which are particularly objectionable on this grade because the heavy traffic of two transcontinental railroads is here carried on a single track line. The manganese rails are costing about 4½ times as much as common rail.

## Electrolysis Conditions Relieved at Winnipeg, Canada

### Three-Wire System of Electric Railway Improves Ground Return—Alkaline Soil Another Cause of Pipe Corrosion

CORROSION of cast-iron water mains by stray currents from the electric railway at Winnipeg, Manitoba, has been relieved by the introduction of the three-wire system of distribution, as an improvement upon the older two-wire system of insulated negative return feeders. The following account of the local situation and development is summarized from an extended paper in the *Electric Railway Journal* of March 26, 1921, p. 584, by W. Nelson Smith, consulting engineer for the Winnipeg Electric Railway Co., who has designed and supervised the carrying out of the entire scheme for reducing the track potentials and gradients to the prescribed legal limit. This corrosion has been the subject of long controversy between the company and the city. In 1915, the late Prof. Ganz made a report to the Manitoba Public Utilities Commission, recommending the establishment of limits of track-potential differences, with permanent means of observing them, an additional substation and insulated negative-return feeders on the old two-wire system. These recommendations, somewhat modified, were embodied in the Manitoba electrolysis act and were accepted by the company in an agreement with the city in 1918. A study of the situation by Mr. Smith showed that owing to the heavy cars and light rails the same amount of copper would go much farther if used on the more modern three-wire system, which was also more convenient for final adjustment in equalizing track potentials. The three-wire system had been applied successfully on a large scale at Los Angeles, Cal., in 1915 (after Prof. Ganz had made his Winnipeg report). In 1918 it was in use also at Brisbane (Australia), Omaha and Milwaukee, besides being proposed at Springfield, Mass., Wilmington, Del., and New Orleans.

In the sectional method adopted at Winnipeg for three-wire operation, the alternate sections of any double-track or single-track line are of opposite polarity. The general plan of sectioning is to set off three zones from each substation to the extremity of its feeding district, and to reverse the middle zone. This arrangement offers the lowest reduction of track potential combined with a tendency of stray currents in underground cables to flow continuously toward the substation, as compared with any other system of sectioning. Mr. Smith states that after more than a year of operation in one district and several months in two others (including the central district) there is no reason to revise the general arrangement of sectioning. Line failures are rare and in extreme emergency everything can be paralleled on the two-wire system if necessary.

Tests made in May, 1919, in the first district (Fort Rouge) showed that the reduction of track potentials between the substation and the principal outlying points was from an average of 11 volts under two-wire operation to 3 volts under three-wire operation, a reduction of 73 per cent. These results were considered to warrant the extension of three-wire operation to the remainder of the system. In October, 1919, it was applied to the St. Boniface district and showed a reduction of the potential from 10 volts under two-wire operation to 4 volts under three-wire operation. On July 1, 1920, three-wire operation was begun in the central district and the system has worked smoothly under congested conditions of traffic on the principal streets. In this district the initial reduction in cable drainage current was 62½ per cent, which will be further reduced owing to the reduction of the area of the present zoning arrangement of this central district.

*Cable Drainage*—The three-wire system causes frequent reversals of stray current in underground cable sheaths in districts where traffic is light. The scheme of cable drainage contemplates maintaining all present drainage connections into the substations but when necessary it is proposed to use small negative boosters, or "suckers," of about 1-kw. capacity, each with resistances in series, if needed, to assist in determining the inward direction of cable drainage current. The plan is subject to the approval of the Public Utilities Commission.

*Alkaline Soil Corrosion*—Deterioration and occasional destruction of underground structures of concrete by alkaline salts in the ground water has been so widespread in western Canada that Mr. Smith made an investigation as to the effect of such solutions upon cast iron and lead, with and without access of stray electric current. The laboratory results and examinations of pipes in areas where stray current does not exist indicate that soil conditions are responsible for part of the pipe corrosion at Winnipeg.

## Power Transmission by Pulsations in Water

A new system of power transmission which is being developed in England and which has been applied to the operation of rock drills, riveting machines and gears for the automatic firing of airplane guns, consists in imparting wave motion or rapid pulsation to liquid contained in a closed pipe. This system differs from hydraulic transmission in that the column of liquid need have no continuous flow. The power generator is a multi-cyclinder high-speed reciprocating pump, the motor also having cylinders and pistons to receive and utilize the pulsations. In the generator as now built a horizontal shaft carries eccentrics with rods pivoted in trunk pistons to which the smaller pump plungers are attached, these pumps being placed horizontally at both sides of the shaft. For rock drill work, there are 2,400 to 3,000 pulsations per minute, with a pressure of 750 to 1,500 lb. per square inch. Flexible steel pipe for carrying the column of liquid to the motor or tool is composed of short sections put together with spherical joints. The cost of operation by liquid wave transmission is said to be very much lower than for compressed air. This system is the invention of George Constantinesco, a Roumanian engineer, and the apparatus is manufactured by W. H. Dorman & Co., engine and machine builders, of Stafford, England.

## Time of Set of Concrete Studied by the Flow Table

By Watson Davis
U. S. Bureau of Standards, Washington, D. C.

*Abstract of paper presented to American Society for Testing Materials, Asbury Park, N. J., June 22, 1921.*

The "time of set" of concrete is an important property to which little attention has been given. Specifications for the time of set of neat cement, the principal active ingredient of concrete, have been formulated and used. Much investigational work has been done using the Vicat and Gillmore-needle methods of measuring time of set of neat cement, and the literature is filled with reports of setting time tests of neat cements of "normal consistency." But a measure for the setting qualities of concrete and mortar, the forms in which cement is used commercially, has not been developed heretofore. This paper presents a method, which may be called the "flow" method, for measuring time of set or rate of stiffening of concrete.

Briefly, the method consists of determining the time at which the concrete ceases to "flow," or when it is no longer plastic. This is accomplished by using the "flow table," a table-like apparatus consisting of a rigid frame with a top mounted on a vertical shaft so that it can be jolted or allowed to drop through a fixed height by means of a rotated cam. A mass of concrete, usually in the shape of a disk or truncated cone, is placed on this table top, jolted a given number of times, and its increased diameter measured by means of calipers. The diameter after jolting divided by the original diameter and multiplied by 100 gives a figure which is a criterion of "flowability" or consistency.

### How Set Is Measured

The flow test for consistency of concrete and the flow test for time of set of concrete are intimately connected. In the test for time of set, the rate of decrease in flow is measured as follows: A number of disks of concrete are molded and at stated time intervals after mixing are tested in succession for flowability. At the beginning of the test the disks are jolted at intervals of an hour, but the intervals between joltings are decreased as the flow decreases. As the concrete stiffens the flow decreases, and the time at which the point of no flow is reached is considered the time of the set of the concrete.

*Effect of Consistency on Set.*—That the wetter the consistency the slower will be the set seems to be a general law, so long as cement, mix, and aggregates are the same. In every case in the data obtained an increase in initial flowability of a given mix is accompanied by an increase in the time of set. Except for the influence of the setting quality of the cement itself, excess water producing wetter concrete is the most important factor influencing the time of setting of concrete. The retardation of set is most marked in the leaner mixes.

*Effect of Richness on Set.*—A rich concrete will set faster than a lean concrete provided the two concretes are of the same consistency or initial flowability and are made of the same materials. The effect of richness on set is minimized when the consistency is so dry that only a small decrease in flowability is necessary to cause the concrete to reach the point of no flow or to become set.

*Effect of Character of Cement on Set.*—The character of the cement is undoubtedly the most important factor that influences the setting time of concrete. Variation of gypsum content, method of manufacture, raw materials and fineness all affect the setting properties of the cement and these properties of the cement are reflected in the concrete in which the cement is used.

While the setting properties of the cement determine in a large measure the setting properties of the concrete, in general, the differences between the setting times of concretes have a tendency to be less than those between the setting times of corresponding neat cements.

*Relation of Time of Set of Neat Cement and Concrete.*—As pointed out above, neat cement sets faster than the concrete made from it. Conditions of temperature, aggregate, cement content and consistency materially affect the

setting time of concrete, and while the setting properties of the cement as determined by a needle test on a neat mix of normal consistency are reflected in the concrete, they are changed and influenced by the conditions peculiar to the concrete. For these reasons it is believed that to determine the setting properties of concrete, tests must be made on the concretes themselves.

*Effect of Temperature on Set.*—Concrete at "low" temperature (35 deg to 40 deg.) took over 2.5 times as long to set as that at high temperature (95 deg. to 110 deg. F.) and the concrete of normal temperature (70 deg. F) set 4 hours before the cold concrete, and 1½ hours after the "high" temperature concrete Strength tests on 3 x 6-in. cylinders kept 24 hours under the different temperature conditions were made and the average of three tests at 24 hours under each condition showed that at high temperature the strength was 2.5 times normal temperature strength and at low temperature the strength was one-sixth that at normal temperature.

### Various Conditions of Set

While it is possible that concretes made of cements of different composition and manufacture would not always exhibit these large differences in set and strength due to temperature, undoubtedly the results presented are indications of what may be expected. In general the lower the temperature the slower a given concrete will set, and the higher the temperature, the faster it will set.

*Method of Measuring Set of Neat Cement.*—Results indicate that the flow method gives times of set that are somewhat earlier than those for initial set given by the Gillmore needle. The tests indicate that time of initial set by the Vicat needle is about the same or slightly earlier than the initial set by the Gillmore needle. The flow method of measuring time of set is fundamentally different from the Gillmore and Vicat methods. In the Gillmore test only a portion of the outer surface of the pat is tested. The Vicat test depends upon the penetration of a needle into a relatively small portion of the pat. When the flow time-of-set piece is jolted on the flow table, the entire mass is affected.

The flow method could be used for routine setting tests of cement. Two set test pieces could be made of normal consistency paste and one tested at 1 hour and the other at 7 hours. Provision could be made that a flow of 105 should not be reached when 1 hour old but that it should be reached by the end of 7 hours.

Incidentally it is believed that the flow table is a better apparatus for use in determining "normal consistency" of neat cement than the Vicat apparatus.

*Nature of the Flow Changes Occurring During Setting.*—The rate of the change in flowability that takes place during the setting seems to be influenced by the consistency and cement content of the mix. When the mix is of small initial flowability or is rich in cement content, a large part of the flow (50 to 75 per cent) is lost in the first hour after mixing. When the mix is of wet consistency and has a small cement content, the decrease in the first hour after mixing is smaller on a percentage basis, but during this first hour the rate of decrease is usually higher than during any other period. A probable explanation of these initial decreases is that they are caused by a combination of setting and absorption. The cement and aggregate gradually absorb water during this period, thereby doing their share in decreasing the flowability.

Tests show comparatively rapid decrease in flowability determined at short intervals (3, 5 and 10 minutes) after mixing, showing that there is a stiffening of the mix due to absorption in the first few minutes during and after mixing. While this absorption of water is comparatively more rapid in the first 10 minutes during and shortly after the mixing, the absorption is probably not completed then. Although diminished, it probably continues through the first hour or more after mixing, and combined with a true setting action, causes the initial decrease referred to above.

*Early Strength as a Measure of "Final Set."*—That flow time of set corresponds approximately to the initial times of set by the needle methods when used for neat cement has been shown in data presented above. But the final set tests by the needle methods can be applied only to neat cements, and even then are of no real use and require much time to complete. The test needed is one that will tell the condition of the concrete at an early age and give definite information that can be used in deciding when to pull forms, or to perform some other operation. A compressive strength test at an early age, say 24 hours, will give such information. A test of this kind is suggested as a substitute for tests of final set.

*Use of Flow-Set Method.*—Probably the chief use of this method of making time-of-set determinations of concrete will be in investigational work in concrete to determine the effect of various factors on set. It is also capable of being applied practically. This is shown by the following example:

A floor was being laid, and a 1:2 mortar topping accelerated by using a calcium-chloride solution for gaging liquid was used for one portion, while the rest was laid with mortar gaged with plain water. Flow set determinations were made and the opinion of the finishers was obtained. This test brought out the fact that a mortar of a flow of about 190 could be wood-floated, while when it had a flow of about 140 it was in about the right condition to finish with a steel trowel. Once these flow constants were determined for the table and mold used, preliminary tests could determine very closely the time at which floating and finishing could be begun.

There is a certain minimum consistency or flowability of concrete that can be used for certain purposes, such as in a reinforced-concrete building, and the length of time that the concrete retains a flowability greater than the minimum can be determined by the flow method.

Undoubtedly this method of measuring time of set can be applied to measuring the rate of stiffening of limes, plasters, clays, etc., and other plastic materials.

*Other Factors Affecting Set.*—Factors other than those already investigated undoubtedly affect the time of set.

The kind of aggregate, depending largely on its absorptive properties, will probably be found to influence the setting. Concretes made of absorptive clay, slag, and stone aggregate will brobably set faster than similar concrete made of non-absorptive quartz aggregates.

Similarly, the moisture condition of the aggregate will tend to affect the set of the concrete. Wet aggregate will probably make the setting relatively slower, while dry aggregate will probably accelerate it slightly.

The gradation of the aggregate, the fineness of the sand and the relative amount of coarse aggregates may have some effect on set, and this is a field for future study. The change in setting time caused by the addition of different salts, admixtures and proprietary compounds may be determined by the method described.

It is believed that humidity has little effect on set, although no correlated data are presented on this factor. It should be noted that the whole test specimen is used in the flow-set test, and that for that reason, surface drying caused by low humidity probably does not materially affect the result. Humidity probably does affect the results of the Gillmore and Vicat methods of determining the time of set of neat cement as these tests are made on the surface rather than the body of the test specimen.

## Dock Improvements for Port of London

With extension of the Royal Albert docks already begun, London water-front facilities are to be extended by the Port of London Authority at an estimated cost of over £14,000,000 for the purpose of attracting to that port a portion of the Transatlantic trade now handled through Liverpool. A floating landing stage 1,700 ft. in length, adjoining the Midland Ry. station at Tilbury, will be provided, with a 35-ft. depth of water at low tide. Additional docks at Tilbury will provide 600 yd. of quay with 42-ft. depth of water. The quay will be completed equipped with freight-handling machinery and trackage. Extensive dry dock facilities will also be provided.

## Bamboo Reinforced Concrete Piles for Bridge Foundations

CONCRETE piles reinforced with bamboo rods were used in 1919 by the Szechuan-Hankow Ry., of China, on account of the high cost of steel. These piles were for the foundations of 65½-ft. spans to replace arch culverts with shallow footings which had been washed out by a flood from the Han River. Timber piles were not suitable as there is a 40-ft. seasonal variation between high water and low water. The piles were 10 x 10 in., 22 ft. long, made with a 1:2:4 mix, using ½-in. stone. For steel reinforcing there were four bars from ½-in. square to ⅝-in. diameter (according to material available), with ¼-in. hoops and wire wrapping. The following particulars are taken from a paper in the *Journal* of the Association of Chinese and American Engineers by C. J. Carroll, chief engineer of the Szechuan-Hankow Ry.:

Three designs of the bamboo reinforced piles were made: (1) four vertical strips ¾ in. wide, split from green bamboo poles, placed 1 in. from each corner and bound with telegraph wire and ¼-in. iron hoops; (2) two bamboo strips lightly wired together were placed in each corner and bound as above, the point and head of the pile being stiffened by a 36-in. length of old boiler tube; (3) eight vertical bamboo trips at the corners and the center of each face were secured by bamboo square hoops one foot apart, a few ¼-in. iron hoops and two 36-in. pieces of boiler tube being used also. This last construction appears to be the most satisfactory. The piles were cast in nests of eight forms and after four days were removed carefully to a storage yard where they remained for at least a month.

In soft blue clay at the first bridge, piles with both steel and bamboo reinforcement were driven easily, although 24 to 36 in. of hard material was encountered at about 18 ft. A 1-ton hand pile driver was used, with a drop of 3¼ to 5 ft. until the hard stratum was reached. For experimental purposes the drop was then increased until the top of the pile was shattered. Both kinds of piles would break under a few blows of over 10-ft. drop, the break extending usually not over 3 ft. from the top.

### Bamboo Piles in Soft and in Stiff Clay

In stiff blue clay at the other bridges the piles were driven slowly and with difficulty as a 6½-ft. drop of the 1-ton hammer would give only ⅛-in. penetration. When the full penetration of 20 ft. was reached, the drop was increased until the pile head was shattered. Piles with bamboo reinforcement took the shock as well as, if not better than, those with steel reinforcement. Care must be taken to have the bamboo in exact position, as some piles failed by shattering of the concrete where the reinforcement had been so displaced that it did not give proper support. Piles 10 x 10 in. and 30 ft. long were driven in an open caisson. A driving cap was used 11 x 11 in. and 3 ft. long, built of ¼-in. steel plates and hoops, with a 3-in. angle across the middle so that the cap dropped 18 in. over the pile. The upper end was packed with old rope, paper and sawdust, a hardwood block extending a few inches above the cap to take the hammer blow.

A 50 per cent saving in cost was effected, the cost for material and labor being about $28 per pile with steel reinforcement and $14 with bamboo. Piles of Oregon pine cost $14 delivered. It is thought that for lengths up to 22 ft. the bamboo-reinforced piles are satisfactory for foundation work, and on long new lines of railway they will reduce the trouble and cost of transporting reinforcement. It is suggested that bamboo reinforcement concrete may be used for temporary work in cofferdams and falsework and that piles may be fitted with pipes for jetting, but caution must be exercised in the design of beams or slabs, especially when subject to tension. Laboratory tests will probably be made at some of the technical colleges of China.

# *Notes From Foreign Fields*

## INDUSTRIAL DEVELOPMENT IN THE HOLY LAND

By A. E. Kornfeld

IT SEEMS a pity to disturb the tranquility of the Holy Land. It is strange to see camels and donkeys walking on macadam roads; it seems out of place to see telephone and telegraph wires strung on the Mount of Olives, on Mount Carmel, at Tiberias, along the Dead Sea; yet this is what one encounters daily in his journey through Palestine. The modernization of the country is going on and will continue.

Agriculturally the country is being developed in an intensive manner. A number of industrial plants are being built, others are contemplated. A plant for boxing oranges for the export market, about completed, expects to ship two million boxes of oranges in 1922. A silicate brick plant at Jaffa will be in operation by July, producing 12,000,000 bricks yearly. As soon as the machinery can be set up a large quarry will be in operation near Haifa. The old King Solomon quarries, which furnished the stones malachite and limestone for King Solomon's temple, are about to be reopened.

It will be necessary to build a large hotel at Jerusalem to accommodate the many tourists that are nightly turned away from the two small hostelries here. There are a large number of unfinished buildings in the city. Some were abandoned during the war, others stopped because of financial difficulties. A superstition exists among the natives whereby they refuse to finish what proved a failure for someone else. An enterprising firm of architects and builders could purchase these unfinished structures at a low price, finish them, and rent them before they were fully completed. Houses for business as well as dwelling purposes are in great demand, and rents are abnormally high.

Harbors will have to be built at Jaffa and Haifa. Streets leading to the harbors will have to be widened. The sanitary conditions are bad in all the large cities, and only fair in the small places, owing to lack of water where it is most needed. The water is here, but engineers will have to bring it to the places where it is required. Hydro-electric plants will be built on the river Jordan, the river Auja and in Beersheba. These plants will furnish illumination for all of Palestine and run tramways if the necessity for the latter is found.

At Tiberias there is a sulphur spring and a small house, in which the Romans bathed 2,000 years ago. The water is so hot it has to be cooled before one can get into the bath. Medical men claim that the curative powers of this spring are wonderful and many chronic cases of rheumatism and skin troubles have been cured. The enterprising modern spirit would take this spring, build a bathing pavilion and sanitarium, and create a great resort; it would prove a paying investment from the day of its completion. Tiberias, beautifully situated on the Sea of Galilee, is a place of great historical value and an unfailing point of attraction for the tourists.

Roads are now being built by pioneers (refugees from Russia) who are working for their homeland; pay is

to them a secondary consideration. I am told they earn about 80c. a day. They are extremely happy and live for the most part in tents close to some colony engaged in intensive farming. Back-to-the-land movements are in evidence all over Palestine except at Beersheba and I am told a new colony is about to be organized here.

As H. T. Cory said in his recent report on the development of Palestine, the natural resources of the country are greater than those of Southern California, and Palestine can support four million people. These statements effectively outline the work that is waiting there. If Great Britain can continue to give the Zionists military protection for the next five years, Palestine will become a prosperous land both agriculturally and industrially.

There are too many engineers here now, they tell me, but I believe the ambitious American or English engineer who is willing to do pioneer work and await his opportunity, will be well repaid for his trouble. Engineers with initiative are needed. Palestine may seem a long way from home to some engineers—but mail reaches Palestine in sixteen days from New York. The climate is ideal, the people courteous, democratic and well educated. Most everyone speaks three languages, a great many five. Sir Herbert Samuel, High Commissioner for Palestine, expresses the opinion that the country is ripe for industrial development, and cordially invites American co-operation in the building of the Holy Land.

# LETTERS TO THE EDITOR

***If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.***

## In Defense of the Alameda Site for the Pacific Coast Naval Base

Sir—In your issues of Dec. 30, 1920, p. 1258 and June 9, 1921, p. 975, there are editorials attacking the proposed construction of the Alameda Naval Base. You state in the latter editorial regarding the Alameda Site that "it is hoped that in its revival the engineering factors will be more governing than they were in the selection of the site by the joint congressional committee." You further intimate that the choice of the Alameda site was influenced by political and not by engineering factors. It is to be regretted that a technical publication should attempt to qualify as a naval engineering authority, in competition with the experts of the Helm and McKean Commissions, and with Admiral Rodman, the man who received the surrender of the German Fleet.

The facts regarding the selection of the Alameda Naval Base are as follows:

The joint congressional committee which presented the final report selecting the Alameda Naval Base Site, was greatly influenced by the previous reports of the Helm Commission and the McKean Board, both of which, after thorough investigation, had favored Alameda above all other sites.

The Helm Commission was a committee of naval experts, consisting of Rear Admiral James T. Helm, Rear Admiral H. H. Rousseau, Chief Constructor W. L. Capps, Captain G. W. McElroy and Commander C. L. Hussey. The McKean Board which was appointed to review the Helm report, and which was even more emphatic in its recommendation of the Alameda site, consisted of the following naval experts: Rear Admiral J. W. McKean, Rear Admiral C. W. Parks, Chief of Yards and Docks, and Commander J. C. Hilton. In addition to the above reports by the engineering and constructing experts of the navy, some of the highest operating authorities of the navy, including Admiral Hugh Rodman, reported to the congressional committee that from a strategical standpoint, it would be utter folly to place a major naval base at Mare Island.

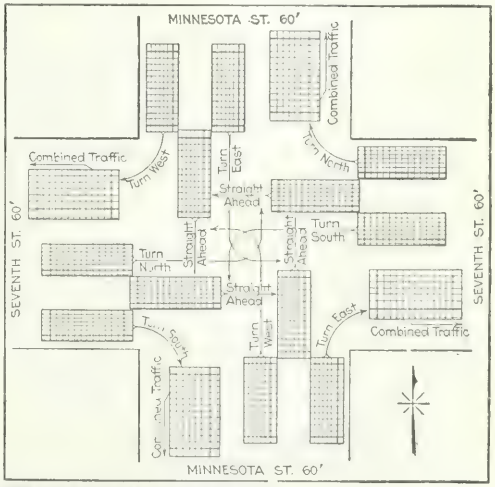
The two naval commissions referred to were officially appointed representatives of the United States Navy, the only agency really qualified to pass upon a subject involving naval matters, either as regards engineering or strategic phases.

C. E. HICKOCK,
Alameda, Cal., June 15. City Engineer.

[This journal is not posing as a naval expert. It merely favors the opinions of the naval officers and engineers who advocated Mare Island, gentlemen who are quite as reputable and expert as those who happened to be on the committees in question.—EDITOR.]

## Diagram for Analyzing City Traffic Used by City Planning Board

Sir—I am sending you herewith a copy of our traffic diagram used for analyzing the traffic count made at various street intersections. This diagram has never been published, and I have never seen anything like it. It was developed




TRAFFIC DIAGRAM, ST. PAUL CITY PLANNING BOARD

For weighting traffic the following rule applies: Passenger automobile = 1 unit; L.T., light truck, = 1 unit; H.T., heavy truck, = 4 units; H.V., horse vehicle, 1 horse, = 2 units; H.V., horse vehicle, 2 horses, = 6 units; car, street car, = 7 units.

in this office and affords a very comprehensive means of analyzing the traffic at a street intersection.

The traffic counts that have been made in connection with our city plan have been made by the graduating classes of the high schools. Two hundred and fifty to two hundred and eighty-five boys from the senior classes of the high schools were released on certain days to make this count. This enabled us to make a simultaneous count on all streets surrounding the central district.

St. Paul, Minn., April 26. GEORGE H. HERROLD,
City Planning Engineer.

# HINTS FOR THE CONTRACTOR

## Handy Concrete Weight for Derrick Line Cheaper Than Iron Ball

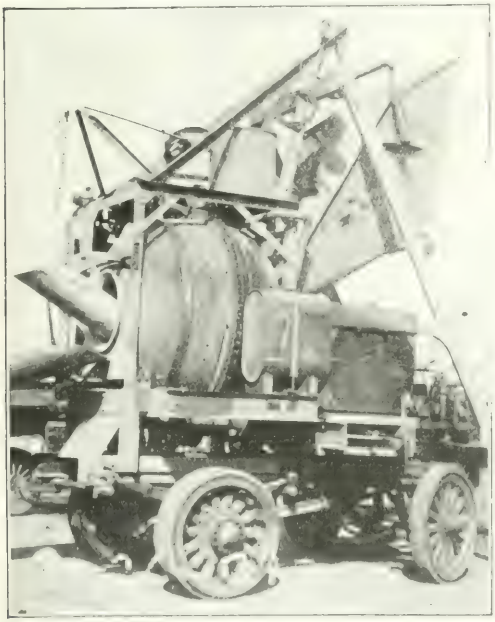
CONCRETE WEIGHT FOR LONG DERRICK LINE

AN EMPTY nail keg to be used as a form, a piece of heavy chain and a few buckets of good wet concrete are all that is required to make an excellent weight for a derrick line on structural work. The metal ball so generally used for this purpose in pre-war times is now less frequently seen on construction jobs in California and the concrete weight, as shown in the accompanying illustration, is taking its place.

## Mixer Mounted on Truck Chassis

BY WALTER B. CANNON
Lankershim, Cal.

THE mixer illustrated has been built with the end in view of having a paver for maintenance work which could make long jumps at the speed of a truck without having the trouble of loading on a truck. Only standard parts, easily obtainable, enter into the construction. The main units were a building mixer, a 3-ton heavy aviation truck chassis, and a power plant from a four-wheel drive truck. The motor and the chassis had been condemned, but the mixer was new.



IMPROVISED MOBILE POWER OUTFIT

The mixer was set on the chassis so that the drum rolls just cleared the frame and then was riveted in place. The countershaft on the mixer was not moved, but the driven sprocket and clutch were reversed in position to bring the sprocket next the bearing, so that the driving chain would come at the small part of the drum.

On account of the increased height of the mixer, the skip could no longer tip on a pivot so a track was built from channel steel by welding. The front end of the skip was turned down to the ground so that charging barrows could be run directly under it.

The front axle of the chassis was moved back as far as possible to shorten the wheel base, and the steering gear connected to the drawbar which was hinged in such a position that it folded up out of the way while the mixer was being used. There was not enough room to get in the original steering gear so one was made out of a worm and worm gear from a grader. As the gearing is irreversible, the gear is removed when the mixer is being moved.

The original transmission was removed and one made having but one speed in each direction, shifted by one lever. The traction can be operated with the drum stationary. The speed is about one mile per hour.

The power plant was mounted as a unit on a subframe across the chassis, and a differential used to give the drive parallel with the chassis. The governor was set for about 800. The magneto was set with a fixed spark.

The bonnet was used with a partition between fan and engine to keep dust from the engine. All controls are within easy reach of the operator and a guard placed so that he cannot get his hands on the skip track. The outfit traveled 250 miles in one month.

## Cement Stocked on Wheeled Platforms Moving with the Mixer

SPEED and ease of charging cement into a paving mixer were increased by wheeled platforms used in place of the usual roadside stock piles in building the Butte-Anaconda concrete road in 1920. As described in the *Concrete Highway Magazine* by J. M. Hicks, superintendent, Clifton, Applegate & Toole, Anaconda, Mont., contractors: The cement was shipped in by rail and stored in two warehouses so located as to afford the most economical haul. It was hauled to the mixer by motor truck and unloaded onto two small platforms mounted on wheels and placed on two sections of track. Each track section was long enough to accommodate both cement cars. As the mixer moved forward, the cement cars were pushed ahead with it, and when both cars were on the front section of track the back section was moved ahead. The cement platforms on the cars were 4 x 8 ft. and were about 2 ft. above the ground. Each car held 100 sacks. Because the cement was on a raised movable platform the work of picking up bags and emptying them into the charging hopper was cut down to such an extent that this job was preferred by the workmen. Before the platform was put into service it was almost impossible to keep men for this task.

# NEWS OF THE WEEK

New York, July 7, 1921

## Phipps Highway Bill Goes to Senate Committee

**Large Majority of Senate Favors Consideration of Principles in Both Dowell and Townsend Measures**

(*Washington Correspondence*)

The Phipps highway bill, with the Dowell rider, passed by the House, has been referred to the Senate committee on postoffices and post roads. After extended discussion, this action was taken rather than that of sending the bill to conference or of concurring in the House amendment.

When the bill was presented to the Senate June 30, Senator Townsend, chairman of the committee on postoffices and post roads, immediately moved that the bill and the amendment made by the House be referred to his committee. Senator McKellar, of Tennessee, a member of the committee who is in favor of the House bill, moved that the Senate concur in the House amendment. The House had attached its bill —the Dowell measure—to the Phipps bill which already had passed the Senate.

### More Changes Probable

The discussion following the motions of Senator Townsend and of Senator McKellar soon indicated that the Senate would not allow this legislation to go on the statute books without having had an opportunity to discuss and amend it. In fact, a filibuster was openly threatened. There was every evidence that the great majority of senators were anxious to consider both the Dowell and the Townsend measures. In view of this sentiment, Senator McKellar withdrew his motion and the Senate, without a roll call, sent the House bill to the Senate committee. Senator Townsend made it clear that there would be no effort to pigeonhole the House bill in his committee.

It is evident that the Senate will insist upon material changes in each of the bills. Strong objection was voiced to any proposition which requires a state to modify its constitution and its laws so as to participate in the benefits of a federal appropriation. It was said that the constitutions of 17 states contain a provision which forbids the issuing of interest-bearing evidences of indebtedness for the purpose of making internal improvements. It was pointed out, however, that this condition would merely prohibit the states from raising the money by bond issues but would in no way preclude the securing of the fund by taxation, which would require no change in the constitutions of those states. It was

*(Continued on p. 38)*

## To Study Timber Strength

At a meeting of lumber interests, held in New York June 21, a resolution was adopted recommending that no revision of the New York building code provisions respecting timber be undertaken until an investigation of timber strength has been carried out. It is proposed that the inquiry shall include a study of prior tests of timbers in commercial sizes, as made, for instance, by the Forest Products Laboratory. Tests on commercial timbers as delivered in the metropolitan district are recommended to check results.

## Bureau of Standards to Study Housing Materials

The Calder bill prior to its passage and signature by the President on June 16, as incorporated in the general deficiency bill, was changed in the wording of that section which proposed a separate division of housing in the U. S. Bureau of Standards. It was demonstrated to the satisfaction of Senator Calder that housing involved so many studies that it would be impracticable to attempt to consolidate them into one division. Much of the Bureau of Standards' work, however, has a bearing on constructional activities. Better results will be accomplished, it is believed, by allowing those activities to remain undisturbed as they are grouped, which will interfere in no way with the correlation of the results from each of the activities. This will be possible under the provision of the appropriation for continuing the investigation of structural materials by the application of the following proviso, which was added by the conferees on the second deficiency bill:

"As much of this sum as is necessary shall be used to collect and disseminate such scientific, practical and statistical information as may be procured, showing or tending to show, approved methods in building, planning and construction, standardization and adaptability of structural units, including farm buildings, building materials and codes, economy in the manufacture and utilization of building materials and supplies, and such other matters as may tend to encourage, improve and cheapen construction and housing."

A special committee headed by Ira H. Woolson, of New York, already has made headway with the draft of the proposed building code. Other members of the committee are Ernest J. Russell, St. Louis; Rudolph P. Miller, New York; Joseph R. Worcester, Boston; William K. Hatt, Lafayette, Ind.; Edwin H. Brown, Minneapolis, and J. A. Newlin, Madison, Wis.

## Engineering Educators Meet at New Haven

**Prof. Burr Advocates Liberal Education as Basis for Engineering Study—Declares Society Neglects Fundamentals**

A paper by Prof. Wm. H. Burr, formerly professor of civil engineering in Columbia University, pleading for a professional plane for engineering courses and declaring that the society was wasting its time on details and neglecting the fundamental features of engineering education, was the chief feature of the twenty-ninth annual meeting of the Society for the Promotion of Engineering Education at Yale University, New Haven, Conn., last week. The remainder of the program was of a quite formal character, only the round-table discussions on the last day affording a session above the general formal level. None of the committee reports excited special attention; in fact, the committee work was criticised by Dean A. S. Evans, of the University of Colorado, who contended that the committees were not given enough work and that their reports, when rendered, did not receive proper consideration.

The registered attendance was about 280, representing 72 institutions. The largest attendance at previous conventions was 238.

### New Officers Elected

The following officers were elected for the ensuing year: President, Charles F. Scott, Yale; vice-president, H. J. Hughes, Harvard; E. J. McCaustland, U. of Missouri; secretary, F. L. Bishop, U. of Pittsburgh; treasurer, W. O. Wiley, New York City; Members of the council, P. H. Daggett, U. of North Carolina, J. K. Dunlap, U. of Iowa, M. L. Enger, U. of Illinois, J. C. L. Fish, Leland Stanford; F. E. Gieseke, U. of Texas, Morris Knowles, Pittsburgh [illegible], and O. M. Leland, U. of Minnesota.

The University of Illinois was announced as the place for the next convention.

### Professor Burr's Paper

Prof. Burr's main contention was that the engineering profession could never teach the plane of law and medicine, until engineering education was put in a professional category. He explained "professional" to mean a series of technical and related courses resting on a foundation of liberal studies. Following high-school preparation a six-year course, three with a liberal arts and three with an engineering content, was advocated. The pres-

ent four-year course Prof. Burr characterized as a "college scientific course." He admitted that it had served a necessary purpose, but contended that engineering educators should be setting for themselves and their students a higher goal. On the matter of time required, he argued that engineer students could afford it just as well as law and medical students.

Prof. Burr severely criticised the Society for the Promotion of Engineering Education; saying that it had neglected a great opportunity to raise engineering education to a higher plane and that it had devoted its energies and its publication to details, rather than to a consideration of fundamentals.

Opportunity to discuss Prof. Burr's paper was not afforded, the president of the society, Dean M. E. Cooley, holding that it was best to let the significance of the paper sink in rather than indulge in adverse immediate criticism. He believed that the older men would agree with Prof. Burr.

At a later session, however, two speakers did refer to the paper, resulting in the passage of a resolution directing the officers to schedule a discussion of Prof. Burr's paper for next year's convention. It developed from the informal discussion outside the meetings that there was much agreement with Prof. Burr's main contention. There were shades of disagreement, of course, but no opportunity was afforded to ascertain the general view of the convention. An abstract of the paper will appear in next week's issue of *Engineering News-Record*.

ROUND TABLE DISCUSSION

In the round-table discussion it was brought out that a number of schools (Iowa State and Purdue being mentioned by name) are giving "problem courses" in which freshmen must solve actual engineering problems. The purpose is to give the beginners some comprehension of what an engineer actually does. At Purdue, next year, similar, but more advanced courses are to be given also to the three upper classes.

Under the topic, "Extension Work," Prof. E. D. Walker, of Pennsylvania State College, told about the expansion next fall of their extension work to include courses of collegiate grade. They are giving courses of elementary and vocational grades now to 7,000 students.

A symposium on selection and training of teachers failed to bring out any information of value.

Among the excellent papers were one by Prof. George F. Swain, of Harvard, pleading for the ideal of mental discipline rather than of culture; one by Prof. P. H. Daggett, on "Student Government at the University of North Carolina"; and one by Prof. J. W. Hallock on "Some Results of the Co-operative System," as exemplified by the experience of the University of Pittsburgh. Following Prof. Hallock's paper there was active discussion, all of it endorsing the co-operative plan. Dean Hughes stated that they were much encouraged by the first years' experience with it at Harvard.

Among miscellaneous announcements were the following: That the secretary's office would henceforth act as a clearing house for finding engineering teachers; that an association of deans and administrative officers of engineering colleges had been formed during the convention; and that the committee of institutional delegates had recommended a referendum on raising institutional dues from $10 to $25.

A committee on the licensing of engineers was created and the council was directed to arrange for carrying farther the inquiry into engineering education of which Dr. C. R. Mann's report formed an initial step.

The hospitality of Yale formed the subject of constant comment. The arrangements for the accommodation of the guests and for their entertainment left nothing to be desired. On the day following the convention the members were taken to New London on navy destroyers to inspect the submarine base and witness submarine manoeuvres, as guests of the Navy.

## Gulf Coast Bridge Renewal Held Up

In answer to a bill of complaint filed in the U. S. District Court at New Orleans by the Louisville & Nashville R.R., in which it was alleged that the railroad commission of Louisiana had issued an order some time ago directing the company to commence construction by June 30 of steel bridges across the Chief Menteur and Bigolets passes, the court, Judge Foster presiding, on June 27 issued a temporary order to the commission and the attorney general restraining them from proceeding against the railroad company until a final hearing has been had in the matter. The company declared in its bill of complaint that the present bridges are safe for all ordinary purposes, that the authority of the commission does not extend over navigable streams, and that the commission had no legal right to order the construction of the new bridges.

## Denver Commercial Association to Pick Water Consultant

A committee of five to seven Denver engineers, appointed by the Denver Civic and Commercial Association, is to recommend to the Denver Water Commission a nationally known waterworks consulting engineer. He is to study and report upon the needs of the plant and wisdom of voting funds. It is believed that such an examination would be a means of establishing confidence among the taxpayers. Because of the negative vote on a $5,000,000 bond issue recently the water problem at an early date will become acute from lack of conduit capacity. The commercial association wants early action.

## Engineers to Investigate Point Bridge at Pittsburgh

A board of engineers to investigate the safety and recommend as to repair or reconstruction of the Point bridge over the Monongahela River at Pittsburgh was appointed June 23 by Director of Public Works N. F. Brown. The board consists of John D. Stevenson, assistant chief engineer, division of bridges, Department of Public Works; T. J. Wilkerson, former chief engineer of the Penn Bridge Co.; and Charles S. Davis, former chief engineer of the Massillon Bridge Co. and recently designing engineer for the 40th St. bridge over the Allegheny River. The bridge is forty-four years old and has a main span of the eyebar suspension type 800 ft. long, with 20-ft. roadway. It was originally designed for a maximum live load of 1,600 lb. per lineal foot, but under present street-car and truck traffic, together with increased weight due to floor reconstruction in the amount of about 300 lb. per lineal foot, is considerably overloaded. The wrought-iron eyebars are stressed to between 13,000 and 16,000 lb. per square inch instead of 12,000.

CONDITIONS DANGEROUS

Mr. Stevenson reported on the condition of the bridge Nov. 19, 1920, and again on Feb. 7, 1921, giving an urgent warning that traffic over the structure should be reduced and repairs should be undertaken at an early date. He reported that failure of 6-in. I-beams of the floor system by crushing of the web constitute a particularly serious element of the situation, that the track rails are loose, that skid chains on heavy trucks crossing the bridge at speed produce very heavy impact, and that trucks up to 13 tons weight operate over the structure; further, that street cars are not spaced as far apart as had previously been agreed upon with the street railway (150 ft.).

As a present measure of safety, upon recommendation of Mr. Stevenson and Charles M. Reppert, chief engineer, Department of Public Works, traffic regulations have been put into effect on the bridge to reduce loads and minimize vibration: Gross weight of trucks limited to five tons; street cars to be spaced at least 150 ft.; skid chains on truck tires to be limited to 1-in. projection; speed of trucks in wet weather to be limited to 6 miles per hour for trucks of four tons or more; and car stops at both ends of the bridge to be made before the cars turn the curves of the approach.

## To Choose City Planning Expert

The City Planning Commission of Cincinnati, Ohio, has appointed a committee to recommend a city planning expert. The committee, which is to report by July 7, consists of Frank S. Krug, city engineer, Charles Meeds, engineer park board, Irwin Krohn, vice-president park board, and Charles S. Hornberger, director public service.

## Name Engineer Staff for Staten Island Tunnel

**Proposed Tubes Under New York Bay Would Carry Both Freight and Passengers**

Under the general direction of Arthur S. Tuttle, chief engineer of the Board of Estimate and Apportionment of New York City, an engineering staff is being organized for the project of constructing the railroad tunnel under New York Bay between Brooklyn and Staten Island, on which work is required by statute to begin within two years from May 12, 1921. In a communication to the Mayor, acting as chairman of the Board of Estimate, dated June 28, Mr. Tuttle recommended the appointment of Col. William J. Wilgus and Frederick C. Noble as consulting engineers, at salaries of $10,000 each, and Jesse B. Snow as tunnel engineer at a yearly salary of $12,000. If these recommended appointments are concurred in Mr. Snow, who is at present serving as principal assistant to Chief Engineer C. M. Holland on the Hudson River vehicular tunnels, will assume immediate charge of the engineering work of the Staten Island tunnel project.

Among others recommended for appointment on the proposed New York Harbor tunnel are Charles B. Drew, principal assistant engineer, at $7,500; W. McK. Griffin, resident engineer, at $5,000; and Albert E. Hill, designing engineer, at $5,000.

In naming the foregoing candidates Mr. Tuttle explains that he has "given the matter of selecting a staff for carrying out this important project careful consideration to the end that the best available talent may be secured, having in view rigid requirements as to trunk line railroad experience and shield and trench tunnel experience in the Harbor of New York, as well as personal qualifications."

At a recent date the Transit Construction commissioner was authorized to contract for borings along two alternate lines across the Narrows in connection with the preliminary studies incidental to the construction of the Staten Island extension of the City's rapid transit lines. In his report to the Board of Estimate on these projects, he estimated the cost of two tunnels for passenger traffic at the southerly crossing at $20,000,000, with an additional $7,000,000 for giving one of them a sectional area large enough for freight train use.

The project which a committee headed by Mr. Tuttle has in mind would necessitate, according to its report, the use of a much flatter gradient in order to adequately handle heavy freight traffic as compared with grades which would be suitable for rapid transit use. If a satisfactory route for this tunnel was provided it should be practicable, the committee believes, to use gradients for the rapid transit line where it crosses the Narrows which would also permit of the use of one of the tubes in this section for freight traffic pending the arrival of the time when both of these services reach a magnitude such as to require separation, and to thereby very substantially decrease the amount which would otherwise have to be expended for the construction of a tunnel for freight use only.

In order that the project may be put in some definite form before further commitments are made, and assuming that the present tenants of the Stapleton piers will be given all reasonable co-operation in securing such temporary rail connections as may be desired, the committee recommends that the presidents of the B. & O., Pennsylvania, and the Long Island railroads, these representing the railroad interests most directly related to the Stapleton and Jamaica Bay developments, be requested to confer with the Commissioner of Docks and a representative of the Board of Estimate for the purpose of determining the practicability of putting into effect a definite plan whereby the rail facilities proposed by the Commissioner of Docks at Stapleton, as well as the additional facilities proposed by the committee, may be made available, and also as to the terms under which these railroads, collectively or separately as the case may be, would co-operate with the city with respect to the financing and carrying out of such a project as may seem feasible.

## Atlantic and Hudson Waterways Association Meets

Fullest use of the New York State Barge Canal, as opposed to the St. Lawrence waterway project, was urged at the first convention of the Great Lakes, Hudson & Atlantic Waterways Association, held at Buffalo, June 29-30, 1921. Following addresses of Henry Moskowitz, chairman of the new association, and P. H. W. Ross, president, National Marine League, the convention was addressed by Charles L. Cadle, New York State superintendent of public works, and Frank M. Williams, state engineer. Other speakers included in the program were: S. Wallace Dempsey, chairman, Committee on Rivers and Harbors, House of Representatives; Albert E. Krell, president, Central Inland Waterways Association; S. A. Thompson, secretary, National Rivers and Harbors Congress; Murray Hulbert, commissioner of docks, city of New York; William Hill, president, New York State Waterways Association; John H. Small, president, National Rivers and Harbors Congress, and Edward S. Walsh, former superintendent of public works of the State of New York.

The view was freely expressed that freight traffic on the barge canal should be developed to the fullest extent, and that when the canal proves itself inadequate to handle business offered it would be proper only then to give serious consideration to the St. Lawrence waterways project.

## Concrete Bridge Contract Illegal

Franklin County (Ohio) authorities have ordered construction work on a concrete bridge over the Scioto River at Shadesville to be stopped and new bids to be called for. The accepted bid on which work has been preceding was for $317,000, but the county prosecutor found that the procedure was irregular in a variety of ways. The commissioners continued "the making of the contract a week or more after the bids were received," bids were advertised for and received in irregular manner, certification of the necessary funds by the county auditor was not made, public inspection of the official plans was not provided for as required by state law, and the commissioners decided in advance of preparation of plans that the bridge must be of reinforced concrete.

## Massive Concrete Unjustified, Says California Commission

To a published statement by the California State Automobile Association, seeking to justify its advocacy of more massive and costly concrete highway construction by reason of the presence in California of adobe and clay soils, the state highway commission has replied, pointing out that the motorists overlook the fact that while adverse frost conditions in the East are universal, adverse soils in California are found on a relatively small percentage of the total mileage. To design unduly expensive specifications for a larger part of the mileage to meet conditions on the smaller part of such mileage hardly appears to the commission like a business-like procedure.

"This is particularly so," the commission says, "when it is realized that thickness of surface slab in the East has not prevented failures there where highways have been built over adverse soils. In fact it is the failure of highways in the East, built under heavy slab specifications but where the foundation soil conditions have been unfavorable, that has turned the eyes of highway engineers away from the surface slab to the conditions that exist beneath the slab."

Answering complaints as to the width of California roads, the state highway commission asserts that the greater part of the mileage of State highways is today amply wide for the traffic it is required to serve. All paved roads are designed so that they can be widened when necessary without loss of the original investment. Certain trunk roads, it is admitted, now need widening, but the opposition of the auto clubs to the Morris bill, which proposed to make the nominal increase of $1 a year in motor vehicle fees on the average passenger car, but a very substantial increase of such fees on trucks, prevented the highway commission from getting sufficient revenue to do as much of this work as it had hoped to do.

## Highway Bill Goes to Senate

(Continued from p. 35)

argued, nvertheless, that the latter plan would not be practicable, since to raise the necessary amount by taxation would call for such a large levy that the people would not vote the tax.

The discussion in the Senate brought out that there is considerable opposition to any change in the existing law. It was declared that the existing law had worked out fairly well and that it would be better to let well enough alone than to embark upon a revolutionary system. The question also was raised as to whether it would be constitutional for the federal government to lay out a post road and then order the state to maintain it. The federal government, it was pointed out, does not build post-offices and then attempt to order the states to keep them in repair.

### Dowell Principles Discussed

The discussion of the Phipps-Dowell bill in the House developed the fact that there is an overwhelming majority in that body which is insistnt upon the Dowell principles, including compulsory maintenance. "The President has clearly indicated," said Representative Robsion, of Kentucky, "that he would not approve further appropriations for federal aid unless the state is made the unit in dealing with the federal government instead of the counties and unless the state would provide a fund for maintenance.

"The Townsend plan," continued Mr. Robsion, "contemplates just a few interstate roads. A commission in Washington lays out the system. This commission will disregard, in my judgment, the system of roads which has been laid out in each state. These systems have been partly built and contracts have been let for other portions. To cut down this system and destroy it after we have spent five years and millions of dollars in building it up would be next to a crime."

The principal obstacle to federal-aid legislation in the House has been Representative Dunn, of New York, the chairman of the committee on roads. In the course of the debate on the House bill, he said: "This is not a proper time to pass this bill. I have been against it from the start. I never thought the existing law was a square deal. The Middle states and the Eastern states pay from two to four times as much as do other states. The bill should be a 50-50 proposition, or the amount should be pro-rated according to assessed valuation instead of according to area.

"It seems singular to me that this bill should be taken up at this extra session, when we should be so busy with other matters. There still remains $150,000,000 in the hands of the Secretary of Agriculture to be met by appropriations of $200,000,000 for the separate states. In these times of financial stringency $350,000,000 is a goodly sum for this country to spend on roads during the next year or two. Under present conditions, the states have about as much as they can do to maintain the roads they already have built."

Texas is one of the seventeen states whose constitution would have to be changed to meet the provisions in the Dowell bill. Representative Rayburn, of that state, declared that the bill is most vicious. "I am getting sick and tired," he said, "of the federal government's everlastingly sticking its hands into the affairs of my state. I am against any building up of more bureaus in Washington to reach out into the states and tell the people what they shall and what they shall not do."

## I. C. C. Completes Valuation Field Work in Eastern District

Engineering field work of the Eastern District, Bureau of Valuation, Interstate Commerce Commission, has been completed, including 43,000 miles of steam railroads, with a total track mileage of 82,590 mile and 50,000 miles of telegraph lines. The district comprises the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, West Virginia, Virginia, and North Carolina. With allowance for the time during which forces were not maintained during the war years of 1917 and 1918, the work was accomplished by twelve full roadway field parties in a net time of five years.

The field party work was begun on Feb. 26, 1914, and completed on June 30, 1921. The district field organization included twelve roadway parties, but this force was not maintained during the war years of 1917 and 1918, due to the fact that the Bureau released over 600 engineers for military and naval service, of which the Eastern District contributed a due proportion. The record shows that the work was in progress about seven years, but after making due allowance for vacancies which existed during the war, and the lesser number of parties in use during the organization and demobilization periods, it appears that the field party work in the Eastern District was completed in five years. This estimate is based upon an average of twelve full roadway field parties.

The field work having been completed, the Eastern District is now concentrating all of its engineering force on the preparation of the reports showing the cost of reproduction new and cost of reproduction less depreciation.

## Abolish Delaware Toll Bridges

Two more bridges across the Delaware River, connecting Pennsylvania and New Jersey, were purchased by the special interstate commission charged with abolishing toll bridges across this stream at its last session. Orders were issued to the engineers of the commission to make a survey of the eleven remaining toll bridges and furnish estimates of the cost.

## I. C. C. Issues More Supplemental Valuation Reports

Fifty more "supplemental" tentative valuations and twenty-five new tentative valuations have been issued by the Interstate Commerce Commission. All contain reports of present cost of condemnation and damages in excess of "present value" of lands, as required by the decision in the Kansas City Southern case, and a single figure as "final value."

The first "supplemental" reports were issued on four properties, including the Kansas City Southern, April 5, as reported in *Engineering News-Record*, April 21, 1921, p. 686. These reports cover properties for which tentative valuations already have been served and include, in addition to the original tentative reports, a statement of the original and present costs of condemnation and damages of lands in excess of "present value" and also the statement of a single sum as "final value." Most of the properties now reported upon are small, but included in the supplemental reports are the Elgin, Joliet & Eastern Ry. Co., the Norfolk Southern R.R. Co., the Georgia Southern & Florida Ry. Co.

### Texas Midland Case

A supplemental report is also issued covering the Texas Midland R.R. This was the first property on which a tentative valuation was reported including a single sum as "final value." At that time, however, previous to the Supreme Court decision in the Kansas City Southern case, present cost of condemnation and damages of lands was not included. This item is now included as $268,734 and "final value" is now reported as $3,096,851. According to a previous computation of final value by Director Prouty, of the Bureau of Valuation, using his formula of value, the final figure for the Texas Midland was $3,323,038. As in the case of all of the reports now issued, no statement is included defining the method used in arriving at final figures of value.

The twenty-five tentative valuation reports now issued are the first original tentative valuations to include single sums as "final value" and a separate statement of the cost of condemnation and damages in acquiring carrier lands. While no statement is included of methods employed in arriving at the single sums named as final value, in all cases the method used to determine excess cost of acquiring land is stated as the same as used in the case of the Kansas City Southern, which was included among the four properties on which "supplemental" reports were issued April 5, 1921. Most of the twenty-five properties on which original tentative valuations are now served are small. However, the Central of Georgia Ry. Co. is included in the reports, and the "final value" of all of the property that it uses and owns for purposes of transportation is reported as $79,083,523 and owned but not used, $64,231,034.

### Road Tax Receipts in Britain

The taxes collected from mechanically propelled vehicles up to May 31, to contribute toward road maintenance, are:

| Vehicle | Number of Licenses | Tax Receipts |
|---|---|---|
| Private cars..... | 226,000 | £3,570,000 |
| Motor cycles..... | 370,000 | 760,000 |
| Invalid vehicles.... | 240 | 60 |
| Commercial cars... | 120,000 | 2,400,000 |
| Road locomotives... | 2,900 | 58,000 |
| Motor plows, etc.... | 10,160 | 2,540 |
| Motor tractors ..... | 1,400 | 19,000 |
| Motor hackneys.... | 96,500 | 1,530,000 |
| Tramcars ..... | 15,200 | 11,400 |

Of the total receipts of £8,750,000, England and Wales contributed £7,922,650, Scotland £811,250, and Ireland £16,100. It was not found possible to begin collection in Ireland until toward the end of the period under review.

## Engineering Societies

**The Engineers' Association of Fairfield County, Conn.,** at its fifth annual dinner, June 2, was addressed by Nelson P. Lewis, formerly chief engineer Board of Estimate and Apportionment, New York, on "Scientific City Planning." The other speakers were F. B. Bartram, president, Stamford (Conn.) Chamber of Commerce, on "Stamford's Future Possibilities in Industries," and Rev. A. G. Walton on "Engineers as Influential Citizens."

## Personal Notes

L. K. Sherman, vice-president of the Edmund T. Perkins Engineering Co. prior to the death of Edmund T. Perkins who was president of the company, has been made its chief enginer.

John J. Swan, formerly with the Prest-O-Lite Co., Indianapolis, Ind., has become associated with the Engineering Business Exchange, New York. He was graduated from Cornell in 1897 and was, for a time, associate editor of *Engineering News*. He later held executive positions with industrial companies among which were the Ingersoll-Rand Co., the Longmead Iron Co., the Chicago Pneumatic Tool Co., Keller Mfg. Co., and the American Arms Corp. During the war he was a member of the committee in the adjutant-general's office in charge of the classification of the personnel of the army and was commissioned a lieutenant-colonel.

Eugene E. Haskell has retired as dean of civil engineering, Cornell University. Dean Haskell is a graduate of Cornell University, C. E. in 1879 and M.C.E. in 1890, and was at the head of the college of civil engineering since 1906. Prior to this date he was in government service in the Mississippi River Commission work and in the U. S. Coast and Geodetic Survey, during which time he invented the Haskell current meter. From 1893 to 1906 he was engaged in reorganizing and directing the U. S. Hydrographic Survey of the Great Lakes Basin. During his connection with Cornell he was appointed by President Roosevelt as one of the three members of the American Section of the International Water Ways Commission. In 1915 he was appointed by the Dominion of Canada as one of the engineers of the Montreal Water Levels Commission. He is also a member of the board of consulting engineers of the New York State Barge Canal. Dean Haskell, during his sabbatic leave this year, was succeeded by Prof. Fred A. Barnes, C.E., M.C.E., Cornell, '97.

Albert J. Mantica, formerly designing engineer with the Compania General de Construcoes, Lisbon, Portugal, agents of the Truscon Steel Co., Youngstown, Ohio, is now sales engineer with the Truscon Steel Co.

Erwin Dames, with Benham & Mullergren, consulting engineers, Kansas City, Mo., has been made resident engineer for the firm at Duncan, Okla., where pavement and water-works improvements costing about $1,000,000 will be installed.

M. C. Welborn, division engineer with the Texas State Highway Department, has resigned to become city engineer of Paris, Tex.

P. S. Gardiner, Eastmen-Gardiner & Co., Laurel, Miss., who has been vice-president of the Southern Pine Association, New Orleans, for five years, has been elected president, succeeding A. L. Clark, Dallas, Tex., resigned. Mr. Clark continues as director representing Florida.

W. J. King of Oswego, Kan., has resigned as county engineer, Labette County and has taken a position as engineer for M. E. Gillioz, Monett, Mo.

Arthur J. Turner, for the past two years chief engineer for the Columbia Basin survey commission of the State of Washington, resigned that office June 1 to become superintendent of construction on the Skagit River power project being carried out by the City of Seattle. C. F. Uhden, chief engineer of the Skagit project, and Mr. Turner held the same relative positions for the Washington Water Power Co. during the construction of the Long Lake dam and power plant and they have gathered together on the Skagit project a considerable number of the same staff that worked together at Long Lake.

Ivan E. Goodner succeeds A. J. Turner as chief engineer of the Columbia Basin project. Mr. Goodner has been office engineer for the Columbia Basin Commission since its organization.

Almirall & Co., Inc., constructing engineers, announce that E. W. Verity, Jr., has been appointed construction manager with headquarters at New York, and that Carl H. Sanborn has been appointed New England representative with headquarters at Boston, Mass.

C. E. Davies has been appointed managing editor of the American Society of Mechanical Engineers' publication *Mechanical Engineering* to succeed the late L. G. French. He was graduated from Rensselaer Polytechnic Institute with the degree of M.E. and then, for several years, specialized in industrial management work. He has been an associate editor on the society's journal since March, 1920.

## Obituary

John F. Wallace, consulting engineer, New York, past-president of the American Society of Civil Engineers, chairman of the Chicago Railway Terminal Commission, chairman of the board, Westinghouse, Church, Kerr & Co., New York, and formerly chief engineer of the Panama Canal Commission, died in Washington, D. C., July 3. Next week's issue will contain a more extended statement of Mr. Wallace's activities in the engineering fiield.

S. T. Morse, consulting engineer, and formerly city engineer of Carlinville, Ill., was killed in an automobile accident on June 3.

Daniel W. Maher, engineer and contractor, secretary of the Marquette Construction Co., Chicago, died June 20.

## Business Notes

The Brown Hoisting Machinery Co., Cleveland, Ohio, has opened an office in New Orleans, La., with Charles H. White as manager.

Leslie H. Allen, formerly with Fred T. Ley & Co., contractors, Springfield, Mass., as sales manager of the New England territory, has been appointed assistant manager of the Cement Products Bureau of the Portland Cement Association.

The Link-Belt Co., Chicago, Ill., has acquired all of the capital stock of the H. W. Caldwell & Son Co.; Frank C. Caldwell has been elected a director of the Link-Belt Co.

A. E. Schroder has been appointed branch manager of the Toledo, Ohio, office of the Truscon Steel Co., to succeed B. E. Bowlus, who has been made a special representative of the cash sales department at the Youngstown, Ohio, office.

John A. Conboy Co., a new sales organization handling contractor's railroad, mine and industrial machinery and equipment, have opened offices in Philadelphia, Pa.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Civil Suit Filed Against Cement Manufacturers Association

A complaint in equity has been filed in the Federal Court for the Southern District of New York by Col. William Hayward, United States attorney, asking for the dissolution of the Cement Manufacturers Protective Association, the nineteen members of which in the Northeast are said to manufacture approximately 90 per cent of the cement produced in this territory. The civil suit supplements criminal indictments returned March 1 charging violation of the Sherman Anti-Trust Law against 116 cement manufacturer defendants. The criminal indictment was an outgrowth of the investigations made by the Lockwood joint legislative committee on housing.

In addition to the nineteen firms, four individuals who are officers of the Cement Manufacturers Protective Association are named in the civil suit. The defendant officers are E. T. Alker, president; C. Raymond Hulsart, vice-president; Miss M. B. Phalen, secretary, and Marion S. Ackerman, treasurer.

The civil suit is the first brought in the name of Attorney-General Daugherty to test the legality of the open-price associations whose members are alleged by the government to fix future prices unlawfully under the guise of discussing current prices, the latter being permitted by law.

The government, in the complaint, prays the court perpetually to enjoin the defendants from continuing the alleged combination and conspiracy. The defendants are given twenty days from date of service of the complaint in which to file an answer.

The cement manufacturers named in the complaint are the Atlas, Allentown, Alpha, Bath, Copley, Dexter, Edison, Giant, Glenns Falls, Hercules, Knickerbocker, Lawrence, Lehigh, Nazareth, Penn-Allen, Pennsylvania, Phoenix, Vulcanite, and the Security Cement & Lime Co.

The Cement Manufacturers Protective Association is an unincorporated body which was organized at the Engineers Club in New York City, Jan. 6, 1916.

## Lumber From Northwest Going to Atlantic Coast

During the first quarter of 1921, 42,500,000 ft. b.m. of lumber was shipped from the Pacific Northwest to the Atlantic Coast, as against 1,200,000 ft. b.m. for the corresponding quarter of 1920. Shipments to Europe dropped from 24,000,000 ft. b.m. to 16,300,000 ft. b.m. The east coast of South America got 600,000 ft. b.m. in 1921 and none in 1920. The figures were compiled by the Pacific Lumber Inspection Bureau at Seattle.

## Contracts Let for First Six Months of 1921 Have Total Value of $579,249,777

### This Year's Contracts Exceed Those of 1920 in Street and Road, and Public Works Construction

The total value of all contracts let during the first six months of 1921, as reported in *Engineering News-Record*, is $579,249,777. No residential building is included in these figures, nor housing, except that classified as industrial, and apartments. Although this figure represents but 60 per cent of the total value of contracts let during the corresponding period of 1920, 1921 has exceeded 1920 in public works construction and street and highway building. One of the most remarkable facts to be noted in connection with an analysis of contracts let is the tremendous activity in street and highway work for the first six months of 1921. The total value of contracts let in this class of the two years approximately on a parity.

In public works constructon the value of contracts let during 1921 is more than 40 per cent in excess of the value of 1920 contracts, the respective figures being: 1921, $33,500,000; and 1920, $23,000,000.

Attention is also called to the steadiness of the contract values for the months of 1921 as compared to 1920. It is seen that June, 1921, returned the greatest contract value of the six months' period, whereas during 1920 April was the big month, with June the smallest.

The greatest disparity in the two years in the value of contracts let is

CONTRACTS LET FOR FIRST SIX MONTHS OF 1920

| | January | February | March | April | May | June | Total |
|---|---|---|---|---|---|---|---|
| Waterworks | 1,143,777 | 2,171,725 | 2,213,262 | 2,719,021 | 1,381,655 | 1,460,501 | 11,089,941 |
| Sewers | 1,563,840 | 622,874 | 1,283,227 | 4,123,907 | 2,314,874 | 2,348,517 | 12,557,239 |
| Bridges | 2,021,553 | 2,137,393 | 2,238,661 | 5,586,877 | 5,363,709 | 3,185,682 | 20,533,875 |
| Streets and roads | 12,203,970 | 21,334,013 | 26,220,967 | 33,340,330 | 30,257,872 | 31,441,154 | 154,798,306 |
| Earthwork | 1,541,576 | 786,943 | 3,151,151 | 415,512 | 403,705 | 604,585 | 6,903,472 |
| Industrial | 56,041,047 | 63,262,290 | 48,861,832 | 65,879,005 | 39,661,869 | 40,453,500 | 314,159,543 |
| Buildings | 87,095,987 | 52,200,466 | 47,541,078 | 90,776,835 | 70,946,738 | 31,271,042 | 379,832,146 |
| Federal Gov't | 4,980,945 | 2,282,373 | 1,483,605 | 4,124,269 | 1,167,045 | 2,625,739 | 16,663,976 |
| Miscellaneous | 8,256,071 | 3,466,519 | 15,129,378 | 9,602,630 | 14,373,320 | 1,319,441 | 52,147,359 |
| Totals | 175,148,766 | 148,264,596 | 148,123,161 | 216,568,386 | 165,870,787 | 114,710,161 | 968,685,857 |

CONTRACTS LET FOR FIRST SIX MONTHS OF 1921

| | January | February | March | April | May | June | Total |
|---|---|---|---|---|---|---|---|
| Waterworks | 519,028 | 2,927,307 | 2,028,055 | 3,342,150 | 4,943,562 | 3,494,584 | 15,254,686 |
| Sewers | 3,140,448 | 2,445,075 | 2,862,131 | 3,817,401 | 2,162,460 | 3,802,040 | 18,230,055 |
| Bridges | 3,030,477 | 885,529 | 1,443,060 | 1,987,808 | 1,642,894 | 2,417,632 | 11,407,400 |
| Streets and roads | 11,597,810 | 12,049,344 | 25,880,109 | 31,026,312 | 35,064,031 | 56,772,257 | 172,389,863 |
| Earthwork | 1,266,346 | 305,740 | 1,625,690 | 580,039 | 2,631,799 | 1,240,398 | 7,650,012 |
| Industrial | 12,881,405 | 4,737,850 | 15,032,130 | 9,346,586 | 7,799,584 | 6,111,307 | 55,909,425 |
| Buildings | 17,455,673 | 31,902,608 | 56,520,231 | 51,647,900 | 48,442,471 | 56,576,768 | 262,545,651 |
| Federal Gov't | 2,071,141 | 1,574,927 | 3,590,617 | 1,186,403 | 1,809,588 | 4,158,430 | 14,391,106 |
| Miscellaneous | 2,358,976 | 1,728,441 | 4,231,823 | 2,732,799 | 4,408,142 | 6,005,398 | 21,465,579 |
| Totals | 54,328,367 | 56,556,821 | 113,213,846 | 105,667,398 | 108,904,531 | 140,578,814 | 579,249,777 |

construction is in excess of $172,000,000, or $18,000,000 more than for the corresponding period of 1920. In comparing these figures—those of 1920 and those of 1921—no account is taken of the decreased cost of construction that has occurred within the past year owing to a decline in material and other costs. Were that differential applied, the total value of the 1921 contracts would be in the neighborhood of $700,000,000.

Another notable feature of the accompanying tables is the fact that during June, 1921, the total value of contracts let exceeded the value of contracts let in June, 1920, by about $26,000,000, the respective figures being 1921, $140,578,814, and 1920, $114,710,161.

It may also be noted that, excluding industrial construction from the total figures for the two years, the 1921 contract value is approximately 80 per cent of the 1920 contract value, again taking no account of the decreased cost of construction which if included would put the contract values of seen to be in industrial work. So far this year industrial work has been extremely quiet, the total value of contracts being approximately $56,000,000 as compared to $314,000,000 during 1920.

Due to the fact that *Engineering News-Record* is receiving news daily of many projects which are either in the proposed stage or upon which bids will soon be received, it is quite likely that both public works construction and street and road work will continue very active in the coming months.

## West Coast Lumber Production

For the week ended June 18, 113 mills in western Oregon and western Washington reported a production to the West Coast Lumbermen's Association of 59,000,000 ft.bm., which is 29 per cent below normal. New business totaled 63,000,000 ft.bm. and shipments 60,000,000 ft.bm. In the cargo trade domestic orders totaled 5,000,000 ft.bm. and export shipments 7,000,000 ft.bm.

### Number Idle Freight Cars Declines

The number of surplus or idle freight rs on the railroads of the country ntinue to decline according to re- rts just received from the carriers the car service division of the nerican Railway Association. These ow that on June 23 there were 377,- 0 cars in excess of current freight quirements or a reduction of 3,896 rs compared with the total on June 15. Surplus box cars totaled 140,627 or decrease of 3,308 in approximately a ek while surplus coal cars numbered 3,982. The latter figure is an in- ease of approximately 4,500 over that eady reported for June 15 but this due principally to a correction that d to be made in the earlier figures sulting from a mistake made by one the large carriers in its report. Reports also showed an increased mand for other classes of freight rs. From June 15 to June 23, sur- us automobile and furniture cars clined approximately 460, flat cars 3 and stock cars 1,140.

### Average Price of Brick Declines $1 During May

As an indication of the price trend, the average price of brick per thousand fell from $16.11 for the May 1 price to $15.14 for that of June 1, says the June digest of the Common Brick Manufacturers Association. This composite price is not the actual price in any market, but is the average taken from the reports of 97 plants. There were fewer plants closed by sixteen than were closed when the previous month's report was compiled. The lowest plant price quoted in the June digest is $10 per thousand for the Southeastern states.

### Pennsylvania Months Ahead of 1920 in Road Building

The Pennsylvania State Highway Department so far in 1921 has finished forty-six road construction projects, involving a total of 169 miles. Up until June 28, the department in 1921 had completed 207 miles of durable thoroughfare, a total not reached in 1920 until mid-September.

### House Fixes Duty on Cement and Structural Steel

Portland, Roman and other hydraulic cement is made dutiable at 5c. per 100 lb., in the tariff bill reported June 30 by the committee on ways and means of the House of Representatives. That rate of duty is to apply when the cement is in barrels, sacks or other packages and the weight of the container is to be included in the weight on which the duty is assessed. When the cement is in bulk, the rate of duty recommended is 4c. per 100 lb. Other types of cement are to be dutiable at 17 per cent ad valorem.

Freestone, granite, sandstone, limestone, lava and all other stone suitable for monumental or building purposes are made dutiable in the bill at 40 per cent ad valorem. When such stone is not dressed, hewn or polished, the duty recommended is 15c. per cubic foot.

The paragraph in the bill applying to structural iron and steel reads as follows:

"Beams, girders, joists, angles, channels, cartruck channels, tees, col-

# Labor Rates and Conditions Throughout the Country

THE PRINCIPAL varified adjustments in labor rates shown in the ular monthly tabulation on this page for Pittsburgh, Minneapolis, Seattle Kansas City. Labor is plentiful in meapolis, but, although $1 per hour he rate for bricklayers as set May y the employers, $1.12½ is being paid ier generally. On the other hand, ough the rate for carpenters in this is 80c., they are reported to be king for as low as 70c. to 75c. The dard rate for common labor is 50c., this is not constant, wages going ow as 40c. an hour in some cases. the July 1 schedule just issued by the building trades of Pittsburgh, bricklayers are listed at $1.12½ as against $1.50, the old rate. Carpenters, structural iron-workers and hoisting engineers are rated at $1, whereas the former rates were $1.25 for carpenters, $1.12½ for hoisting engineers and $1.25 for iron-workers. The former rate for laborers was 80c., whereas now no rate is given, indicating that the market is open. Denver reports that carpenters and painters have accepted the Industrial Commission wage award of $1 per hour, thus ending a controversy that has lasted several months. On the whole, conditions show a decided improvement in Denver. The Seattle rates are those paid by the Master Builders' Association, which handles nearly all construction in Seattle and the Puget Sound district. The association employs only non-union men, and the union scale is approximately 10 per cent higher than the figures shown. All classes of labor are plentiful in this city. For Kansas City we show the rate for bricklayers and structural iron-workers $1.07½ per hour, as against $1.12½ and $1.10 respectively. The present rate for hod-carriers is 80c., against 90c. previously. Common labor is 70c., as against 75c.

S means scarce, E, enough, P, plentiful—Higher rates indicated by +, decreases by—

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| nta | $0.60P | $0.70P | $1.00P | $0.30P | ..... | $1.00P | $0.25P |
| more | 1.25P | .80P | .87½P | .54P | $0.74P | 1.00P | .35P |
| mingham | 1.00 | .87½ | ..... | .25@.40 | ..... | 1.00 | .20@.25 |
| on | .90 | .90P | .90P | .60P | .90P | .90P | .55P |
| innati | 1.25P | 1.00P | .70E | .85P | 1.00E | 1.25P | .35@.40 |
| ago | 1.25 | 1.25 | ..... | ..... | ..... | 1.25 | 1.00 |
| eland | 1.25P | 1.25P | 1.25P | .87½P | 1.10P | 1.25P | .87½P |
| as | 1.00P | 1.00P | 1.00E | .60E | 1.00E | 1.00E | .50@.75P |
| ver | 1.37½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | .37½@.50 |
| oit | 1.00P | .80P | .80@.90P | .50@.60P | 1.00P | .60@.80P | .50P |
| sas City | —1.07½ | 1.00 | 1.00 | —.80 | —1.07½ | 1.07½ | —.70 |
| Angeles | 1.25P | 1.00P | 1.00P | 1.12½P | 1.00P | 1.00P | .75P |
| neapolis | 1.00P | .80P | .80P | .65P | ..... | .80P | .50P |
| real | .90P | .65P | .60P | .35P | ..... | .65P | .30P |
| Orleans | 1.00P | —.88P | —.85P | —.40P | 1.00P | 1.00P | —.30P |
| York | 1.25 | 1.12½ | 1.25 | .87½ | 1.12½ | 1.12½ | .75@.80 |
| burgh | —1.12½P | 1.00P | —1.00P | —.80P | ..... | —1.00P | Open |
| uis | 1.25P | 1.25P | 1.25P | .85P | 1.25P | 1.25P | .67½P |
| Francisco | 1.25P | 1.12½P | 1.12½P | 1.00P | 1.12½P | 1.12½P | .81¼P |
| tle | 1.00P | .80P | .80P | .70P | 1.00P | .87½P | .50P |

umns and posts, or parts or sections of columns and posts, deck and bulb beams, and building forms, together with all other structural shapes of iron or steel, not assembled, manufactured, or advanced beyond hammering, rolling, or casting, seven-twentieths of 1c. per pound; any of the foregoing if machined, drilled, punched, assembled, fitted, fabricated for use, or otherwise advanced beyond hammering, rolling, or casting, 25 per centum ad valorem."

## Bethlehem Reduces Steel Prices

The Bethlehem Steel Co., which recently announced a 15 per cent reduction in wages for July 16, has now reduced its schedule of prices, as follows: Bars, from $2.10 to $1.90; structural shapes and plates, from $2.20 to $2; sheet bar, from $39 to $35; billets, 4 x 4, from $37 to $33; slabs, from $38 to $34; blue annealed sheets, from $2.85 to $2.65; black sheets, from $3.75 to $3.50; galvanized sheets, from $4.75 to $4.50; tin plate, from $6.25 to $5.75; skelp, from $2.20 to $2. This is a reduction of $4 per ton on bars, structural shapes, plates, skelp, billets, sheet bar, slabs and blue annealed sheets, and a $5 per ton reduction on black and galvanized sheets.

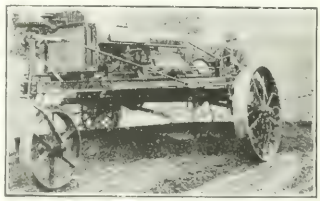
In making the announcement, E. G. Grace, president of the company, states: "Present manufacturing costs do not in any sense warrant these reductions, but this company desires to contribute even more than its full share to re-establish conditions in the steel trade on what might be regarded as a normal basis. The increase in freight rates has been the largest factor in increasing the cost of manufacturing steel products, because making a ton of finished steel involves transportation of more than five tons of raw materials. The cost factors next in importance are materials and labor."

## Unemployment in New York Decreases

The ratio of workers seeking employment to each 100 places open was 135 in April, according to the tabulation of the April reports from the offices of the New York State Employment Bureau. The ratios for recent months were 145 for March, 169 for February, and 169 for January. These ratios indicate January and February as the months of greatest unemployment, and that unemployment decreased materially from these months to the end of April. The reduction in unemployment was due to the usual seasonal activities.

## A New Road Blade-Grader

The Avery Co., Peoria, Ill., has recently put upon the market a one-man road maintainer in the form of a tractor-operated blade-grader, as shown in the accompanying photograph. The operator, sitting at the rear of the tractor, with the blade in front of and



NEW ONE-MAN ROAD GRADER

below him, can see the work done by the machine. The blade attachment, 12 ft. long, consists of three sections and is adjustable both to the curvature of the road and the depths of cut. The tractor is equipped with a six-cylinder motor and three-speed transmission.

## Southern Pine Shipments and Demand Exceed Production

May shipments of Southern pine were 108 per cent of production, and May demand 101 per cent of production, says the monthly trade barometer of the Southern Pine Association. The production for the month was 80 per cent of normal with 191 subscribers' mills reporting. Orders for the month of May were—137 mills reporting—84 per cent of normal, and shipments for the month were 86½ per cent of normal. The stocks on hand as of May 1 amounted to 1,260,900,005 ft.bm. The May cut was 389,744,552 ft.bm. and the May shipments, 420,662,930 ft.bm., with 191 subscriber mills reporting. The stocks on hand May 3 were 1,229,981,627 ft.bm.

## Building in New York City

The estimated cost of building operations authorized in the ten chief cities of New York State increased from $32,235,467 in March to $34,900,309 in April, a gain of 8 per cent, says the *Labor Market Bulletin*, published by the bureau of statistics and information of the New York State Industrial Commission. The April amount, however, was 26 per cent below that reported in the same month a year ago. The total estimated value of building work authorized in the period from January to April of 1921 was $106,259,094 compared with $136,291,432—28 per cent more—reported in the first four months in 1920.

The gain in building activity in April, contrary to the tendency of the preceding three months, was mostly in up-state cities. Every up-state city showed an increase in the estimated value of prospective building work, the increase ranging from 8 per cent in Rochester to 99 per cent in Troy. The New York City gain was 5 per cent.

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Pig Iron**—Owing to slackness of the market, prices are useful only as a guide. They are generally lower than a month ago, and sales have been made on small lots at even lower prices than we quote. For example, although our price is $24.96 per ton for No. 2 foundry, Valley furnace, it is reported that small sales have been made at $21.

**Railway Materials**—No change in price of standard rails and although new light rails are held at $2.10 per 100 lb., light rails rolled from old rails have been available at $1.80. Track supplies are weaker, standard spikes being obtainable at as low as $3.25 per 100 lb., and track bolts at $4. Cross-ties are the same price in St. Louis, but are down 10c. per tie in Chicago.

**Pipe**—No changes on steel pipe. Cast-iron pipe down in New York, Birmingham, Chicago, St. Louis, and San Francisco. Sewer pipe down in St. Louis.

**Road Materials**—Very few changes since last month. Asphalt slightly cheaper in Atlanta and down $5 per ton in Cincinnati. Paving stone is being shaded slightly in Cincinnati. Wood blocks were not quoted in Minneapolis last month but the latest sale to the city was at $2.37 per sq.yd.

**Sand, Gravel and Crushed Stone**—Sand and gravel down in Cincinnati, Atlanta and Detroit, and sand down 30c. in New Orleans. Crushed stone down 25c. in Atlanta.

**Lime**—Hydrated down in Cincinnati and Atlanta, while lump is reported to have advanced slightly in those cities.

**Cement**—Nothing to report.

**Common Brick and Hollow Tile**—Market slightly firmer in New York, although delivered price remains the same. Price slightly weaker in Minneapolis and down in Boston, Dallas, Kansas City, Seattle, Detroit and Atlanta. Hollow tile down in New York and Chicago, Seattle.

**Roofing Materials**—Prepared roofing are down 8 to 25c. Asphalt felt and tar pitch are also cheaper.

**Steel**—The price reductions announced by the Bethlehem Steel Co., effective July 5, are given in detail elsewhere in this section. The United States Steel Corporation advises of no revision in their schedule at present. Dealers have decreased warehouse prices a week ago.

**Lumber**—The base wholesale price of Southern pine in New York is now $45 per 1,000 ft., b.m., the carload price to contractors being about $5 higher. Fir and hemlock down in Boston; fir down in Denver and Seattle. General reduction in Minneapolis

Price advances since last month are indicated by **heavy type**; declines by *italics*

**G IRON**—Quotations compiled by The Matthew Addy Co.:

| | Current | One Year Ago |
|---|---|---|
| **NCINNATI** | | |
| No. 2 Southern (silicon 2.25 @ 2.75) | $35.80 | $45 80 |
| Northern Basic | 25.50 | 42 60 |
| Southern Ohio No. 2 (silicon 1.75 @ 2.25) | 25.52 | 46 80 |
| **EW YORK, tidewater delivery** | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | 32.26 | 49 70 |
| **IRMINGHAM** | | |
| No. 2 Foundry (silicon 2.25 @ 2.75) | 22.00 | 42 00 |
| **HILADELPHIA** | | |
| Eastern Pa., No. 2X, (2.25@2.75 sil.) | 26.26 | 46.00* |
| Virginia No. 2 (silicon 2.25 @ 2.75) | 27.00* | 45.00* |
| Basic | 25.00† | 44.50† |
| Grey Forge | 24.40 | 43 50* |
| **HICAGO** | | |
| No. 2 Foundry Local (silicon 1.75 @ 2.25) | 28.00 | 43 00 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | 28.67 | 47.00 |
| **TTSBURGH, including freight charge from the Valley** | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | 24.96 | 45 65 |
| Basic | 23.46 | 44 40 |
| Bessemer | 24.96 | 44 90 |

*F.o.b. furnace. † Delivered.

## RAILWAY SUPPLIES

**EEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and icago for carload or larger lots. For less than carload lots 5c. per 100 lb. is rged extra:

| | Pittsburgh | | Birmingham | Chicago |
|---|---|---|---|---|
| | Current | One Year Ago | | |
| ndard bessemer rails | $45.00 | $45.00 @ 60.00 | | $45 00 |
| ndard openhearth rails | 47.00 | 47.00 @ 60.00 | $47 50 | 47 00 |
| ht rails, 8 to 10 lb | 2.30@2.30* | 2.58@ 3.75 | | 2.45@3.00* |
| ht rails, 12 to 14 lb | 2.15@2.25* | 2.54@ 3.75 | 2.20* | 2.41@2.95* |
| ht rails, 25 to 45 lb | 2.10@2.20* | 2.45*@ 3.75 | 2.20* | 2.32@2.85* |

Per 100 lb.

**ILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8½ Ft. | 7 In. x 9 In. by 8 Ft. 6 In. |
|---|---|---|
| cago, White Oak | $1.85@$1.40 | $1.45@$1.50 |
| cago, Hardwood and Red Oak | 1.25@1.30 | 1.20@1.45 |
| cago, Empty Cell Creosoting (add'l) | 45 | 50 |
| Francisco, Green Douglas Fir | 80 | 1.12 |
| Francisco, Empty Cell Creosoted, Douglas Fir | 1.76 | 2.48 |

ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pine and Cap Cypress |
|---|---|---|---|
| de 3 | $1.35 | $1 20 | $1 10 |
| de 2 | 1.25 | 1.10 | 1 00 |
| de 1 | 1.15 | 1.00 | 90 |

**RACK SUPPLIES**—The following prices are base per 100 lb. f.o.b. Pittsgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh | | | | San Fran- |
|---|---|---|---|---|---|
| | Current | One Year Ago | Chicago | St. Louis | cisco |
| ndard spikes, ½-in. and rger | $3.35@$3.40 | $4.00 | $3.40 | $3.50 | $5.20 |
| ck bolts | 4.00@4.35 | 6.00@6.50 | 4.60 | 5.60 | 6.65 |
| ndard section angle bars | 2.50 | 3.00@4.00 | 2.75 | 3.25 | 4.50 |

| | BUTT WELD, EXTRA STRONG, PLAIN ENDS | | | |
|---|---|---|---|---|
| 1 to 1½ | 60½ | 49 | 1 to 1¾ | 35½ | 21½ |
| 2 to 3 | 61½ | 50 | | | |

| | LAP WELD, EXTRA STRONG, PLAIN ENDS | | | |
|---|---|---|---|---|
| 2 | 52½ | 41 | 2 | 31½ | 18½ |
| 2½ to 4 | 56½ | 45 | 2½ to 4 | 34½ | 22½ |
| 4½ to 6 | 55½ | 44 | 4½ to 6 | 33½ | 21½ |
| 7 to 8 | 50½ | 37 | 7 to 8 | 24½ | 12½ |
| 9 to 12 | 45½ | 32 | 9 to 12 | 19½ | 7½ |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | 54% | 62½% | 50½% |
| 3½ to 6 in. lap welded | 49% | 58½% | 46½% |

| | Galvanized | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | 40% | 50% | 36½% |
| 3½ to 6 in. lap welded | 35% | 46% | 32½% |

Malleable fittings, Class B and C, from New York stock sell at net list prices. Cast iron, standard sizes, 20—5% off

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York | | | | | |
|---|---|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
| 4 in. | 53.30 | $79 30 | 50.00 | 53.10 | $75 00 | $85.00 |
| 6 in. and over | 48.30 | 76 30 | 45.00 | 54.10 | 75 00 | 80.00 |

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton

**CLAY DRAIN TILE**—The following prices are per 1000 lin. ft.

| | New York | | | | | |
|---|---|---|---|---|---|---|
| Size, In. | Current | One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
| 3 | $50 00 | $35 00 | $60 00 | $50 00 | | $55 00 |
| 4 | 60 00 | 51 00 | 60 00 | 60 00 | $90.00 | 65 00 |
| 5 | 90 00 | 65 00 | 85 00 | 80.00 | 115.00 | 84 00 |
| 6 | 115 00 | 90 00 | 85 00 | 100.00 | 150 00 | 110 00 |
| 8 | 185 00 | 130 00 | 100 00 | 150 00 | 250 00 | 181 00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots

| Size, In. | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | $0 22 | $0 132 | | 1.20 | $0 135 | $0 13 | |
| 4 | 22 | 132 | $0 11 | 1.20 | 135 | 1625 | $0 18 |
| 5 | 34 | 198 | | 1.85 | 2025 | 1195 | 165 |
| 6 | 34 | 198 | $ 165 | 1.85 | 2025 | 2275 | 25 |
| 8 | 52 | 308 | 275 | 2.50 | 315 | 325 | 35 |
| 10 | 78 | 462 | 355 | 3.50 | 4725 | 455 | |
| 12 | 1 00 | 594 | 4675 | 4.75 | 6075 | 585 | 80 |
| 15 | 1 50 | 792 | 6875 | 6.50 | 81 | 975 | |
| 18 | 2 18 | 1 10 | 935 | 8.50 | 1 125 | 1 365 | |
| 20 | 2 60 | 1 32 | 1 2375 | 11.75 | 1 35 | | |
| 22 | 3 50 | 1 98 | | 14.50 | 1 80 | | |
| 24 | 3 90 | | 1 7875 | 17.50 | 2.025 | 2 34 | 2 40 |
| 27 | | | | 21.00 | 3.75 | 3 25 | |
| 30 | | | 4 00 | 24.00 | 4 75 | 3 90 | |
| 33 | | | | 27.50 | 5 50 | | |
| 36 | | | | 31.00 | 6 00 | | |
| | 3 | 5 | | 8 | 12 | 24 | 36 |
| Boston | $0 138 | $0 207 | $0 322 | $0 621 | $2 07 | $5 433 | |
| Minneapolis | | | 42 | 77 | 2 45 | 5 66 | |
| Denver | | 13 | 50 | 50 | 1 95 | | |
| Seattle | 145 | | 56 | 72 | 2 50 | | |
| Los Angeles | 11* | 165* | 275 | 465 | 1 65 | | |
| New Orleans | | 1102 | 27 | 48 | 1 75 | | |
| Cincinnati | 126 | 189 | 294 | 567 | 1 89 | 5 0225 | |
| Atlanta | 11* | 165* | 27 | 4675 | 1 7875 | | |
| Montreal, *delivered* | 30* | 45* | 85* | 1 35 | 4 50 | 6 50 | |
| Detroit | 123 | 1845 | 287 | 5535 | 2 34 | 5 8425 | |
| Baltimore | 13 | 198 | 31 | 595 | 2 00 | | |
| Baltimore, *delivered* | | 28 | 44 | 86 | 2 84 | | |

*4-in., 6-in., 9-in., 30-in. respectively

## PIPE

**WROUGHT PIPE**—The following discounts are to jobbers for ... from the Pittsburgh basing card of April 13, 1921:

| | BUTT WELD | | | | |
|---|---|---|---|---|---|
| | Steel | | | Iron | |
| Inches | Black | Galv. | Inches | Black | Galv. |
| ½ | 62½ | 50 | ⅜ | 33½ | 18½ |
| | | | ½ to 1½ | 35½ | 20½ |

| | LAP WELD | | | | |
|---|---|---|---|---|---|
| 2 to 6 | 54½ | 58½ | 15 | 42½ | |
| 7 to 12 | 58½ | 46 | 2 | 30½ | 16½ |
| 13 and 14 | 54½ | 41 | 2½ to 6 | 33½ | 20½ |
| | 45 | | 7 to 12 | 29½ | 16½ |

## ROAD AND PAVING MATERIALS

**ROAD OILS**—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45° asphalt (at terminal) | $0.06½ | $0 13 |
| New York, 65° asphalt (at terminal) | 06 | 13 |
| New York, binder (at terminal) | 07 | 13 |
| New York, flux (at terminal) | 06½ | 14 |
| New York, liquid asphalt (at terminal) | 08 | 10 |
| St. Louis, 40-60% asphalt (*f.o.b.*) *Tulsa, Okla.* | 03½* | |
| Chicago, 40-50% asphalt | 06 | 08 |
| Chicago, 60-70% asphalt | 06½ | 08½ |
| Dallas, 40-50% asphalt | 10 | 07 |
| Dallas, 60-70% asphalt | 13 | 08 |
| Dallas, 75-90% asphalt | 15 | 10 |
| San Francisco, binder, per ton | 15 00 | 2 25 |

* Freight $21.75 per ton to Whiting, Ind.

**ASPHALT** [illegible] 350-lb. bbl. or 425-[illegible] lots f.o.b. [illegible]

| | Paving | Bulk |
|---|---|---|
| New York, Bay, one N. J. | $28 00 | $16 00 |
| Boston | [illegible] | [illegible] |
| Chicago | 28 50 | 21 00 |
| St. Louis, delivered, Chicago | 21 [illegible] | 15 00* |
| Dallas | 35 00 | 27 00 |
| Seattle | 27 50 | [illegible] |
| Denver | [illegible] | 50@75 |
| Minneapolis | [illegible] | 25 93 |
| St. Louis | [illegible] 8 cents for 1921 | |
| Baltimore | 40 00 | |
| Los Angeles, refinery | 22 50 | 15 00 |
| Montreal | 28 00 | 21 00 |
| Atlanta | 32 50 | |
| Detroit (petroleum asphalt) | 24 50 | 20 00 |
| Cincinnati | [illegible] | [illegible] |
| Maurer, N. J. (asphalt) | 27@38 | |
| Maurer, N. J. (asphalt cement) | 29@36 | 25@31 |

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are required for asphalt cement prices. Above in bbls. are to be ten, and from 4 to 5 drums. Refer [illegible] $1 per bbl. to rebate for drums.

**PAVING STONE**—

| | | |
|---|---|---|
| New York | 5-in. granite | No quotations |
| Chicago | Alcatraz 4x8x4 [illegible] | $3 35 sq.yd. |
| | Alcatraz 4x8x4 [illegible] | 3 00 sq.yd. |
| San Francisco | Basalt blocks, 4x7x8 | 65 00 per M |
| Boston | [illegible] granite | 4 20 sq.yd. |
| Atlanta | Granite | 2 00 sq.yd. |
| Detroit | Granite, 2½ to 3-in. per sq.yd. | 107 00 per M |
| Baltimore | Granite | 2 25 sq.yd. |
| Montreal | Granite | 130.00 per M |
| New Orleans | Granite, 4 x 8 x 4 | 3 25 sq.yd. |
| Cincinnati | Granite | 4 25 sq.yd. |
| St. Louis | 4x8x4 [illegible] | 3 40 sq.yd. |
| | 4x8x4 [illegible] | 3 00 sq.yd. |
| Kansas City | [illegible] | 3.90@3.95 sq.yd. |

**FLAGGING**

| | | | |
|---|---|---|---|
| New York | Bronx | $0 25 | sq.ft. |
| | Manhattan, 4 ft. | 26 | sq.ft. |
| | Queens, 5 ft. | 26 | sq.ft. |
| | 6x20-in. [illegible] walk | 1 00 | lin.ft. |
| Chicago | 18-in. [illegible] | 70 | lin.ft. |

**CURBING**—Prices [illegible] for New York [illegible] 70 for 5x16 to 8x20 [illegible] for 6x15 to 8x20 [illegible]

**WOOD BLOCK PAVING**

| | Size of Block | Treatment | Per Sq.Yd. |
|---|---|---|---|
| New York | 3 | Ib | $ [illegible] |
| New York | 3½ | Ib | [illegible] |
| New York | 4 | Ib | [illegible] |
| Boston | [illegible] | Ib | 3 45 |
| Chicago | 4 | Ib | 3 75@4 00 |
| Chicago | 3 | Ib | 3 25@3 50 |
| St. Louis | 3½ | Ib | 3 05 |
| St. Louis | 4 | Ib | 3 50 |
| Seattle | 4 | Ib | Off market |
| Minneapolis | 3½ | Ib | 2 37 |
| Atlanta | 3½ | Ib | 2 20 |
| New Orleans | 3 | Ib | 2 99 |
| New Orleans | 3½ | Ib | 3 42 |
| New Orleans | 4 | Ib | 3 85 |
| Denver | 4 | Ib | 3 90 |
| Baltimore | 3 | Ib | 3 75 |
| Montreal | 4 | Ib | 4 50 |
| Detroit | 3 | Ib | 2 84 |
| Detroit | 4 | Ib | 3 00 |
| Cincinnati | 4 | Ib | 3 30 |
| Kansas City | 4 | Ib | [illegible] |

## CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—[illegible] per cu.yd.

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago | Sand Current | Sand One Year Ago |
|---|---|---|---|---|---|---|
| New York | $2 60 | $3 00 | $2 50 | $3 00 | $1 25 | $1 50 |
| Denver | 2 [illegible] | 1 85 | 1 80 | 1 80 | 1 40 | 1 40 |
| Chicago | 2 25 | 2 15 | 2 25 | 2 15 | 2 25 | 2 15 |
| St. Louis, delivered | 1 [illegible] | 1 75 | 1 60 | 1 82 | 1 [illegible] | 1 [illegible] |
| Seattle | 1 [illegible] | 1 25 | 1 50 | 1 25 | 1 50 | 1 25 |
| Dallas, [illegible] | 3 [illegible] | 2 50 | 4 00 | 2 50 | 3 50 | 2 00 |
| Minneapolis | 2 [illegible] | 1 60 | [illegible] | 1 35 | 1 00 | 75 |
| Cincinnati | [illegible] | [illegible] | [illegible] | 1 55 | 1 [illegible] | 1 50 |
| San Francisco | 2 [illegible] | 2 [illegible] | 2 50 | 2 50 | 1 50 | 1 [illegible] |
| Boston, per ton | 2 65 | 3 00 | 2 65 | 3 00 | 2 00 | 3 00 |
| New Orleans | 2 [illegible] | 3 [illegible] | [illegible] | [illegible] | [illegible] | 1 [illegible] |
| Los Angeles, per ton | 1 [illegible] | 1 25 | 1 45† | 1 25 | 1 [illegible] | 1 15 |
| Atlanta, per ton | [illegible] | 2 25 | [illegible] | 2 25 | 1 [illegible] | 1 15 |
| Detroit | [illegible] | 2 [illegible] | [illegible] | 2 00 | [illegible] | 1 85 |
| Baltimore, per ton | 1 [illegible] | 1 [illegible] | 1 60 | 1 60 | 70 | 80 |
| Montreal, per ton | 1 [illegible] | 1 25 | [illegible] | [illegible] | 1 25 | 1 40 |
| Birmingham | [illegible] | 3 25 | [illegible] | 3 75 | 43 | 1 25 |

* Lime [illegible] Portland, $5 [illegible] Gravel, $6
† Freight [illegible] quarry to Los Angeles, 80c. per [illegible]

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | ½ In. Current | ½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1 90@2 00 | $1 90 | $2 15 | $2 15 |
| Chicago | 2 50 | 2 15 | 2.50 | 2.15 |
| St. Louis, *delivered* | 2 60* | 1.90 | 2.60* | 1.90 |
| Dallas | 2 80 | 3 50 | 2 80 | 3.50 |
| San Francisco | 2 25 | 2.50 | **2 50** | 2.75 |
| Boston | 3 00* | 3 00 | 3 00* | 3 00 |
| Minneapolis, [illegible] | 2 00 | 1 50 | 2.25 | 1.60 |
| Kansas City† | 1.25 | 2.35 | 1.40 | 2.35 |
| Denver | [illegible] | 3 75 | [illegible] | 3.75 |
| Seattle, *delivered* | 3.50 | 3.50 | 3.50 | 3.50 |
| Atlanta | 2 25* | 3.10 | [illegible] | [illegible] |
| Cincinnati, *delivered* | 3.24 | [illegible] | 3.24 | 1.65 |
| Los Angeles | 1 [illegible] | 1 60 | 1 80* | 1 70 |
| Detroit | 2.00* | 1.75 | 2.00* | 1.75 |
| Baltimore | 1.75* | 1.60 | 1.75* | 2.00 |
| Montreal | 2.00* | 1.75 | 2.10* | 2.00 |
| Seattle, *delivered* | 3.00 | [illegible] | 3.00 | [illegible] |

*Per ton. †F.o.b. Joplin, Mo.

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants

| | 1½-In. | ¾-In. | Roofing | Sand |
|---|---|---|---|---|
| Lebanon or Bethlehem, Pa. | $1 00 | $1.00 | $2.50 | $0 [illegible] |
| Easton or Catasauqua, Pa. | 1 00 | 1 00 | 2.00 | [illegible] |
| Buffalo, N. Y. and Erie, Pa. | 1.25 | 1.25 | 2.25 | 1 [illegible] |
| Emporium, Pa. | 1 25 | 1 25 | [illegible] | 1 [illegible] |
| East Catasauqua, Conn. | 1 25 | 1 35 | 4 00 | 1 [illegible] |
| Birmingham, Ala. | 1 25 | 1.25 | 2.05 | 1 [illegible] |
| Toledo, Ohio | 1.50 | 1.50 | 2.35 | [illegible] |
| Atlanta, Ga. | [illegible] | 2 [illegible] | [illegible] | [illegible] |
| Eastern Pennsylvania and New Jersey | 1.20 | 1.20 | 2.50 | [illegible] |
| Western Pennsylvania and New Jersey | 1 25 | 1 25 | 2 50 | 1 [illegible] |

Birmingham, f.o.b. pit $1.15 (or $2.75 per cu. yd. on site)

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per 200-Lb. Barrel Finishing | Lump, per 200-Lb. Barrel Common |
|---|---|---|---|---|
| New York | $21 00 | $19 00 | $3 50* – at plant – | $3.30 |
| Chicago | 20 00 | [illegible] | [illegible] | 1 75 |
| St. Louis | 26 00 | 20 00 | [illegible] | 2 50 |
| Boston | 25.25 | 21.25 | 3.50 | 3 25 |
| Dallas | 27.50 | 25 00 | [illegible] | 3 00 |
| Cincinnati | [illegible] | [illegible] | [illegible] | 14 50 |
| San Francisco | 25 40 | 22 00 | [illegible] | 2 25 |
| Minneapolis | 29 00 | 22 00 (white) | 1 80 | 1.50 |
| Denver | [illegible] | 3 20 (bbl.) | 1.00 (bu.) | [illegible] |
| Detroit | 22 00 | 19 00 | 2 00† | 1 80 |
| Seattle | 27 00 | [illegible] | 3 25 | [illegible] |
| Los Angeles | [illegible] | 30 00 | 3 00* | 3 00 |
| Baltimore | 22 25 | 17 50 | [illegible] | 12 75 |
| Montreal | 30.00 | [illegible] | 15 00† | [illegible] |
| Atlanta | 21 00 | 17 50 | 1 60 | 1 50 |
| New Orleans | [illegible] | 17 00 | 2 75 | 2 00 |

*300-lb. barrels. †Per 180-lb. barrel. ‡Per ton.

NOTE—Refund of 10c. per barrel.

**NATURAL CEMENT**—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

| | Current | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2.80 | $1.50 |
| Kansas City (Ft. Scott) | 1.60 | 1.60 |
| New Orleans | 3 36 | 3.36 |
| Atlanta (Magnolia) | 11 00 [illegible] | 1 90 |
| Cincinnati (Utica) | 1.87 | 2 85 |
| Boston (Rosendale) | 2.85 | 2 35 |

**PORTLAND CEMENT**—Current prices are for barrels in carload lots, with bags, to contractors:

| | Current Without Bags | One Month Ago Without Bags | One Year Without Bags |
|---|---|---|---|
| New York (delivered) | $2 80 | $2 80 | $3 30 |
| New York, alongside dock to dealers | 2 40 | 2 40 | 2 65 |
| Jersey City (delivered) | 2 89 | 2 89 | 2 47 |
| Boston | 2 86 | 2 86 | 2 60 |
| Chicago | 2 17 | 2 17 | 2 15 |
| Pittsburgh | 2 17 | 2 17 | 2 20 |
| Cleveland | 2 43 | 2 43 | 2 42 |
| Detroit | 2 43 | 2 43 | 2 28 |
| Indianapolis | 2 43 | 2 43 | 2 42 |
| Toledo | 2 49 | 2 49 | 2 28 |
| Milwaukee | 2 39 | 2 39 | 2 20 |
| Duluth | 2 10 | 2 10 | 2 20 |
| Buffalo | 2 45 | 2 45 | 2 32 |
| Cedar Rapids | 2 51 | 2 51 | 2 40 |
| Davenport | 2 47 | 2 47 | 2 38 |
| St. Louis | 3 00 | 2 60 | 3 05 |
| San Francisco | 3 09 | 3 09 | 2 63 |
| New Orleans | 3 36 | 3 36 | 2 96 |
| Minneapolis | 2 41 | 2 41 | 2 22 |
| Denver | 3 10 | 3 10 | 2 82 |
| Seattle | 3 10 | 3 10 | 3 03 |
| Dallas | 2.60 | 2 60 | 2 15 |
| Atlanta | [illegible] | 2 75 | 2 70 |
| Cincinnati | 2 62 | 2 57 | 2 90 |
| Los Angeles | 3 31 | 3 21 | 3 10 |
| Baltimore (del.) drayload lots | 3 58 | 2 58 | 3 85 |
| Detroit | 2 43 | 2 43 | [illegible] |
| Birmingham | 3 05 | 3 05 | [illegible] |
| Kansas City | 3 20 | [illegible] | 2 56 |
| Montreal | [illegible] | 3 44 | 3 48 |

NOTE—Bags 10c. each, 40c. per bbl.

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

| Style Number | Weight in Pounds | Pittsburgh, Mill | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|
| 032 | 0 022 | $0 87 | .... | $1 15 | $1 38 |
| 049 | 0 028 | 1 11 | .... | 1 46 | 1 74 |
| 068 | 0 035 | 1 35 | .... | 1 80 | 2 14 |
| 093 | 0.045 | 1.73 | .... | 2.30 | 2.75 |
| 126 | 0 057 | 2 14 | .... | 2 86 | 3.42 |
| 153 | 0 068 | 2 55 | .... | 3 40 | .. |
| 180 | 0.078 | 2.93 | .... | 3.93 | .... |
| 245 | 0 103 | 3 86 | .... | 5 15 | .... |
| 287 | 0 119 | 4 46 | .... | 5 96 | 7.16 |
| 336 | 0 138 | 5 18 | .... | 7.32 | .... |
| 395 | 0 160 | 6.00 | .... | 8.00 | .... |
| | | PAVING | | | |
| 036P | 0.017 | $0.66 | .... | $0.88 | .... |
| 053P | 0 024 | 0 94 | .... | 1.24 | .... |
| 072P | 0 031 | 1 18 | .... | 1 57 | .... |
| 097P | 0 040 | 1 52 | .... | 2 02 | .... |
| 049R | 0 024 | 0 94 | .... | 1 24 | .... |
| 067R | 0 031 | 1 18 | .... | 1 57 | .... |
| 089R | 0 040 | 1 52 | .... | 2 02 | .... |

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 50-, 200- and 300-ft lengths. Galvanized is about 10% higher

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | $27 35 | $27 50 | $29 35 | $34 20 | $31 55 |
| 26 | 250 | 29 00 | 28 90 | 29 35 | | 33 00 |
| 25 | 300 | 31 00 | 31 15 | 32 00 | | 36 00 |
| 24 | 340 | 32 90 | 33 10 | 33 90 | 42 70 | 37 45 |
| 22 | 450 | 36.05 | .... | .... | .. | 43 30 |

*Material shipped from mill, freight allowed, or at warehouse. Delivery charge 1c. per sq. yd.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb:

ROLLED FROM BILLETS

| Inches | Pittsburgh Mill | New York | Birmingham Mill | Chicago | St. Louis | Dallas | San Francisco |
|---|---|---|---|---|---|---|---|
| and larger | $2 10 | $3.28 | $2 35 | $3 13 | $3 22½ | $3 75 | $2 35 |
| and larger | 2 15 | 3.33 | 2 50 | 3 17 | 3 27½ | 3 80 | 2 40 |
| and larger | 2.20 | 3.38 | 2 50 | 3 23 | 3 32½ | 3 85 | 2 45 |
| and larger | 2.35 | 3.43 | 2 50 | 3 38 | 3 47½ | 4 00 | 2 60 |
| and larger | 2.60 | 3.73 | 2 50 | 3 83 | 3 52½ | 4 45 | 2 85 |

*Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| and larger | $2.00 | $2.25 | $4.25 | ½ | $2 50 | $2 50 | $3 40 |
| | 2 05 | 2.30 | 4 30 | ¾ | 2.50 | 2.75 | 3 45 |
| | 2.15 | 2.35 | .... | .... | .... | .... | 3 50 |

**BRICK**—Contractors price per 1,000 in cargo or carload lots as follows:

| | Common Current | Common One Month Ago | Common One Year Ago | —Paving 3-inch* | Block— 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $18.40 | $18.40 | $33.00 | $45.00 | $45.50 |
| New York (at dock) | 15@15 50 | 15 00 | 25 00 | .... | .... |
| Chicago | 12.00 | 12.00 | 14 00 | 34.00 | ..... |
| St. Louis, salmon | 17 00 | 15.00 | 16.00 | ..... | ..... |
| Denver, salmon | 14.00 | 14.00 | 17 00 | ..... | ..... |
| Dallas | 12.50 | 16.00 | 24 00 | 44 00 | .... |
| San Francisco | 18 00 | 18 00 | 15 00 | ..... | 44 38 |
| Los Angeles | 15 50 | 15 00 | 13 50 | (not used) | |
| Boston (del.) | 20.00 | 21.75 | 32.00 | 45.50 | 50.05 |
| Minneapolis (del.) | 17.00 | 18.00 | 21 00 | 37.00 | 43 00 |
| Kansas City | 15.50 | | 22 00 | .... | .... |
| Seattle | 14.00 | 19.00 | 15 00 | 48 00 | 53 50 |
| Cincinnati | 18@20 | 20.00 | 24.00 | 41.50 | ..... |
| Montreal (del.) | 18.00 | 18.00 | 16.00 | 100 00 | 120 00 |
| Detroit (del.) | 16.25@18 | 18.00 | 23.00 | 41 30 | 44 00 |
| Baltimore (del.) | 25 00 | 25.00 | 25 00 | 40.00‡ | 44.00‡ |
| Atlanta | 11.00 | 12.00 | | 40.00 | ..... |
| New Orleans | 14.50 | 17.50 | 24.50 | .... | .... |

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

**HOLLOW TILE**—Price per block in carload lots for hollow building tile:

| | New York— Current on Trucks* | New York— One Year Ago | Chicago | St. Louis building partition | St. Louis | San Francisco | Perth Amboy N. J.* Factory |
|---|---|---|---|---|---|---|---|
| 8x12x12 | $0 14@20 | $0 11@25 | $0 09@25 | | $0 085 | $0 145 | 8 |
| 10x12x12 | 16@20 | 153 | 15 50 | .... | 085 | 21 | |
| 12x12x12 | .219 | .204 | .16@05 | ..... | .095 | .29 | .08½ |
| 8x12x12 | ..... | ..... | .14@20 | $2 23 | 1 26 | ..... | .05 |
| 10x12x12 | ..... | ..... | .23@50 | 2 66 | 1 70 | ..... | .06 |

* per cent off for cash

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Boston | $0 1107 | $0 207 | $ 286 |
| Minneapolis | .084 | 161 | .230 |
| Minneapolis (delivered) | .092 | .175 | .250 |
| Cincinnati | .069 | 148 | .202 |
| Kansas City | .115 | .207 | |
| Denver | .09 | 16 | .23 |
| Seattle | .10 | .175 | 30 |
| Los Angeles factory | .11 | .192 | 23* |
| New Orleans | .10 | .215 | 3750 |
| Montreal (delivered) | .107 | .250 | .2776 |
| Montreal | .20 | 30 | .35 |
| Baltimore | .16 | 27 | .45 |
| Atlanta | 09875 | 175 | .... |
| Dallas | .13 | .... | .... |

**STRUCTURAL MATERIAL**—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

| | Pittsburgh, Mill | New York (del.) | Birmingham | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | $2.00@ $2.20 | $3.23 | $2 20 | $4 50 | $3 32½ | $3.13 | $4 35 |
| Channel, 3 to 15 in. | 2.00@ 2 20 | 3.23 | 2 20 | 4 50 | 3 32½ | 3.13 | 4 35 |
| Angles, 3 to 6 in., 1 in. thick | 2.00@ 2.20 | 3.23 | 2 20 | 4 50 | 3 32½ | 3.13 | 4 35 |
| Tees, 3 in. and larger | 2.00@ 2 20 | 3.23 | 2 20 | 4 50 | 3 32½ | 3.13 | 4 35 |
| Plates | 2.00@ 2 20 | 3.23 | 2 20 | 4 50 | 3 32½ | 3.13 | 4 50 |

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Pittsburgh, Mill | New York— Current | New York— One Year Ago | Warehouse— Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | $3.70 | $4 65 | $6 00 | $4.50 | $4 97½ | $6.00 | $5 35 |

BOILER CONE HEAD BOILER

| | | | | | | |
|---|---|---|---|---|---|---|
| ½ in and larger | 3 80 | 4 75 | 7 10 | 5.63 | 5 07½ | 6.10 | 5 90 |
| ⅝ and ¾ | 3 95 | 4 90 | 7 25 | 5.78 | 5 22½ | 6.25 | 6.05 |
| ⅞ and 1 | 4 20 | 5.15 | 7 50 | 6.05 | 5 47½ | 6.60 | 6.30 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $ 00@$3 25 | $3.75 | $5.25 | $5.00 | $4.10 | $4.95 |
| Cut | .... | 6.85 | 6.28 | 7.75 | 4.75 | 5 00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

| | New York 1-Ply l.c.l. | New York 2-Ply l.c.l. | New York 3-Ply l.c.l. | Philadelphia 1-Ply l.c.l. | Philadelphia 2-Ply l.c.l. | Philadelphia 3-Ply l.c.l. |
|---|---|---|---|---|---|---|
| No 1 grade | $2 07 | $2.43 | $2 85 | $1.95 | $2.38 | $2 75 |
| No 2 grade | 1 77 | 2 08 | 2 45 | 1 65 | 1.95 | 2 35 |

* Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $7.95 per square in carloads. $8.20 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices per ton f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq. ft | [illegible] |
| Tar pitch (in 400-lb. bbl.) per 100 lb. | [illegible] |
| Asphalt pitch (in barrels) per ton | 47 50 |
| Asphalt felt (light) per ton | 80.50 |
| Asphalt felt (heavy) per ton | 84 50 |

**SHEETS**—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

| Blue Annealed | Pittsburgh, Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $3.10 | $3.97½ | $3.88 | $6.00 | [illegible] |
| No. 12 | 3.15 | 4.02½ | 3.93 | 6.05 | [illegible] |
| No. 14 | 3.20 | 4.07½ | 4.08 | 6.10 | [illegible] |
| No. 16 | 3.30 | 4.17½ | 4.18 | 6.20 | [illegible] |
| **Black** | | | | | |
| *Nos. 18 and 20 | 3 85 | 5 30 | 4.45 | 6 80 | [illegible] |
| *Nos. 22 and 24 | 3.90 | 5 35 | 5.00 | 6 85 | [illegible] |
| *No. 26 | 3.95 | 5.40 | 5.05 | 6.90 | [illegible] |
| *No. 28 | 4.00 | 5.50 | 5.15 | 7.00 | [illegible] |
| **Galvanized** | | | | | |
| No. 10 | 4.00 | 5.25 | 5.46 | .... | [illegible] |
| No. 12 | 4.10 | 5.35 | 5.55 | 7 | [illegible] |
| No. 14 | 4.25 | 5.35 | 5.65 | 7.25 | [illegible] |
| Nos. 17 to 21 | 4.40 | 5.45 | 5.85 | 7.40 | [illegible] |
| Nos. 22 and 24 | 4 55 | 5 80 | 6.00 | 7 55 | [illegible] |
| *Nos. 25 and 26 | 4.70 | 5.95 | 6.30 | 7 70 | [illegible] |
| *No. 28 | 5.00 | 6.25 | 6.40 | 8.00 | [illegible] |

* For painted corrugated sheets add 30c per 1000 lb. for 5 to 25 gage; 25c for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gage.

**LINSEED OIL**—These prices are per gallon:

| | New York— Current | New York— One Year Ago | Chicago— Current | Chicago— One Year Ago |
|---|---|---|---|---|
| Raw in barrel (5 bbl.) | $0 80 | $1 73 | $0 75 | $1 78 |

**WHITE AND RED LEAD**—Prices per pound:

| | Current | | 1 Year Ago | | [illegible] | |
|---|---|---|---|---|---|---|
| | Dry | In Oil | Dry | In Oil | Dry | In Oil |
| 100-lb. keg | 13 00 | 14 50 | 15 50 | 17 | [illegible] | [illegible] |
| 25- and 50-lb. kegs | 13 25 | 14 75 | 15 75 | 17 | [illegible] | [illegible] |
| 12-lb. keg | 13 50 | 15 00 | [illegible] | 17 | [illegible] | [illegible] |
| 5-lb. cans | 16 00 | 17 50 | 18 [illegible] | [illegible] | [illegible] | [illegible] |
| 1-lb. cans | 18 00 | 19 50 | 20 50 | 22 00 | 18 00 | 20 50 |

500 lb. lots less 10% discount; 2000 lb. lots less 10 2½% discount

## LUMBER

San Francisco—Prices of [illegible] common, [illegible] load lots:

| | Lumber Prices in Yards at San Francisco | | | |
|---|---|---|---|---|
| | 6-8 and 10 Ft. | 12 to 16 and 20 Ft. | 22 Ft. | 25 to 32 Ft. |
| 3x3 and 4 | $24 50 | $25 00 | $26 00 | $28 00 |
| 3x6 and 8 | 25 50 | 26 00 | 27 00 | 29 00 |
| 4x4-6 and 8 | 26 00 | 27 00 | 28 00 | 29 50 |
| 3x10 and 12 | 26 00 | 27 00 | 28 00 | 30 00 |
| 3x14 | 26 50 | 27 50 | 28 50 | 30 50 |
| 4x10 and 12 | 26 00 | 27 00 | 28 00 | 30 00 |
| 4x14 | 27 00 | 28 00 | 29 00 | 31 00 |

| | 24 Ft. and Under | 25 to 32 Ft. | 33 to 40 Ft. |
|---|---|---|---|
| 4x10 | $25 50 | $27 50 | $28 50 |
| 6x14 | 27 00 | 29 00 | 29 50 |
| 8x10 | 25 50 | 27 00 | 28 50 |
| 3x14 | 27 00 | 29 00 | 29 50 |

New York, Chicago and St. Louis:

| | New York | | Chicago | |
|---|---|---|---|---|
| | 20 Ft. and Under | 22-24 Ft. | 20 Ft. and Under | 22-24 Ft. |
| 3x4 to 8x8 | $33 00 | $34 00 | [illegible] | [illegible] |
| 3x10 to 10x10 | 38 00 | 39 00 | *52 00 | *53 00 |
| 3x12 to 12x12 | 43 00 | 44 00 | [illegible] | [illegible] |
| 3x14 to 14x14 | 48 00 | 49 00 | [illegible] | [illegible] |
| 3x16 to 16x16 | 55 00 | 56 00 | [illegible] | [illegible] |
| 3x18 to 18x18 | 67 00 | 68 00 | [illegible] | [illegible] |
| 4x20 to 20x20 | [illegible] | [illegible] | [illegible] | [illegible] |

*Wholesale prices to dealers of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

Prices to contractors, on lighters or cars, New York, about $5 additional.

**St. Louis:** Yellow pine, 22@24 ft. long, 3 x 4 to 4 x 4, $35; 3 x 6 to 8 x 8, $33; 3 x 12 to 5 x 12, $43; 3 x 14 to 4 x 14, $48; 3 x 16 to 7 x 16, $52; 3 x 18 to 5 x 18, $58.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under; for sizes over 12 x 12 add $2 for merchantable and $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities:

| | 8 x 8-In. x 20-Ft and Under | | | 12 x 12-In. 20 Ft and Under | |
|---|---|---|---|---|---|
| | Fir | Hemlock | Spruce | Fir | Fir |
| Boston | $45 00 | $[illegible] | $55 00 | $[illegible] | $[illegible] |
| Seattle | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| New Orleans | 35 00 | [illegible] | [illegible] | 38 00 | [illegible] |
| Baltimore | 58 08 | [illegible] | [illegible] | [illegible] | [illegible] |
| Cincinnati | 50 00 | 50 00 | [illegible] | [illegible] | 64 00 |
| Montreal | 78 00 | 85 00 | 68 00 | 78 00 | 100 00 |
| Los Angeles | [illegible] | 47 00 | 46 00 | [illegible] | 49 00 |
| Detroit | Quotations f o b mills only | | | | |
| Denver | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Minneapolis | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Atlanta | 27 50 | [illegible] | [illegible] | [illegible] | [illegible] |
| Dallas | 35 00 | [illegible] | [illegible] | 40 00 | [illegible] |
| Kansas City | 34 00 | 35 00 | [illegible] | 39 00 | 37 00 |

| | 1-In. Rough, 10 In. x 16 Ft — | | 2-In. T. and Gr. 10 In. x 16 Ft. | |
|---|---|---|---|---|
| | Fir and Larch | Hemlock | P. Fir | Fir |
| Boston | $45 00 | $[illegible] | $43 00 | $48 00 |
| Seattle | [illegible] | [illegible] | [illegible] | [illegible] |
| New Orleans | 55 00 | [illegible] | 35 00 | [illegible] |
| Baltimore | 42 50 | [illegible] | 40 00 | [illegible] |
| Cincinnati | 70 00 | 80 00 | 40 00 | [illegible] |
| Montreal | 120 00 | 60 00 | 80 00 | 80 00 |
| Los Angeles | [illegible] | 41 00 | [illegible] | [illegible] |
| Denver | [illegible] | [illegible] | [illegible] | [illegible] |
| Minneapolis | 38 00 | [illegible] | 36 00 | [illegible] |
| Atlanta | 15 00 | [illegible] | 18 00 | [illegible] |
| Dallas | [illegible] | 35 00 | 35 00 | [illegible] |
| Kansas City | 36 00 | 36 00 | [illegible] | 31 00 |

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

† Minneapolis—Shipments to [illegible] delivered on building site $26@$28. For 8x8x20 and smaller, 85 per cent heart, $33; 12x12x20 and smaller, 85 per cent heart, $42; 1x10x16 and smaller, rough, $16; 2x10x16 t. and g., $22; f o b. [illegible]

Detroit—[illegible] Rough fir, 2 x 12 and 2 x 4, by 16 ft., $44; 3 x 12 x 16 ft., $48; 2 x 4 x 16, $41.

## FREIGHT RATES

On [illegible] products in the Pittsburgh district [illegible] the tural [illegible] mercial steel bar [illegible] and [illegible] rivets [illegible] freight rates are [illegible] at 3 cents.

| | | |
|---|---|---|
| Baltimore | $0 33 | |
| Boston | [illegible] | 81 |
| Buffalo | 41 | 51 |
| Buffalo | 23 | 38 |
| Cincinnati | 35 | 1 cent |
| Cincinnati | 33 | 35 |
| Cleveland | 24 | 47 |
| Denver | 1 35 | 69 |

Note—Add 3% transportation tax [illegible] carload, 40,000 lb.

Minimum carload, 50,000 lb. for [illegible] to 84,000 lb. for iron or steel pipe.

## CONTRACTORS' SUPPLIES

**STEEL SHEET PILING**—The following prices f.o.b. Pittsburgh, with a comparison of a month and a year ago:

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $2.55 | $2 55 | $2.55@$3.65 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | New York |
|---|---|
| [illegible] tiller and traction constructions | 20% |
| Cast steel flattened strand, special and cast steel | 20% |
| Patent flattened strand, iron rope | 5% |
| [illegible] steel flattened strand | 35% |
| Special steel round strand rope | 30% |
| Cast steel round strand rope | 22½% |
| Iron strand and iron tiller | 5% |
| Galvanized iron rigging and guy rope | +12½% |

San Francisco—Galvanized rope, rigging and guy ropes, +17½%; bright plow, 30% off.

Chicago—Plow steel round strand, 30% off; cast steel round strand, 15%; cast steel [illegible] 17½.

Western, and California territory, 30% plow steel, +17½% galvanized iron rigging and guy ropes.

Montana, Idaho and Arizona, 25% plow steel; +22½% galvanized iron rigging and guy rope.

**MANILA ROPE**—For rope smaller than [illegible] the price is [illegible] to 2c. extra, while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 4; ½-in., 3; ⅝-in., 2 ft. 10 in.; ¾-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0.20 | New Orleans | .18 |
| New York | .16½ | Los Angeles | .14 |
| Chicago | .18 | Seattle | .16 |
| Minneapolis | .17½ | St. Louis | .17 |
| San Francisco | .15 | Montreal | .30 |
| Atlanta | .19 | Detroit | .18 |
| Denver | .21½ | Baltimore | .23 |
| Cincinnati | .22 | Kansas City | .16 |
| Dallas | .29 | | |

*780-ft. coils.

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | $0 31 | $0 [illegible] |
| Boston | [illegible] | [illegible] |
| Kansas City | .2425 | [illegible] |
| Seattle | 90 | .24 |
| Chicago | .2425 | .26 |
| Minneapolis | .2249 | .25 |
| St. Louis | .28 | .31 |
| Denver | .2475 | .27 |
| Dallas | 29 | .37 |
| Los Angeles | [illegible] | .39 |
| Atlanta | .2875 | .32 |
| Baltimore | .2875 | .31 |
| Cincinnati | .2625 | .28 |
| Montreal | .32 | .37 |
| Birmingham, delivered | .1925 | .22 |

**PILES**—For spruce and plain pine piles, delivered New York, the price is as follows:

| | |
|---|---|
| Spruce 10-in. butts, 5-in. tops, length 20-30 ft. | $11 |
| Spruce 12-in. butts, 6-in. tops, length 30-40 ft. | 10 |
| Pine 12-in. butts, 6-in. tops, length 41-50 ft. | 13 |
| Pine 14-in. butts, 6-in. tops, length 51-60 ft. | 22 |
| Pine 14-in. butts, 6-in. tops, length 61-71 ft. | 25 |

| | Dallas | | St. Lo |
|---|---|---|---|
| 6-in. x 20-ft. | $4 60 | 6-in. x 30-ft. | $7 |
| | | 7-in. x 30-ft. | 10 |
| 6-in. x 30-ft. | 7 10 | 7-in. x 35-ft. | 15 |
| | | 8-in. x 35-ft. | 16 |
| 8-in. x 30-ft. | 8 45 | 7-in. x 40-ft. | 16 |
| | | 8-in. x 45-ft. | 27 |
| 8-in. x 35-ft. | 10 38 | 8-in. x 50-ft. | 28 |

**SCRAP**—The prices following are per gross ton paid by dealers and producers in New York. In Chicago and St. Louis [illegible] are per net ton for cover delivery at the buyer's works, including freight transfer charges:

| | New York | Chicago | St. Lo |
|---|---|---|---|
| No. 1 railroad wrought | $10 50 | $11 00 | $11 0 |
| Stove plate | [illegible] | 14 00 | 11 5 |
| No. 1 machinery cast | 17 50 | 15 00 | 14 0 |
| Machine shop turnings | [illegible] | 4 00 | 5 0 |
| Cast borings | [illegible] | [illegible] | 7 0 |
| Railroad malleable cast | 8 50 | 14 00 | 12 5 |
| Re-rolling rails | 10.00 | 13 00 | [illegible] |
| Relaying rails | [illegible] | [illegible] | [illegible] |

**SHIP SPIKES**—Current prices per 100 lb.:

| In. | San Francisco Galv. | San Francisco Black | Seat Bla |
|---|---|---|---|
| [illegible] | $9 10 | $8 40 | $8 |
| [illegible] | 8 65 | 6 65 | 8 |
| [illegible] | 8 50 | 6 50 | 8 |

Pittsburgh base, $3.35@$3 40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 87 — NEW YORK, JULY 14, 1921 — Number 2

## British Coal Strike

THOUGH the British coal strike was terminated ten days ago, after it had been in progress eighty-eight days, full details of the agreement are not yet available. This much is certain, however, that the settlement has been underwritten by the British taxpayers to the tune of £10,000,000. Also, some sort of profit-sharing scheme has been agreed upon, conditional, of course, on there being profit, but whether this profit sharing is through national or through district pools is not clear. The full details should make interesting reading.

## Professor Burr on Education

ATTENTION was called last week to the forceful address delivered by Prof. William H. Burr before the Society for the Promotion of Engineering Education. The address is referred to again because it is printed in this issue and his views are therefore available to the members of the profession. There are not many subjects that would yield more value to the profession than a serious consideration and discussion of Professor Burr's paper. How many engineers feel that a college course is a *desirable* prerequisite to engineering study? How many would go further and hold that a college course should be made a *compulsory* prerequisite to engineering study? The profession needs to know where it stands on this all important subject.

## Relief for the Railroads

REFUNDING by the government of the indebtedness to the railroads for capital expenditures under Federal control will not only afford material relief to the railroad industry, but also to business in general. Ordinarily under private operation, such totals for capital expenditure would be provided for by long-time bonds or in a few cases by the issuance of stock. Even in normal times it would be unusual for the carriers to be called upon immediately to pay cash for a $500,000,000 improvement program. In the present serious situation of the railroads it would be practically impossible. Refunding the government debt should go far toward relieving the railways.

## Heroic Flood Protection Work

EMERGENCY levee construction demanding heroic measures for the safety of hundreds of people and millions of property value was a spectacular feature of the recent accomplishment by engineers at Trotter's Front, described elsewhere in this issue. The work was noteworthy not only as record breaking construction, but also as an example of the cool judgment of engineers during times of great stress. The flood threatened a territory of more than 3,000 square miles with the populations of many prosperous towns and property assessed for over $100,000,000. While observations were being taken and forces for the work organized, the engineers made their plans. Then construction started, gathering momentum as it progressed. The work was a success and a disaster was averted.

## Tunnel Work Resumed

THE opening of bids this week for the Jersey ventilating shafts of the Hudson River vehicular tunnel and the fixing of a date early next month for the official ceremony of breaking ground at the west end of the tubes marked a resumption of amicable relations between the New York and New Jersey commissions, which have been at loggerheads for many weeks. The result has been that while the two commissions debated their differences over the proposed widening of Jersey City streets at the joint expense of the two states, a valuable portion of the construction season was slipping by with no work in progress on the Jersey side of the interstate subaqueous route. At this writing the long-drawn-out controversy over the status of the board of consulting engineers, "dismissed" by the Jersey commission, is still in doubt, but the indications are that this will be adjusted at an early date. The important thing is that the deadlock has been broken and that sufficient progress will have been made on the Jersey shafts to advertise for bids by Sept. 1 for the construction of the shield-driven twin tunnels under the river. These constitute, of course, the main contracts. The engineering plans and specifications for the river portion of the tunnel are completed, so that, so far as the technical features of the work are concerned, there is nothing in sight to delay actual tunnel excavation.

## Try the Cement Suit

AS ANNOUNCED in our news columns last week the Department of Justice has instituted another civil suit against the cement manufacturers for a violation of the Sherman Act, although the similar action brought in New Jersey in August, 1919, has never come to trial. The bringing of the former action was the occasion of a "grand-stand play," in which the Washington correspondents were given to understand that this was a first move on the part of the then administration "to reduce the cost of living." It did not seem to occur to Washington that the connection between the cost of living and cement was rather remote. In fairness to the manufacturers and users of cement no delay in the new action should be permitted or encouraged by the Attorney General. If the open-price and other methods jointly followed by the manufacturers are illegal, cement users who presumably suffer by such illegal methods are entitled to early relief. If those methods are legal, the much attacked cement makers should be given a clean bill of health. There has been too much talk of trade restraint in the cement business to permit the situation to drag along on general impressions and one-sided accusations.

### Baltimore Sewage-Works

LARGEST of American cities to treat its sewage, Baltimore has been remiss in not publishing annual reports giving operating data for its sewage-works. This makes all the more welcome the article begun on p. 50 of this issue summarizing operating experiences and results for the nine full years since the plant was put in operation. The changes in design and operation outlined, together with the monthly and yearly averages of laboratory results and the yearly costs of treatment, make the article unique in the literature of sewage treatment. Of special interest are the comparative data for one-story settling tanks, separate sludge digestion tanks and for two-story or Imhoff tanks, and the account of the alterations made in the latter. Interesting also are the brief summaries of activated-sludge and of grease-recovery tests at Baltimore. Every city owes to itself and other cities well-presented data on the operation of its public works, particularly those having so many and vexing problems as are constantly present in sewage treatment. It is to be hoped that Mr. Schaetzle's excellent summary of nine years experience in operations of the Baltimore sewage-works will stimulate the responsible city authorities to make sure that full annual reports are published hereafter.

### Steel Lower

FOR the second time in three months the United States Steel Corporation announces a reduction in prices. The prevailing market had been below the official figures for some time. The announcement thus follows rather than leads the market. The corporation in former years maintained an unquestioned leadership in prices—a leadership which Judge Gary succeeded in holding for many years, and from which much good resulted. The stability of the steel market was never in doubt while that policy prevailed. The readjustment now going on in this country is part of the slow, downward drift of steel prices. What point in that movement has been reached? Probably under existing conditions of low demand, the bottom level will be determined less by production cost than by the confidence of the industrial world in the soundness of the schedule. Whether the present readjustment will establish this confidence and revive purchase and production cannot yet be foretold. It is our judgment that it will not. Prices must go still lower before they will help to stimulate demand. The 1913 average price for shapes, Pittsburgh base, was $1.50; in December, 1914, the minimum of $1.08 was reached. The newly announced price reduction brings the figure to $2.00. The price will, we believe, have to go under that to tempt large buying.

## Radio on Construction Work

IN THE last two years the use of radio as a means of communicating with construction camps in remote regions has received much attention in the West. This has been because of the much more effective apparatus developed during the war and the comparatively large number of men now available who have had training in the installation and operation of radio equipment. The cost and time required for constructing telephone lines through rough mountainous territory and the difficulty of maintaining those lines in high altitudes during the winter season are strong arguments for the use of wireless. Power companies adding new generating plants to their systems were naturally the first to apply the idea because their staff included engineers more or less familiar with the principles of radio and because in their case the equipment promised to be permanently useful. After construction was completed it would enable the company to maintain communication with the remote generating stations independently of the telephone lines which are so often subject to derangement, particularly in times of storm when means of communication are likely to be most urgently needed.

In addition to the two radio systems described on p. 57, many Western power companies are using radio in a small way or are considering plans for extensive installations. It is safe to say that very soon this will be the generally accepted means of communication with all mountain stations and camps operated by the power companies.

Manifestly the radio telegraph, requiring specially trained operators (and, if a wave length of over 200 meters is desired, operators holding a commercial grade license) is not as convenient as the radio telephone. The latter has been used successfully but the simplification gained by substituting speech for code signals seems to be lost in the extra skill required to keep the telephone apparatus in a stable working condition. Moreover, the range and dependability of the radio phone, even with the most skilled operator, is less than with the telegraph, so that, on the whole, experience to date suggests the use of the telegraph with means for switching over from telegraph to telephone when conditions become favorable.

The West will naturally lead in the application of wireless communication to construction service because of the particular advantages attending its use there. Present indications are that development will be rapid. Now that the power companies have paved the way, engineering contractors may be expected to follow in adopting wireless on construction work.

## John F. Wallace

NO NAMES in American engineering, up to the present at least, are likely to be more enduring than those associated with the construction of the Panama Canal. It is the foremost of our Federal engineering enterprises. It is a project of tremendous importance in world trade. It has important international political bearings. It was the scene of a notable failure in the history of engineering enterprises, a failure turned into brilliant success by American engineers.

Last week the first of the chief engineers on the Panama Canal, John F. Wallace, passed to the beyond. Though constantly engaged on important engineering enterprises since his retirement from the Panama work, his personality was largely merged with that of the corporation of which he was the head. Consequently he has not stood out as strongly among engineers as his previous work and his later achievements warranted. His standing among engineers and his great ability, however, are fully attested by his selection, after painstaking search, as the first chief engineer of the Panama enterprise. He had won his spurs by his achievements in the Middle West, and his engineering associates had honored him in 1900 with the presidency of the American Society of Civil Engineers. That he displayed at Panama the same qualities which had won him such national recognition among his associates is attested by all who are familiar with the Panama job. His was the work of picking up the wreckage of the French

enterprise and bringing some semblance of order and organization out of that chaos. General Goethals himself has generously given credit to his predecessors, Wallace and Stevens, for what they accomplished previous to his advent on the job.

His passing is a fitting time to emphasize the place which his connection with the Panama Canal will give him in the annals of American engineering.

## Through Foreign Glasses

GETTING the viewpoint of the man at a distance is usually as valuable as it is refreshing. Customary ways of doing things somehow look different when seen through another's glasses; we are apt to perceive a problem where previously everything looked secure and standardized. Of course the recognition of a problem paves the way to its ultimate solution. It is quite possible, therefore, that the comments of P. H. Chen on bridges and locomotives in China may have a constructive effect.

Since the first step in dealing with a new problem is to examine the correctness of its premises and statements, it will be necessary before much headway can be made in the present case to weigh Mr. Chen's charge that bridges of American design are heavier and more costly than their European counterparts—a charge none the less for the mildly questioning way in which it is put. Sufficient information on this subject should be obtainable at home for at least tentative conclusions, and it is to be hoped that American engineers will take the trouble to record their observations of facts supporting or traversing the Chinese comparison. Certain pieces of evidence to hand at the moment are conflicting, some confirming and others opposing the claim made as to the relative economy of bridges designed by American and by European engineers. But a prime difficulty of the case is that it is not easy to know whether a given comparison is on an even basis—whether it involves the same loading, similar conditions as to clearance and other governing factors, and equal excellence of design.

Passing over for the present what the article says on the subject of bridges, we come to a point that may prove to be of pivotal importance, namely, the behavior of American and European locomotives. An experiment is recorded which shows that an American locomotive sets up lateral vibrations in a bridge several times as violent as those set up by a European locomotive. The test is perhaps too crude to be conclusive, but until disproved by more careful experiments it must be taken as indicating that American locomotives are needlessly rough on the structures that carry them. It would appear that there is a good bit of room for improvement in locomotive construction.

So far as this locomotive effect concerns bridges, it would require stiffer construction. Does this, possibly, account for the fact that we build our bridges of stiffer proportioning, with very much heavier bracing, and with larger allowance of extra metal for "impact" than do European bridge constructors?

Obviously, if we *must*, for certain operating advantages, tolerate great unbalance in the driving wheels and violent nosing effects, then our bridges must be made correspondingly more robust; but the added expense involved here should be justified by the operating gain and by the gain in service value of these rougher locomotives. Is any such gain in fact realized?

What is much more important than the effect of locomotive unbalance on bridges, however, is its effect on track. It seems a fair inference that if a particular locomotive is two or three times as severe in its lateral effect on a bridge as another locomotive, the former will also be more severe on track and roadbed. Track injury and maintenance costs presumably are a function of these lateral effects, and would be reduced by lessening the lateral forces. Since maintenance charges are a weighty element of railroad costs today, their reduction would be eminently worth while, especially as a gain in safety of operation might also be expected to follow such a change. In other words, the question presented is whether the locomotive with unnecessary unbalance and nosing may not have much more to answer for than merely additional cost of bridge construction. If the answer is affirmative, then our standard locomotive construction is indeed challenged; its operating advantages, if any, must be balanced against not merely a bridge charge but, possibly, a considerable part of the entire track maintenance charge of our railways.

## Safety in Service

COMMON practice in proportioning the wooden floor joists of bridges or of buildings where the loading is likely to produce shock or severe vibration is to make an additional strength allowance for the impact and vibration effects. This is done either by increasing the computed (static) stresses by a certain percentage (impact increment) or by the substantially equivalent process of proportioning the parts for a heavier loading than will actually be applied; the former method is the customary one for bridges, the latter for warehouses and dancing floors. It is now proposed to do away with such extra strength allowance, on the ground that timber is stronger under the shock of suddenly applied load than under quiescent load. This proposal is made by the Timber committee of the American Society for Testing Materials in its recent report.

After recommending certain values for working stresses for quiescent load the committee makes these values applicable to impact loading by giving formulas which increase the allowable working stress for design in exactly the same ratio that the computed stress is increased by the impact allowance. Thus the committee virtually says that impact may be ignored entirely so far as timber is concerned. Undoubtedly the underlying experimental fact, namely, that steady load has a more severe effect on timber than transitory load, is well established. But heretofore no one had interpreted this fact as wiping the impact factor off the slate entirely. Blows or vibratory influences produce rather complex effects on structures—hardly as simple as those arising from mere transitory loading.

It seems likely that engineers and architects who have heretofore considered it necessary to make impact allowances in timber structures as well as in steel, may be reluctant to change their practice on the recommendation of those who speak only for the quality of material, not for the action of structures and their loads. The problem at issue is one that on the face of it involves both the material and the service, and its proper answer is bound to call for the experience of the representatives of both. In the meantime it may be said that the proposal of the committee is of unusual interest, and distinctly of a kind to invite discussion since it involves the important issue of due safety in service.

# Nine Years' Operation of the Baltimore Sewage-Works

## Plant Comprises Bar Screens, Venturi Meters, Hydrolytic and Separate Sludge Digestion Tanks, Imhoff Tanks, Sludge Drying Beds, Revolving Screens for Tank Effluents and Sprinkling Filters—Sludge Sold

By Theodore C. Schaetzle
Principal Sanitary Chemist of Sewage-Works, Baltimore, Md.

With the publication of the 1914 report of the Baltimore Sewerage Commission the last consistent record of the development of Baltimore's vast sewerage system ended. Throughout the years that this report was published some mention was made of the sewage-works, always in reference to its construction features—except for the 1911 report, which dealt extensively with the experiments upon the results of which the present system was adopted. Numerous articles on the construction of the plant appeared in the engineering periodicals but little as to its operation, and some erroneous ideas regarding the Imhoff tanks completed in 1916 have been circulated. These facts combined

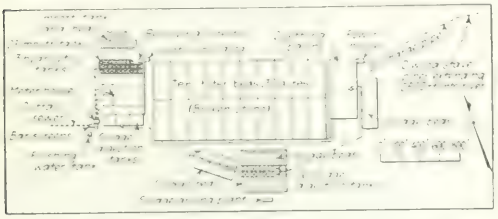


FIG. 1 GENERAL PLAN OF THE BALTIMORE SEWAGE-WORKS

with numerous requests for information have led me to prepare the following résumé of the operation of the Baltimore sewage-works from their first full year of use in 1912 to the close of 1920. To make the account more readily understandable an outline description of the plant will first be given.*

On April 7, 1904, the Maryland Legislature passed the sewerage enabling act which stated that the Sewerage Commission of Baltimore had no authority to construct any sewerage system which would discharge sewage, as distinguished from storm water or ground drainage, into the Chesapeake Bay or any of its tributaries. Accordingly the commission "resolved, that the effluent proposed to be discharged into the Chesapeake Bay or its tributaries in the system to be recommended by the engineers shall be of the highest practicable degree of purity."

To meet these requirements the Black River Disposal Works were constructed—and put into operation on Oct. 30, 1911. Additions have been made from time to time to care for the increasing sewage flow and at the present writing further extensions are under contract.

*Description of Works*—The existing plant consists of preliminary vertical bar screens spaced 1 in. apart; a meter house with five 42 x 21-in. venturi meters; 3 preliminary plain sedimentation tanks, known as hydrolytic tanks; 28 radial-flow Imhoff tanks, 19 separate sludge digestion tanks and 7.8 acres of sludge drying beds; 4 cylindrical revolving screens, trickling filter control house, 30 acres of trickling filters, 4 small pumphouses, each equipped with an electrically-driven centrifugal pump, a hydro-electric power house, generating power from available head in the treated sewage, and a final effluent conduit discharging into Black River.

The hydrolytic tanks are divided into two compartments by a curtain wall, the first compartment being 103 ft. 11 in. long by 101 ft. 9 in. wide and 10½ ft. deep, while the larger or secondary compartment is 313 ft. 9 in. long by 101 ft. 6 in. wide and 13 ft. deep. Both compartments have sloping bottoms.

The Imhoff tanks are circular. They were originally of the downward and outward radial-flow type, but some have since been converted to a radial horizontal flow. All of them are to be converted in this manner. These tanks are 39 ft. inside diameter, 13½ ft. deep to the bottom of the sedimentation chamber, and 27 ft. total depth. The sludge chamber is 23 ft. in diameter, with a conical bottom 5.3 ft. deep. The capacity of the sedimentation chamber is 8,920 cu.ft., and of the sludge chamber 3,663 cubic feet.

Of the 19 separate sludge digestion tanks three are 140 x 103 ft. 2 in. in plan and 13 ft. in depth and 16 are cylindrical tanks, 38 ft. inside diameter, 15 ft. deep to the conical bottom, which is 9½ ft. deep, making a total depth of 24½ ft.

Each revolving screen, open at one end only, is 12 ft. in diameter and 10 ft. long, weighs approximately 1½ tons and is constructed of well seasoned white oak. The stiffness is provided by ¾-in. steel tierods. The surface is covered by Monel metal cloth, 24 meshes to the inch, reinforced with No. 10 gage galvanized wire. Each screen revolves on a bearing at the closed end and on trunnions at the open end, and is driven by a 2-hp. motor.

The trickling filters cover an area of 30 acres, divided into 10 beds. They are filled to an average depth of 8½ ft. with 1- to 2½-in. hard broken stone. The stones rest upon slotted tile which covers the numerous underdrains leading to a larger underdrain and finally to the settling basins. These beds are provided principally with the Merritt square nozzles, although a few Taylor nozzles are still in use.

The flow onto these beds is regulated from the control house, which contains a constant-head chamber, valves electrically operated for turning on and off an entire three-acre bed, and butterfly valves for causing a fluctuation in the spray, which has a cycle of approximately four minutes.

*The principal articles on the operation of the plant heretofore published have been: "Operation of the Baltimore Sewage Disposal Plant," *Municipal Journal*, Nov. 2, 1916; "The Truth About Imhoff Tanks at Baltimore," *Engineering News-Record*, July 11, 1918, p. 81.

Summaries of the "Report of the Advisory Engineers of the Sewerage Commission of Baltimore" appeared in *Engineering Record*, July 28 and Aug. 4, 1906, pp. 101 and 129, and in *Engineering News*, Aug. 16, 1916, p. 177. A description of the experimental sewage-works built and operated to secure data for the design of the plant was printed in *Engineering News*, Feb. 28, 1907, p. 235, and the same journal for July 22, 1915, p. 164, described the activated-sludge experiments then being conducted.

Articles on design and construction are: "The Sewage Disposal Works at Baltimore," *Engineering Record*, Feb. 27, 1909, p. 237; "The Construction of the Baltimore Sewage Disposal Works," *Engineering Record*, Nov. 13, 1909, p. 545, and Nov. 20, 1909, p. 580; "Sewage Disposal Works at Baltimore," *Engineering Record*, Feb. 24, 1912, p. 201, and "Imhoff Tanks to Increase Capacity of Baltimore's Sewage Treatment Plant," *Engineering Record*, July 4, 1914, p. 4; "Additions to the Baltimore Sewage-Works," *Engineering News*, Aug. 5, 1915, p. 278; "Completion of the Sewerage System of Baltimore," Oct. 19, 1916, p. 736.

The settling basins are 275 x 290 ft. in plan and 10 ft. deep, with sloping bottoms.

The power house is equipped with two 150-hp. turbines. A direct connection to two 110-kw. generators is established by horizontal shafts passing through stuffing boxes in the wall of the building. The generators supply 2,300 volts to be stepped down to 220 and 110 volts. The power house is also equipped with a large switchboard, one two-stage centrifugal pump of 600 gal. per min. capacity against a 157-ft. head, and a gas engine which was used for driving one of the generators before the sewage flow was sufficient for operating the turbines continuously.

FIG. 2. THE BALTIMORE SPRINKLING FILTERS IN WINTER

The sand beds are of three distinct types. The original bed consisted of 30 in. of sand upon 6 in. of gravel, but because of poor drainage the sand depth has been decreased from time to time until at present it is 18 in. and drains satisfactorily. The setting-basin sand beds have a 12-in. depth of sand with no gravel except over the underdrains. The beds built in 1914 aggregate 5.17 acres and are constructed with 4 in. of sand on an 11-in. layer of gravel.

*Normal Operation Methods*—Baltimore has separate sewers connected to the sewage-works by a single large outfall sewer 30,370 ft. long, 12 ft. 3 in. wide and 11 ft. high. The sewage first passes through the bar screens, depositing an average of 35 wheelbarrow loads of rags, fruit peelings, sticks, etc., per day or 30 lb. of dry screenings per 1,000,000 gal. This material is removed by hand and sold to neighboring farmers. The liquid then continues on through the venturi meters, where it is divided, part going to the hydrolytic and part to the Imhoff tanks. The hydrolytic tanks are kept in operation until they show signs of undesirable septic action or until the laboratory analyses show the settling efficiency to be below normal. The supernatant liquid is pumped to one of the other hydrolytic tanks and the residual sludge is pumped into any one of the 19 separate sludge tanks. The Imhoff tanks, on the other hand, are run continuously except for a short interval every two weeks when about 600 cu.ft. of sludge is run out of each tank—producing good sludge. The effluents of the hydrolytic and Imhoff tanks discharge into the same channel and from there pass through the revolving screens. Here the finer particles which adhere to the under side of the screens are washed off by a continuous spray of purified effluent which has been pumped from the hydro-electric power house to a tower 128 ft. high. The return water from these screens is then run through two of the Imhoff tanks used temporarily for this purpose. A special tank to care for this return water will be constructed. The sewage then passes on through the control house to the trickling filter beds and from there through the final settling basins to the power house, thence through the land conduit, and is finally discharged into the river 2,500 ft. from the shore line.

The sludge from the hydrolytic tanks having been pumped into digestion tanks is removed from these when in the proper condition, spread upon the sludge drying beds to a depth of 12 in. and, when dry enough, is removed by cars to the Heineken Reduction Co.'s drying plant, where the material is dried still more, bagged and shipped for fertilizing purposes. The Imhoff tank sludge is removed from the drying beds by farmers who purchase it for 25c. per load.

There being two settling basins, one is cleaned while the other operates, the cleaning time being determined under conditions similar to those for the preliminary sedimentation tanks. These tanks are not normally cleaned as frequently as the primary tanks. When neither is cleaning both are in operation. The sludge from these tanks is either disposed of directly upon a sand bed provided for this purpose or, when not in the proper condition, it is pumped to any available sludge digestion tank.

### Operation Results for Nine Full Years

*Actual Operation 1911 to 1920 Inclusive*—Although the above outline is the method of operation to which it is well to adhere, actual conditions have not allowed this procedure at all times. Therefore an attempt will be made to show just what the more important changes have been and at the same time figures will be presented to show the results of such operation.

On Nov. 6, 1911, the first quantity of sewage recorded as having reached the plant was 2,411,000 gal., the same being a seven days' flow. From this time on until February, 1912, no consistent records were kept but after the latter date both operation and laboratory analyses records were made regularly.

During these early days the plain sedimentation tanks were used as a dosing chamber, the trickling filters being operated but once a day and then only for a short interval. As more laterals were connected the fill-and-draw method of operation was abandoned and the continuous flow for one bed adopted. The 1912 records show an average daily flow of 11,800,000 gal., whereas the 1920 flow was 52,120,000 gal. per day.

Owing to the fact that the outfall sewer had been designed to care for 1,000,000 people at 150 gal. per day the first few years of operation with a small flow saw the deposition of considerable solid matter on the bottom of the outfall sewer, as well as a distinctly septic sewage to be handled. The former difficulty could only be overcome by cleaning the lower end of the outfall until such a time as the flow should become large enough to produce a scouring velocity. The cleanings were made about twice yearly, the last in 1916. At the present time, with a normal peak load of 69,970,000 gal., the deposit from the outlet end to a point two miles up stream varies from 4 to 28 in. The cleaning was ac-

complished in the following manner: An adjustable dam, in cross-section the same shape as the lower part of the sewer but 1 ft. less in diameter, was hinged to the rear of a scow (see *Engineering News*, July 22, 1915, p. 178). To take the scow up stream a rope was attached to it and a man in a rowboat carried the free end to the first manhole, where he tied it to the iron steps. Then the men in the scow pulled themselves up to this point. The same operation was repeated from manhole to manhole, the dam floating in a horizontal position. When ready to start cleaning the dam was placed in a vertical position and braced with guy ropes which could be quickly released if necessary. The rapid flow of water beneath the scow and dam scoured the deposit and as the water backed up the dam would be suddenly released, thus carrying the sediment along. This procedure was not abandoned because the velocity had become sufficient to scour, although there is considerable improvement in this matter, but was discontinued because the volume of sewage is at all times of such an amount as to keep the flow line too high to allow sufficient head room for the scow and workmen.

### Hydrolytic and Imhoff Tanks

*Preliminary Sedimentation or Hydrolytic Tanks*—During the early years of operation the small volume of sewage received at the plant made it possible to clean the hydrolytic tanks every ten days to three weeks in the summer, and six weeks in the winter. When cleaned this often very little water had to be added to cause the sludge to run to the pump well from which it was delivered to the separate digestion tanks. This condition held because the scum had not had sufficient time to become thick and dry. At this time there was always one hydrolytic tank in service, one being cleaned and one in reserve. In June, 1916, the flow had become too great for one tank and a second one had to be placed in service for the peak load, making two in parallel. Although the Imhoff tanks began operating in August, 1915, it was necessary to continue the operation of two hydrolytic tanks, and eventually to run the two continuously in parallel. The reason for this will be mentioned when the Imhoff tank operation is considered. A gradual accumulation of sludge has put to use all the available storage capacity provided by the separate digestion tanks. This has resulted in less frequent cleaning of the hydrolytic tanks, which in turn has produced a heavy scum, pretty well dried out. This has of necessity increased the cost of cleaning because considerable water must be added to remove the scum and sludge to the digestion tanks.

Soundings made from 1915 through 1920 show that the cubic yards of 90 per cent undigested sludge produced per million gallons of sewage treated has been 5.70, 5.53, 7.34, 6.06, 5.14 and 6.37 for the respective years during this period. An average detention period of 3½ hr. produces the best effluent, and approximately 65 per cent efficiency, based upon settling solids removed, can be maintained under normal conditions.

*Imhoff Tanks*—The operation of the Imhoff tanks began in August, 1915, when 7 of the 28 were put into service. Each tank was "seeded" differently to determine the best method of producing well-digested sludge in the minimum length of time. Among some of the methods used was the addition of newspapers, lime, digested sludge, etc., but no advantage was found over the usual method of allowing the sludge to accumulate and digest in the natural way. Other tanks were gradually put into service until by March, 1916, all but two, which were reserved for activated-sludge experiments, were operating.

The tanks were operated at a low rate during the ripening period, which was rather long, but as soon as proper bacterial action seemed to have set in the rate was increased. Considerable trouble was soon experienced, with foaming and excessive scum formation. Sludge was removed as frequently as conditions would warrant, there being times when nothing but water could be drawn off, the sludge having gone to scum. The sloping walls were squeegeed by a regular attendant, but in spite of all this the scum in the sedimentation chamber at times reached a thickness of 2 ft. and more.

To prevent and quiet foaming a fire hose was used, but the best method was to shut the tank off from a few days to two or three weeks, during which interval skimming of the sedimentation chamber and spraying of the gas stack were usually resorted to. The tanks were then restarted very slowly.

Although these tanks were designed to treat 5,000,000 gal. each, per day, with a 50 per cent overload, the average maintained for about two years for 26 tanks was 4,800,000 gal. per day. That is to say, no more than this amount could be treated with a proper settling efficiency and without considerable scum escaping. At this rate, however, the average efficiency maintained was 61.6 per cent.

### Imhoff Tanks Taken Out of Service

On June 6, 1917, the Imhoff system was taken out of service because, at this time, the volume of flow had become too great for one sedimentation tank and the Imhoff tanks with their limited capacity, and not enough for two hydrolytic tanks and the Imhoffs. That is, if the latter combination were used the detention period in the hydrolytic tanks would become so long that odors would be materially increased. Another reason for discontinuing the Imhoff tanks was one purely local and strictly of a hydraulic nature. Because of the excessive loss of head through the Imhoff system the water level in the large effluent channel leading to the revolving screens had to be carried a foot lower than when the hydrolytic tanks operated by themselves, thereby reducing the available area of the revolving screens very considerably. Furthermore, as soon as the head in the outfall sewer dropped below a certain elevation the Imhoff system would stop operating and then as the flow increased the water would seek its level through the hydrolytic tanks because of the less loss of head through them. In consequence of this the sewage would enter the Imhoff tanks backward, thereby disturbing the scum, pieces of which would leave the tanks for an hour or more after they had started operating. This condition also tended to overwork the revolving screens.

When the Imhoff system was discontinued the average daily rate of flow was 44,380,000 gal., but by 1919 this had increased to 55,060,000 gal. This made it possible to restart the Imhoff system by slightly increasing the detention period in the hydrolytic tanks. With this end in view two tanks were remodeled and put in operation in May, 1919, for experimental purposes. The results of a long period of experiment warranted to change being made in all the tanks. Accordingly this work was car-

ried on as rapidly as possible and by January, 1921, 18 of the 28 tanks were in service. The alterations consist of a raise in the flow line so that there can be no back flow into the tanks, reducing the number of weirs in the outlet channel of each tank from 52 to 35, reducing their depth to 1 in. and closing permanently all but one of the ports in the bottom of the influent ring around the gas stack. This one port is closed with a wooden plug to which is attached a long handle so that the same can be withdrawn once or twice a day to flush the sediment out of the influent channel. The changes as made cause the tanks to operate with a

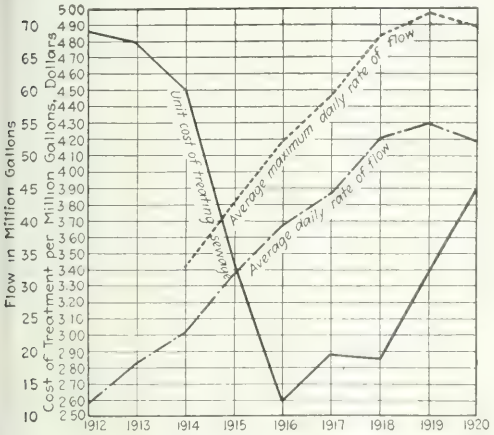



FIG. 3. DAILY RATES OF FLOW AND UNIT COST OF TREATMENT, BALTIMORE SEWAGE-WORKS

radial horizontal flow instead of a radial downward and outward flow.

The tanks now in operation give results practically as good as the two run experimentally, showing an average efficiency of 72.8 per cent, with a rate of 365,000 gal. per tank per day during 1920, as against 61.6 per cent, with a rate of 285,000 gal. under the designed method of operation.

Although they are not up to the designed capacity of 500,000 gal. per tank per day, it is the writer's belief that approximately this quantity could be treated if the hydraulic features were such that the tanks could operate the full 24 hr. instead of 20. It is interesting to note that with the revised tanks little scum has formed in the sedimentation chamber except for a short interval when the scum in the gas stack became so thick that it apparently short circuited and came up through the slot at the base of the flare wall. By removing some scum from the gas stack, thereby raising the bottom of the scum layer above the slot, this trouble was overcome. Very little trouble was caused by foaming, though when it did occur, it was easily controlled by the use of a hose for a few moments.

*Revolving Screens*—In 1912 two large revolving screens constructed of cast iron and steel, weighing approximately ten tons each and costing $9,645, were put in service. Because of their excessive weight they wore out the trunnions in ten days or less, whereas repairing the damage took about two weeks per screen. Thus they gave actual service less than half the time besides being very costly. After fair trial they were abandoned and the wooden screens designed by J. J. Neal, formerly superintendent of the plant, superseded them. As stated before, they were constructed principally of oak, were built with the plant force and weigh about 1½ tons each. There are four of these, the first of which was installed in January, 1914. The others have been built as needed and in consequence have cost different sums which may be stated as approximately $1,100, $1,500, $1.800 and $2,500, or a total of $6,900. They haxe given excellent satisfaction, no one screen having been out of service, on an average, more than two weeks per year because of mechanical difficulties. The Monel metal cloth is renewed from time to time and the screens are rewound with reinforcing wire. All told, each screen operates about 90 per cent of the time. The only important change in construction is the substitution of a 24-mesh screen for the 26-mesh since the latter has given trouble by clogging.

An idea of the efficiency of the screens is obtained by noting that when in service from 5 to 15 per cent of the sprinkling nozzles are cleaned daily as against 37 to 141 per cent when not running. As a result two men working eight hours daily are able to keep 30 acres of sprinkling filters looking well practically all the time. Furthermore, a series of analyses made in 1919 show that the return water from these screens contains 186 p.p.m. of suspended solids, consisting principally of surface floating material, such as grease, lumps of scum, etc. Approximately 100,000 gal. of purified sewage per screen is used daily for washing purposes.

### Treated Effluent Used to Wash Screens

The purified effluent used as a spray on the revolving screens is conveyed to them by means of 2½-in. pipes placed horizontally over the uppermost part of the screens. As the screens revolve with the suspended matter adnering to the under side of the wire mesh the spray of purified effluent washes this material off into a trough beneath the spray, which returns it to the Imhoff tanks previously referred to. These pipes were formerly equipped with a number of nipples having ⅞-in. orifices and acted as a reciprocating arm by means of a cam attachment. The orifices clogged readily and were hard to clean and the reciprocating arm gave mechanical troubles. Because of these facts the arrangement described was replaced by stationary pipes with an 0.008-in. width slot cut on the under side. Any clogging is now easily removed by sliding back and forth through the pipe and on the under side of the slot a small V-shaped piece of metal attached to the end of a long pole. The material broken loose in this manner is then removed from the pipe by flushing.

*The Trickling Filter Control House*—This has operated continuously, as designed, except for one or two changes. The automatic float switches for operating the filter beds have been abandoned because the operator was not always present to record the changes as they took place. Now the switches are operated by hand whenever the water level in the channel leading to the control house rises above or falls below a given elevation. This arrangement also allows a better operation of the Imhoff and hydrolytic tanks in parallel. The loss of head through the operating gates leading to the control house constant-head chamber proved to be so great that one of these gates had to be opened permanently. The butterfly valves, driven by friction disks, have given excellent satisfaction although the

blades have been broken or washed away occasionally, which has resulted in minor changes of reinforcement.

*The Trickling Filters*—In 1912 the filter beds operated 30.69 acre-days per week as against 125.08 acre-days per week at present. As additional beds were required a new bed was ripened by using it for a short interval each day at the start, then gradually increasing the daily period until, after about six weeks, it would be found normal. After being ripened the beds would be so rotated that the new one ordinarily would operate at least one hour daily and was never idle more than three days at a time. They have sluffed regularly and apparently to such an extent that from all indications it will not be necessary to remove the filter stone for cleaning at the end of ten years, as predicted by the advisory engineers, and it is doubtful that they will ever need to be removed for cleaning purposes. The pipe line installed in the galleries, carrying purified sewage for flushing the underdrains, has not been used for this purpose. However, the lateral distributing pipes have to be flushed occasionally. This was originally done by opening the valves in the galleries at the end of each distributor and allowing the sediment to drain into a wooden trough which emptied into the filter channel leading to the settling basins. This method was not entirely satisfactory because of the splashing over the trough and into the small underdrains. Now the laterals are flushed by removing the nozzle at the end of each distributing line, leaving it off during two cycles of the butterfly valve and then replacing the nozzle. Thus all sewage passes through the filter beds. Occasionally it is necessary to flush out this section of each bed with a hose. The laterals on each bed are flushed about once every ten days.

### Filter Operation

The cleaning of nozzles referred to when speaking of the revolving screens is accomplished by removing the nozzles and knocking the sediment off while the beds are running at the cleaning point, or at approximately one-third the quantity of regular service. At times of excessive flow, the butterfly valves are stopped entirely, so that the flow through the beds is constant and at its maximum rate, this being 1.39 times the normal rate. Although the advisory engineers recommended a rate of 2,500,000 gal. per acre per day the rate has varied considerably at times, but the yearly averages shown in Table I have been maintained with generally good nitrification.

TABLE I AVERAGE YEARLY OPERATION DATA BALTIMORE TRICKLING FILTERS

| Year | Rate of Filtration, Mil. gals. per acre | Nitrates, P.P.M. | Relative Stability Number |
|---|---|---|---|
| 1912 | 2.78 | 8.5 | 93 |
| 1913 | 2.64 | 8.2 | 91 |
| 1914 | 2.72 | 7.2 | 78 |
| 1915 | 2.88 | 6.2 | 87 |
| 1916 | 2.84 | 4.4 | 93 |
| 1917 | 2.96 | 7.4 | 92 |
| 1918 | 3.00 | 8.2 | 96 |
| 1919 | 2.79 | 7.7 | 89 |
| 1920 | 2.91 | 7.0 | 92 |

In spite of the regular cleaning of the nozzles a thin scale forms on the under side of the deflector plate, altering the radius of the spray to such an extent that the scale must be removed. This has been accomplished in two ways, one of which can be done in warm or windy weather only. That is, the bed is allowed to be idle for about two days, when this scale becomes thoroughly dried. The flow is then turned on and the scale flushes off. This method is objectionable because of the strong odor arising from the bed treated in this manner. The other method is efficient but laborious. The nozzle is boiled in lye water, scrubbed with a steel brush and then replaced.

Two alterations have been made in the nozzles proper. The threads of the cast-iron nozzle plates had gradually deteriorated until the nozzle would no longer hold in place.

Instead of using new plates a threaded brass bushing has been placed in the plates needing this revision and their life seems to be longer than under the original condition. Approximately 4,000 of the 5,830 nozzle plates have been altered in this manner. The other change has been to cut the threads off of the deflector plate stem as they became worn and loose and to rivet the stem into the nozzle base.

### Two Basins Run in Parallel

*The Final Settling Basins*—These basins, of which there are two, were recommended for a 3-hr. detention period, whereas actually the average for all the years of operation has been 6.04 hr. Originally it was possible to operate one basin while the other was being cleaned or held in reserve. As the flow grew larger it became necessary to run both basins in parallel. Then the loss of head through the mixing chamber and inlet valves to the settling basins proved to be so great that it was necessary to raise the walls of the channel leading to the mixing chamber, to build a bypass around it (to the settling basins) and to make additional inlet openings into the basins. It might be said, in passing, that the mixing chamber, originally installed for the addition of hypochlorite of lime, has never been used except experimentally, and then only once.

*The Hydro-Electric Power House*—This part of the plant has been operated as designed except for minor mechanical and electrical changes. When the plant first started it was necesasry to use the gasoline engine for generating electricity part of each day, but there has been sufficient sewage at all times since early in 1916 to allow the permanent closing down of this engine.

*(To be continued in next week's issue)*

## Hydro-electric Development in Italy

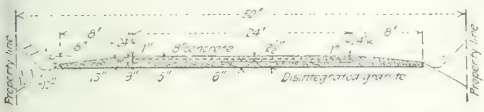
Commercial Attaché H. C. MacLean reports from Rome that during the war, in spite of the shortage of labor and the difficulty in obtaining equipment, hydro-electric development in Italy made rapid progress. It is estimated that whereas in 1915 Italy's electric power resources amounted to 2,500,000,000 kw.-hr. per annum, this figure had been increased to 3,700,000,000 before the end of the war, and now approximates 4,000,000,000. Whereas in 1915 the capital of Italian electric companies was less than 600,000,000 lire, it now reaches about 1,500,000,000 lire. During the five years from 1915 to 1920 there were completed new hydro-electric plants yielding 265,000 hp., and plants now under construction will yield 400,000 hp. additional. In these new undertakings it is estimated that approximately 1,200,000,000 lire will be invested. If studies now being made with the view to increasing further Italy's power resources are materialized an additional 1,000,000 hp. will be provided. Italy fully appreciates the exceptional value of its wealth with regard to water power.—*Commerce Reports.*

# Special Concrete Highway Built for Motor Trucks

## Methods in Laying Heavy Reinforced Section of Road Connecting Center of Los Angeles With Port District

AN 8-in. reinforced-concrete pavement 24 ft. wide is being laid from the center of the city of Los Angeles to the harbor for the express purpose of encouraging motor-truck traffic between the waterfront and the industrial districts of the city. The work is being done by Los Angeles County so no paving is being laid within city limits; a total of 13¼ miles is being built of which 7½ miles has already been completed. Features of the work are the methods used and care exercised to secure a very smooth dense surface. There are no sharp curves and the maximum grade will be 1.47 per cent. The total cost of the highway will be about $52,000 per mile, of which only a very small proportion is for grade separation and bridges.

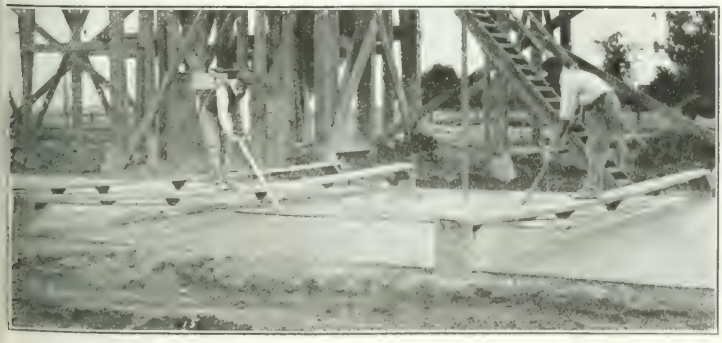
The earth formation traversed is, for the most part, light sandy loam. After the roadway had been graded with fresnos a 6-in. layer of decomposed granite was brought in to serve as subgrade. This was alternately sprinkled and rolled, with a little spotting here and there, until it had been worked down to a compact surface. A subgrade planer, traveling on the header boards and carrying several V-shaped sets of knife edges whose




TYPICAL SECTION OF SUBGRADE AND PAVEMENT

elevation could be adjusted by means of quadrants, was then drawn behind the roller, grading the surface to about 1½ in. above the level desired as finished grade. This was then rolled down to exact level. Two rollers were used, one weighing 12 and the other 15 tons. Shaping the subgrade and setting headers is being done for about 25 cents per lineal foot.

The 2 x 8-in. header boards are spiked to 2 x 4-in. stakes driven every 4 or 5 ft. Reinforcing consists of ½ in. deformed square bars, spaced on 18 in. centers both ways. This reinforcing is wired together in sections 7 ft. long extending the full width of the road.



TWO-MAN LONGITUDINAL FINISHING FLOAT WORKED FROM BRIDGES

POURING THE LOS ANGELES-HARBOR TRUCK PAVEMENT

These short lengths were adopted after it was found inconvenient to have the reinforcement under the mixer. There is just room to place a 7-ft. section on the roadway behind the mixer and ahead of the finished section of concrete. Steel is lapped 40 diameters at joints.

A three-runner sled is used for holding the steel up off the subgrade. This sled is made of 7-ft. pieces of 2 x 6's held on edge at quarter-points of the road width by ½-in. spacer rods. The rods extend through the runners between which pieces of pipe, slipped over the rods, are used to keep the runners spaced as desired. The sled is attached to the mixer and moves forward with it, and as it comes just to the end of the mixer spout it always slips out from beneath the reinforcing just ahead of the pouring.

The concrete is mixed in the proportion of 1:2:4, using a well-graded washed gravel with a maximum size of 3 in. The materials are piled on the subgrade ahead of the mixer; the cost of unloading from freight cars and hauling to the job is about 35 cents per ton. With an 8-in. pavement it was felt that there would be better opportunity to avoid air pockets and secure a uniformly dense mass if the mix was made rather wet as compared to the mix usually used for thin slabs. The mixer is advanced 3 to 4 ft. at each move. The only expansion joints used are those put in at the close of each day's run. They consist of asphaltic compound ½ in. thick.

Two mixers are used. One taking a three-sack batch has a crew of 22 men that ordinarily places about 175 ft. of completed pavement in 8 hours. This crew is distributed as follows: 1 mixer man, 1 finisher, 1 finisher's helper, 2 tampers, 2 spreaders, 8 wheelers and shovelers, 1 cement dumper, 1 material man, 1 chute man, 2 placing reinforcement, 2 covering and watering. The other, a 4½-sack-batch mixer, using a crew of 26 men averages about 325 lineal feet of completed pavement per day with the crew organized as follows: 1 mixer man, 1 finisher, 1 finisher's helper, 2 tampers, 2 spreaders, 12 wheelers and shovelers, 1 cement dumper, 1 material man, 1 chute man, 2

SHOWING POSITION OF SLED AND CONSTRUCTION OF TEMPLATE

placing reinforcement, 2 covering and watering. The largest yardage poured with the 4½-sack mixer in an 8-hour run advanced the pavement 371 lineal feet.

The template for finishing off was made 12 in. deep and well trussed to insure retaining the 1-in. crown on which the surface is finished. It weighs about 240 lb. In placing the concrete care is taken to keep the space between the header boards so filled that the template will carry at least 2 in. of concrete ahead of it. After the template, a hand roller is used to smooth off the surface. This roller, which is made of sheet iron, is 7 ft. long and weighs about 80 lb. It is drawn from side to side by ropes manipulated by men standing on the road shoulders. The roller is ordinarily passed over the surface twice.

The next operation is done with a two-man float worked from a pair of bridges spanning the roadway and from each of which a man can walk from header to header while working the float with a sawing motion parallel to the center line of the road. This float is worked across the road, keeping the advancing edge inclined slightly upward to rise over irregularities, until all traces of corrugations are removed. The float ordinarily moves, say, ¾ in. of concrete ahead of it. Successive operations of this float are made to overlap about 2 ft. to secure a continuity of the finish it gives. The float is made as light as possible so as to avoid bringing an excess of water to the surface. This float is 12 ft. long and 6 in. wide with a vertical rib in the center of its back. It is faced with light sheet iron.

Finally, a steel trowel is used to retouch the surface where the float may have left any irregularities. The finished pavement is covered with water, retained in the usual way with dikes and checks, which is left on for 14 days. Traffic is permitted after 21 days.

The work is being done by force account by the Los Angeles County Highway Commission under the direction of George W. Jones, road commissioner.

## Drainage Canal at East St. Louis

To intercept the hill water which flows into the bottom lands around East St. Louis, Ill., a canal is being built along the foot of the bluffs by the East Side Levee and Sanitary District, this canal connecting with the Prairie du Pont diversion channel which is nearing completion and discharges into the Mississippi River. As the levees of this channel are above the highest known flood level of the river, this disposal of the water will avoid the necessity of pumping the run-off from 80 square miles of hill territory.

The 11½-mile canal will have a low-water channel 11 ft. deep with 50-ft. bottom and 1 on 2 slopes, making a top width of 94 ft. On each side will be a 50-ft. berm to the levees, which will be 20 ft. high above the berm, with 12 ft. top and slopes of 1 on 2 and 1 on 3 for the canal and land sides respectively. This will give widths of 194 and 274 ft. between the toes and tops of the levees.

Contracts have been awarded to A. V. Willis & Sons and H. J. Sternberg, St. Louis, for the two lower sections, Nos. 1 and 2, 18,800 ft. and 17,200 ft. respectively. Two dragline excavators with 100-ft. booms and 3½-yd. buckets are now at work. These two sections will cost about $1,500,000, including right-of-way and bridges. The total cost of the entire three sections is estimated at $2,621,000, of which $1,621,000 is for the canal and levees and $1,000,000 for highway and railway bridges. E. R. Rodenberg is chief engineer of the East Side Levee and Sanitary District. This diversion canal was considered in the plans proposed by Alvord & Burdick, consulting engineers, Chicago, as described in *Engineering News-Record* of Oct. 30, 1919, p. 815, but it was recommended as a future supplement to a canal across the district and having a pumping plant. As the railways would have to pay a part of the cost of this latter work but are not financially able to provide the necessary funds at this time, the District has decided to proceed with the diversion canal as the first part of the project.

SUBGRADE PLANER CUTS SURFACE TO WITHIN ONE AND ONE-HALF INCH OF DESIRED GRADE

# Radio Replaces Telephone Lines on Remote Construction

## Avoids Line Maintenance Under Snow and Ice and Establishes Dependable Communication Quickly at Low Cost

TWO large hydro-electric construction projects are now being carried out by California power companies on which sole dependence is placed on radio as a means of communication. Both these jobs are in the High Sierras where the country is extremely rough and broken and where snow and sleet conditions very unfavorable to telephone line maintenance obtain in the winter time. The report of both companies is that the use of radio has been a pronounced success and will be continued as a permanent feature in their construction programs.

The Southern California Edison Co. in extending its system of generating plants in the Big Creek and San Joaquin River districts found it necessary to maintain reliable communication service between Cascada, the construction headquarters at the end of the railroad, and two other points farther back in the mountains. Natural conditions were not favorable for radio communications because Cascada is in the head of a canyon approximately 2,000 ft. deep with abrupt walls on three sides, and the other two points are 7 and 15 miles distant respectively in an air line, and are separated by a range of mountains 10,000 ft. high.

*Experiment Showed What Was Required*—Because of the high altitudes and the meager information available about radio communication in mountainous territory, considerable experimenting was done before the type of radio equipment to be used was selected. That these experiments were well justified was shown by the fact that sets which gave satisfactory service in the level country around Los Angeles were found to require about ten time more power for transmission over corresponding distances in the rough, high mountainous country. Continuous wave sets radiating 2½ amperes antenna current gave louder and clearer signals than damped wave sets radiating 4 amperes antenna current, and the former were adopted. The sets operate on a 440-meter wave length and the design is such that either telephone or telegraph may be used. The use of the telegraph was found to be the more practicable because of the comparative stability of the transmitting set as well as its greater range under unfavorable atmospheric or topographical conditions. The masts for the antenna at all three stations consist of tall pine trees stripped of their branches.

### Means of Supplying Power

The set at Cascada obtains its power from the generating plant located there, while the field sets are supplied by 220-volt, 3-phase motors, coupled to direct current generators wound for 32 volts and 1,500 volts respectively. Under normal conditions the 32-volt generator furnishes power for the filament and the 1,500-volt generator serves the plates of the thermionic tubes used in these sets. In case of failure of the transmission line which supplies both the field camps, power for the radio sets is supplied by the storage batteries of the mine locomotives which are in use at both camps. In this emergency the 32-volt generator is operated as a motor and drives the 1,500-volt generator. In case of a breakdown of either the motor or the generators the radio sets may still be used for telegraphic operation by means of a switching arrangement which makes possible the use of alternating current on both filaments and plates.

The success which has attended the operation of these sets during winter months under conditions where company officials regard it as doubtful if a metallic circuit could have been used, has led to very satisfactory reports of the use of radio sets and additional studies and investigations are now contemplated. During December, 1920, with the operators on duty 8 hours a day, approximately 32,000 words were handled between Cascada and the first field camp. This included a considerable amount of private commercial communication. The company has announced that a radio station somewhere near the proposed Colorado River development is planned so that direct communication may be maintained between that point and the general offices in Los Angeles, a distance of some 400 miles.

When the San Joaquin Light & Power Corporation last year undertook the construction of the Kern Canyon hydro-electric development, 125 miles from the headquarters office in Fresno, descision was made to place entire dependence on radio. Within a month after this decision was reached two 2-kw. sets, one at the site and one at Fresno headquarters, were installed, the total cost for the two stations is stated by company officials to have been approximately $750.

### The Damped Wave System

The transmitting equipment at both stations is the spark or damped wave system. Ordinary distribution transformers of 2-kw. rating are used to raise the voltage from 220 to 6,600. Other parts of the equipment were purchased from radio manufacturers and assembled under the direction of power company engineers. The receiving apparatus is the self-contained cabinet type supplied by any one of several manufacturers.

In the absence of an alarm or calling device, a schedule of operation is fixed for the day each morning; the operator coming on at the beginning of the day and after clearing all business in hand, setting a time for the next period of communication. Ordinarily there are about half a dozen intervals during the day when the two stations are in communication. While not actually operating the sets, the operators are kept busy at the drafting table or some other clerical work.

Thus far, under all weather conditions, the operation of these stations has been very satisfactory, power officials report, despite the necessity for erecting the aerial at the site not far from a high tension line from which some inductive interference was unavoidable. This company is also operating, in an experimental way, two radio telephone stations and has begun the assembling of portable radio sets which are to have a range of 25 mi. and will be used to keep the various construction camps in communication with the main or base camp during the construction of the Kings River hydro-electric generating station. The latter camp will be equipped with a larger radio set intended for constant communication with the Fresno head office. The prospects are, company officials state, that during the construction of extensions to this company's system in the mountain regions, radio will hereafter be depended upon as the chief means of communication.

# Railway Bridge Construction and Service by American and European Standards

## Higher Unit Stresses Used by European Designers—Soft vs. Hard Metal—Rigidity and Heavy Bracing of American Practice—A Comparative Impact Test with European and American Locomotives

BY P. H. CHEN
Engineer of Construction, Tientsin-Pukow Line, Chinese Government Rys., Tientsin, China

WHEN the writer came back from America about two years ago, he was very much interested in studying the present condition of bridges in China. To his great surprise some of the bridges, rated according to American standards, have a capacity of only about E10 to E30, while the engines now in service range from E30 to E45. This led the writer to compare the standards and specifications of American, French, British, Belgian, and German practice. Finally, the writer investigated the effect upon bridges of the locomotives manufactured in different countries.

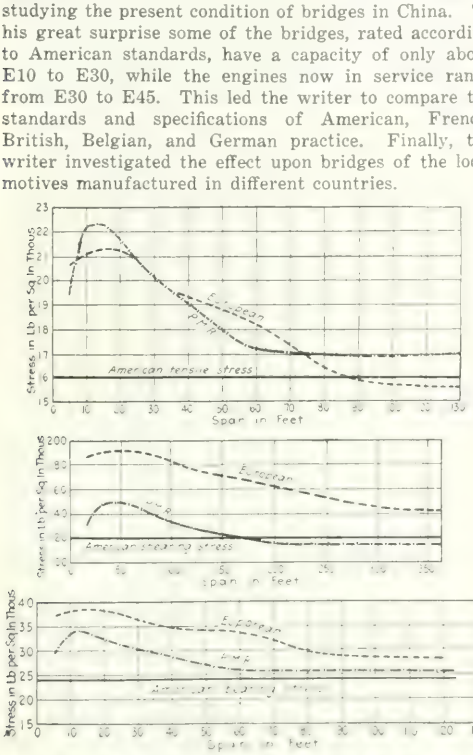



FIG. 1. UNIT STRESSES OF EUROPEAN AND AMERICAN BRIDGE PRACTICE COMPARED

The specifications and standards for bridge structures of different countries proved to be a great puzzle. The principal points of perplexity are those which effect strength and rigidity under railroad service.

*Unit Stresses*—European unit stresses seem to be high. Many people think that Europeans do not take impact into consideration; others hold that impact is covered by the allowed unit stresses. But it appears that the low unit stress used by Europeans is not low enough to equalize the impact allowance of the American formula, especially in short spans. The writer has taken live load, dead load, and impact into consideration in analyzing European allowable unit stresses, and the results are shown in the three diagrams reproduced herewith as Fig. 1. The excess of the equivalent European unit stress over the American is 40 to 60 per cent on short spans. It should be observed particularly that these large percentages affect the stringers and floor beams of every through bridge. This and some of the following matter are taken from a paper which the writer recently presented before the Association of Chinese and American Engineers.

The allowable shearing stress in continental Europe is 90 per cent of the tensile stress, or about 19,000 lb. per sq.in. as a maximum. In bearing, a maximum stress of 1.8 times the tensile stress or about 38,000 lb. per sq.in. is considered allowable. Rivet holes are sometimes taken as equal in diameter to the rivets. For these reasons stringer and floor-beam connections in European design seem to be weak.

*Quality of Material*—Some people think that European structural steel is of better quality than the American, inasmuch as European specifications prescribe higher ultimate strength. In the writer's opinion, the tensile strength to be specified depends on the amount of impact produced by traffic: If the American impact allowances are correct, the soft steel is desirable, while traffic that produces less impact would permit the use of higher carbon steel. American practice uses high-carbon steel for long span bridges, where impact action is small.

*Bridge Types*—Pony trusses are quite popular in continental European practice, while in America they are generally considered unreliable for railroad structures. It seems to be considered that any severe lateral vibration produced by passing trains might tend to throw out of line the top chords, with long column action and lacking bracing, and that this would reduce the degree of safety of the structure.

*Rigidity and Bracing*—The writer is greatly surprised to find marked differences in top-chord bracing between European and American designs. A corresponding difference is found in truss depth, and in general proportioning and rigidity of construction. This is represented by the accompanying cross-section of two bridges (Fig. 2), both in service, having the same span length and designed for almost the same live loads. The European bridge, at the left, seems to be weak and wanting rigidity; it is braced on top with only one 3 x 3 x ⅜-in. angle, without cross struts, while the American bridge is braced with two heavy struts, a full lateral system, and kneebraces. Moreover, the American bridge has a much greater truss depth, and the transverse frame is rigidly connected at both upper and lower corners.

As appears at once from the drawing, the European bridge seems weak and slender, while the American bridge looks stiff and rigid. Undoubtedly, Americans use a great deal more metal for bridges of the same span lengths with identical live loads.

*Differences in Locomotive Impact.*—The impact effect of three different locomotives on a 150-ft. bridge was measured by the writer on Feb. 17, 1921. The vertical

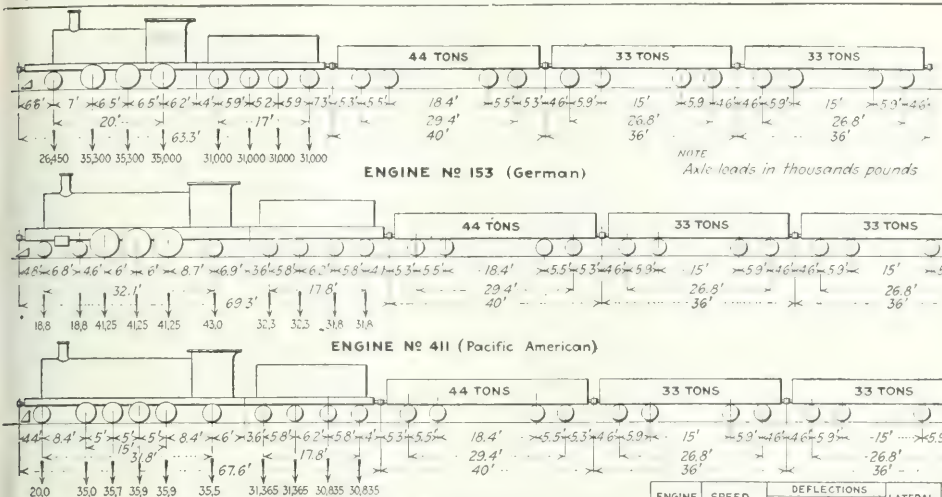



FIG. 3. IMPACT TEST OF 150-FT. BRIDGE WITH THREE LOCOMOTIVES
Vertical deflections and lateral vibration measured at different speeds.

| ENGINE Nº | SPEED, MILES PER HOUR | DEFLECTIONS CTR OF MIDDLE FLOORBEAM | DEFLECTIONS CENTER OF TRUSS | LATERAL VIBRATIONS | REMARKS |
|---|---|---|---|---|---|
| 153 | —— | 21.5mm | 20.0mm | 11.5mm. | Shaking not noticeable |
| | 20 | 22.0 " | 21.5 " | | |
| | 40 | 23.0 " | 21.5 " | | |
| 411 | —— | 24.0 " | 23.2 " | 4.8mm. | Shaking quite severe |
| | 20 | 27.0 " | 27.7 " | | |
| | 40 | 27.0 " | 28.0 " | | |
| 272 | —— | 24.0 " | 22.5 " | 7.0mm. | Shaking very severe |
| | 20 | 27.0 " | 29.5 " | | |
| | 35 | 26.0 " | 24.5 " | | |

Effect of Three Engines on 114-Ft. Bridge

deflection and the lateral vibration was measured, as recorded in the table included in Fig. 3 herewith. Though the work was done with crude instruments, the results were strongly in favor of European locomotives. The most astonishing thing was the severe lateral vibration caused by American locomotives. The writer is trying to continue the investigation with more accurate instruments.

Before the world war China used no American locomotives, and accordingly the bridges were designed to Belgian, French, British, or German standards. The Peking-Hankow line was the first Chinese line to try American engines; two severe bridge accidents resulted. The American engines which caused these failures were actually lighter than the French engines still in service. Bridge engineers design their structures so as to bear the traffic with a certain factor of security. If the locomotives of different countries differ, naturally the bridges are likely to differ correspondingly. This may tend to explain the differences in the bridge practice of different countries. As regards China, however, it is an unfortunate fact that it has bridges and locomotives designed for entirely different conditions.

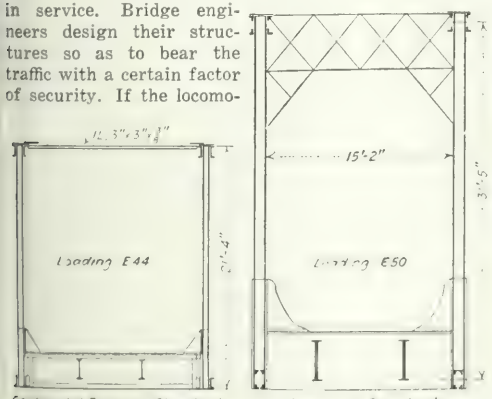



FIG. 2 CONTRAST IN CROSS-SECTIONS OF TWO 150-FT. BRIDGES OF SIMILAR CAPACITY

If engine designs could be improved so as to reduce impact, there might be a great saving in cost of bridge construction.

*Questions Concerning Bridge Design.*—The reasons for the wide difference in standards and specifications above referred to should be investigated. The American impact formula is certainly correct, as it was derived from the results of stress measurements, and has been carefully checked by a great number of well known engineers. On the other hand, the unit stresses of European practice must also be correct, because European engineers also have measured the actual stresses in bridge members.

Specific questions that present themselves are:

1. If American practice is correct, how can European bridges endure long service without signs of failure?

2. If European practice is correct, why do Americans waste so much money in building heavy structures?

3. If different conditions require different standards and specifications, how should Chinese practice be fixed for best efficiency and economy?

## Erie Reciprocating Pumps Should Have Lowest Cost

In a brief summary of the paper on the water-works of Erie, Pa., by J. N. Chester, published in *Engineering News-Record*, June 16, p. 1043, reciprocating pumps should have been credited with operating at lower cost than centrifugal in the four-day working test outlined in Mr. Chester's paper.

# Negligible Vibration Effects from Subway Traffic

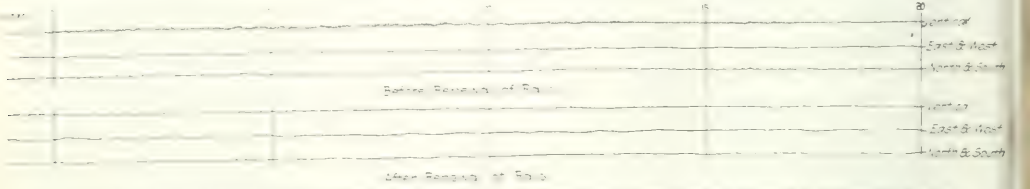
## New York and Philadelphia Experience Indicates Occasional Rumbling and Tremor But No Structural Effect

INFORMATION received from the transit departments of New York, Boston and Philadelphia in answer to inquiries as to whether structurally harmful vibrations originate from subway traffic and are transmitted through the ground to adjacent buildings indicates that no such effects occur. It was suggested by the report on the collapse of the Strathmore apartment building in New York (*Engineering News-Record*, Feb. 17, 1921, p. 315) that some kind of vibration might have been the immediate cause of the collapse, although the looseness of the structure of the building was ultimately responsible. As a rapid transit subway line passes the building, and the possibility that vibrations transmitted from the track might have played some part in the disintegration of the building, inquiries were addressed to the authorities of New York and Philadelphia as to their experience and observation of any possible effects of this kind.

Summarizing the experience so developed, it can be said that twelve to seventeen years' experience with many thousands of buildings of all kinds of foundation, type of construction and structural condition, located along high-speed subway lines, show no case of any disintegration or other discoverable harmful effect of subway traffic on adjacent structures. Only in relatively few cases is there audible rumbling or sensible tremor (vertical vibration). This evidence is essentially negative, but the large number of cases it covers makes it significant. Further, several buildings alongside New York subway lines, on soft-ground foundations, which had settled badly out of plumb due to actions occurring prior to subway construction or operation, show no effect of years of subway operation, either in increase of settlement or in evidence of disintegration.

In New York subway operation, according to Robert Ridgway, engineer of subway construction, a few cases of complaint of rumbling occurred early in the history of operation, and some cases also of alleged shaking or high frequency tremor. All these cases were investigated. E. G. Haines and A. D. Prince, of the engineering organization of the Public Service Commission, studied many or them by a seismographic recorder of the pendulum type, designed and built by the latter for the purpose. With the help of the records furnished by this instrument it was possible to eliminate numerous cases in which the effects complained of were not due to the subway but to the operation of pumps or other machinery in the buildings themselves, producing distinct lateral vibrations, usually of low frequency. In a few instances, as the Times building, the instrument demonstrated that vertical tremor occurred on the passage of trains. The tremor had a frequency as high as fifteen or twenty complete vibrations per second, and correspondingly small amplitude, the largest amplitude measured being about 0.004 in. vertical motion (in the middle of a floor panel). It was found in the case of the Times Building, which is located directly over a sharp curve in the subway line with its columns close to, though on separate footings from, those of the subway framing, that most of the disturbance arose from rail corrugation, and was largely eliminated when the corrugated curve rails were renewed.

Motions of the same order were recorded in several Brooklyn theater buildings where noise or tremor was complained of, though here the principal trouble occurred on the basement (ground) floor, which was concrete on the natural earth. In Carnegie Hall, in Manhattan, a faint sound is heard in the auditorium from the operation of the new Seventh Ave. subway alongside, but nothing has been observed in the way of vibration. Under similar circumstances, in the Academy of Music, a Brooklyn theater, a slight instrumental record was obtained, but no sound, from the operation of the Flatbush Ave. subway, 200 ft. away. The last example illustrates the transmitting power of the ground, in this case sand.




SEISMOGRAPH RECORD OF VIBRATIONS IN BUILDING CAUSED BY PASSAGE OF SUBWAY EXPRESS TRAIN
Curves taken both before and after changing of worn rails in track are shown. The record shows the movement at greatly magnified scale, being twenty times that of the actual movement of the structure. Practically all of the vibration was vertical.

Slight noise and occasionally sensible vertical vibration occur in one or two Brooklyn locations, also in sand (e.g., Joralemon St.). In similar locations, several complaints have been made, at different times, of a jarring effect of passing trains, that became noticeable suddenly, not having been troublesome before. Such effects were in all cases traced to a roughness of the track, such as a wheel burn of the rail head or a similar irregularity, and ceased on removal of the defective rail. The seismograph curves reproduced herewith illustrate the nature of such records.

On Fourth Ave., Brooklyn, there are several houses that are as much as 10 in. out of plumb (on a four-story height). These houses, whose condition is the result of settlement in construction, prior to the building of the subway, have stood now for nearly ten years with the subway operating alongside, with no change or any complaint of injury. At this point the subway is in four-cell reinforced-concrete structure. Many other cases along the various subway lines in the city involve houses whose structural condition is suspicious, to say the least, but no deterioration from subway effect has been observable.

As to the desirable degree of isolation of building structures from the subway structure, the view of the engineering staff of the Transit Construction Commis-

sioner of New York is that it is desirable to avoid direct contact. Complaint has resulted both in sand and on rock where steel or concrete parts of the two structures were rigidly connected; the connection apparently enabled high-frequency tremor to communicate from the railway structure to the framework of the building, so that the tremor is perceptible in the building.

Philadelphia experience is just as conclusive that no injury to structures results from proximity of rapid-transit subways, according to H. H. Quimby, chief engineer of the Philadelphia Department of City Transit. Even with buildings in very poor mortar, Mr. Quimby states, no injury results. He expresses the opinion, however, that if both building and railway roadbed are on soft clay or a mud bank, vertical vibration may be transmitted into the building, with the possibility of harmful effect to the latter.

### Effect of Surface Traffic

Surface street traffic produces the most sensible effect in buildings, Mr. Quimby has observed. Street cars with flat wheels or trucks rolling over rough pavements set up lateral vibrations which strike the foundation walls of a building sideways and tend to set up lateral vibrations of the structure. Studies that have been made in preparation for planning subway lines under theaters or similar buildings have led to the conclusion that no effect on the service of a theater is to be apprehended, and that practically all disturbing traffic effects complained of in various buildings are traceable to street traffic action.

In Boston the subject of vibration in buildings has been considered repeatedly, according to Ernest R. Springer (chief engineer of the city's transit department.) Twelve years ago the subject was given special attention, as summarized in the 14th annual report of the Boston Transit Commission (1908):

As a considerable portion of the Washington St. tunnel lies directly under private buildings, experimental study was given to the question of preventing annoyance to the occupants by sound and other vibrations caused by the running of trains. Among the means thought of were: (a) Building the track on separate foundations, like piles or piers, passing through the invert or floor of the tunnel and having little or no connection with said floor; (b) Substituting for the ordinary stone ballast some other support for the track itself, such as concrete made with portland cement or with asphaltic material.

Consultation on this general subject was had by letters with A. Mallock, who had made a careful study of vibrations in buildings near the Central London Ry., and directly with Prof. C. R. Cross of the Institute of Technology and with Prof. George W. Pierce of the Department of Physics of Harvard University, and others.

Mr. Mallock did not expect any benefit to result from the above named plans. His belief, based on his extended study and experience, was that relief was to be expected almost entirely from having the weight of the trains, as far as practicable, borne on springs. When trouble occurred on the Central London Ry. the non-springborne load of the locomotives there used amounted to about 8 tons per wheel, while with the motor cars which will run in the Washington St. tunnel the maximum non-springborne load will be only about 1½ tons per wheel.

Among other experiments a radial truck was used, with a non-springborne load, revolved by an electric motor on a circular rail, the latter having forms of support (a) and (b) mentioned above. Experiments were also made with standard cars, running on about 200 lin.ft. of track. The relative effects of various experiments were measured directly with the ear; also by observing with a telescope with cross wires the movements of an image on a surface of mercury; with the vibration instrument of Mr. Mallock and with the sound measuring apparatus of Prof. Pierce. The information obtained indicated that sound or sensible vibrations coming from the tunnel were much less likely to be noticed by occupants of buildings than vibrations caused by teams and cars on the surface of the street. It also appeared that the support of ties by means of ordinary stone ballast was nearly or quite as good as any form tried, and accordingly that method has been used in all parts of the Washington St. tunnel.

Summarizing all the experience in Boston before and since that time, Mr. Springer says that in general, although rumbling sounds are occasionally noticeable at some points, the effects in the way of vibrations in buildings are negligible. The first subway has been in operation for 24 years, and no complaints of vibration due to the operation are recalled. This first subway has been used largely for trolley cars, although for a while a portion of it was used for elevated trains.

The East Boston tunnel, used entirely for trolley cars, has been in service for 17 years. The Washington St. tunnel, used exclusively by elevated trains, has been in use for 13 years, and although it lies largely under private buildings there have been no complaints of vibration; rumbling sounds have been noted at certain places, however. The Boylston St. subway, carrying trolley cars exclusively, has been in operation for 11 years. The Dorchester tunnel, and the tunnel under Beacon Hill connecting with the Cambridge subway, has been used by subway trains made up of the heaviest type of car. This tunnel is built through very compact ground, composed largely of sandy clay containing small stones, and so hard that dynamite was used in the excavation. A slight rumbling sound may be heard when trains pass at a point near the westerly portal, where the cover over the roof is only 2 ft. No vibration has been noted, however.

## Copper-Bearing Steel in Atmospheric and Immersion Corrosion Tests

Exposure tests of numeorus samples of sheet iron and sheet steel conducted by the committee on Corrosion of Iron and Steel of the American Society for Testing Materials have progressed so far that the committee was able to report at the society's last meeting (June, 1921) that "copper-bearing metal shows marked superiority in rust-resisting properties as compared to non-copper-bearing metal of substantially the same general composition, from which superiority we may truly anticipate a marked increase in the service life for copper-bearing metals under atmospheric exposure of uncoated sheets." This conclusion was essentially based on the samples exposed at Pittsburgh, where, in 22-gage thickness, the percentage of failures among the non-copper-bearing sheets was as high in sixteen months (35.7%) as in copper-bearing sheets at forty-one to forty-six months (27.4-44.5), and the copper-bearing sheets in fifty-two months had fewer failures than the non-copper-bearing sheets in twenty-two months; and in 16-gage thickness the copper-bearing samples showed no failures after fifty-two months, while 43 per cent of the non-copper-bearing sheets of this thickness had failed. Supporting this series of tests, however, the committee finds that "the light-gage, non-copper-bearing bessemer and openhearth metals which failed first at Pittsburgh have also failed first at Fort Sheridan," where another series of exposures was made.

# Emergency Levee on Mississippi Built in Record Time

## Only Seven Weeks Required to Throw Up 240,000 Yards at Trotters Front for Protection of Yazoo Delta District

By A. L. Dabney
Consulting Hydraulic Engineer, Memphis, Tenn.

CONSTRUCTION of an emergency levee or loop 6,000 ft. long with an average fill of over 17 ft., containing 240,000 cu.yd., in seven weeks last January and February, was the result of the Yazoo-Mississippi Delta District being threatened by the continued caving of the river bank below the old levee at Trotters Front. At one time there were 1,040 mules on the work handling 184 wheel scrapers (with necessary "snap" and plow teams) and 116 "four-up" wagons. At the rate of work during maximum construction it would only have required twenty-eight working days to build the entire levee. The extent of the work and the caving of the old bank is shown in Fig. 1. A profile of the actual fill required for various stages of the emergency loop, or curtain levee, is indicated by Fig. 2. Sections of existing and emergency levees are shown in Fig. 3.

Occasions still arise when flood protection on the Mississippi River demands heroic measures. Such demands formerly were more frequent and exacting than now, and some of the accomplishments in earlier years bordered on the picturesque. Thus in 1897 when levees generally were below standard, the "Upper Yazoo" Levee District hastily raised fifty miles of its lines with temporary topping one-half to three feet high, keeping barely above the rising flood. Since that time the entire system of levees has been raised and increased in section, and except for a nominal cost for maintenance, there would be little further expense but for caving river banks.

A caving bank at Trotters Front, which suddenly assumed an alarming aspect, made necessary the building of an emergency levee; and probably the record for rapid levee construction has been made in the building of this "loop," now about completed. More than a mile of new levee, containing 240,000 cu.yd., was built by teams in about seven weeks. In one month nearly a mile of caving bank was revetted with temporary willow mats 75 ft. wide.

The emergency levee or "loop" is 6,000 ft. long, with average fill 17½ ft. It was built through woods where clearing and grubbing of the base and most of the borrow pits was necessary. One-fourth of the line is through cypress swamp, the fill ranging from 20 to 25 ft. for a distance of 1,200 ft. A series problem was drainage for the work, which had to be provided. Practically the entire work was accomplished between Jan. 1 and Feb. 15, 1921.

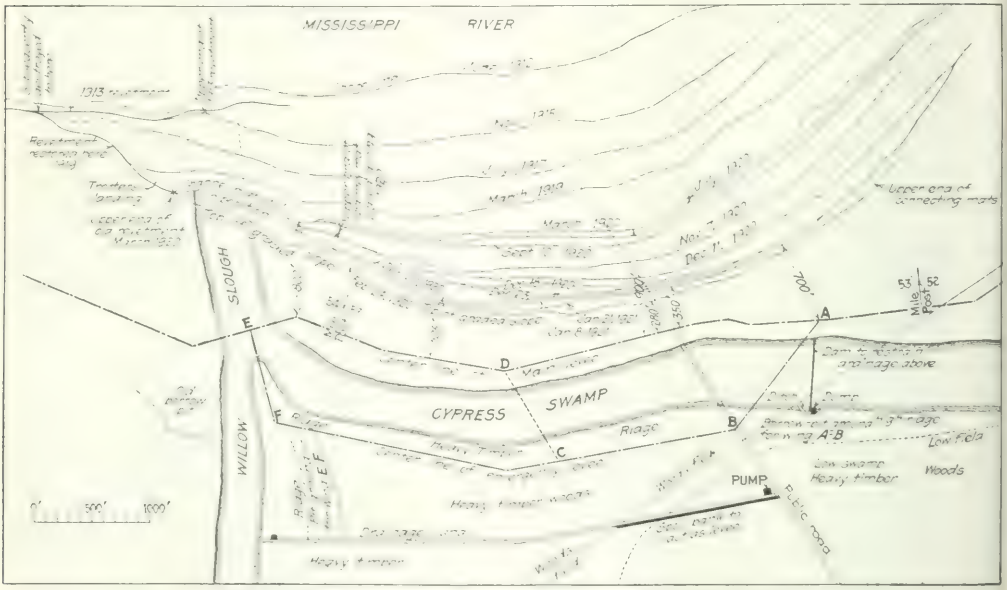



FIG. 1. EMERGENCY LOOP LEVEE BUILT BACK OF CAVING BANK

The levee, where threatened by this caving bank, is about midway of the system, 100 miles long, of the Yazoo-Mississippi Delta Levee District. This system protects 2,370,000 acres of valuable "delta" land, 550 miles of railroad and a number of prosperous towns. The total assessed value of property in the district (for state and levee taxes) is $115,000,000. A break here would have been a calamity.

In the past, many miles of new levee have been built to replace levee that caved into the river. The Federal Government has not, as yet, generally applied revetment to caving banks; although much revetment work has been done in isolated bends. For some years there has been concern for the integrity of the levee line at several caving bends in this district. The appropriations by the Government were insufficient to revet these bends as speedily as necessary to save the levee line,

and the Levee Board, in 1912, began a policy of contributing to the construction of river bank revetment on its front. Up to this time the Levee Board has contributed $962,-500 for revetment work and there are now 6½ miles of permanent revetment, most of which was built under this co-operation. The Government furnishes the plant, does the work and pays part of the cost. The extent of revetment that can be built in a season has been limited by both funds and the size of available plant; hence only the most critical bends have been treated.

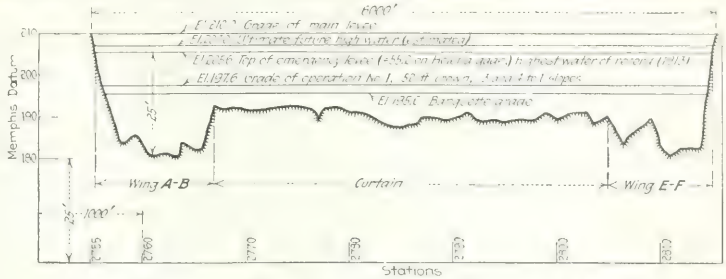



FIG. 2. PROFILE OF EMERGENCY LEVEE AT TROTTERS FRONT

While the bank along Trotters Front has been caving for many years, it was neglected because of more exacting demands elsewhere. In 1913 nearly a mile of revetment was built a short distance below the emergency levee, and in 1919 this was extended upstream to nearly opposite its lower junction, point *E* in Fig. 1.

It will be seen on the map that for a mile above the 1913 revetment, the bank caved, from 1912 to 1920, at a fairly uniform rate, averaging about 200 ft. per year, and that in March 1920, caving had advanced to within 800 ft. of the levee center at the nearest point.

It was designed to extend the revetment upstream, from the 1919 work, as far as practicable during the season of 1920, the Levee District paying $100,000 of the cost. It was expected that the season's operation would cover about 4,000 lin.ft. Because of the general labor shortage, normal progress was not made and up to November the extent of bank covered was only about 1,500 ft.

Early in November, it became apparent that the caving had assumed an accelerated rate. The river was at a low stage and the extension of a sandbar opposite had resulted in confining the water to a comparatively narrow channel against the concave bank. The bank here is sand from its top to below water. After this development the revetment plant was moved about 4,600 ft. upstream, from which point it was expected to work back. Three weeks were expended in futile efforts to get a mat down. Deadmen for anchorage cables would be placed as far as 100 ft. inland, and would cave off before the mat could be completed and sunk. It was then decided to rush the building of "connecting mats" along the threatened front, and a second fleet was ordered here to aid in this work. By Feb. 1, 1921, the connecting mats were continuous from the permanent revetment to above the upper junction of the loop. They were made 75 by 250 ft., the short dimension being transverse to the shore line. Before this work was finished, the bank had moved to within 350 ft. of the levee center. A persistent "Pocketing" above the mats, and grading to a slope, has since brought it within 280 ft. Construction of a second line of connecting mats, overlapping the first, was afterward undertaken.

The rapid caving, the small margin remaining and the uncertainty about holding the bank with the temporary revetment, made it imperative that steps be taken, at whatever cost, to build a loop behind the threatened levee. As first located (Dec. 23, 1921), the loop was 3,600 ft. long, the lower junction being at *D*, Fig. 1. During the next six days after this location was made, the bank 600 ft. below *D* caved, 140 ft., to within 525 ft. of the levee. It was then decided to extend to a junction at *E*, making the total length 6,000 ft. The extension was located about Jan. 1, 1921.

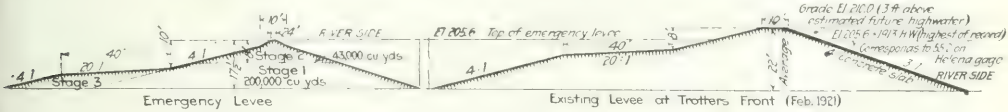

Stage 3
Stage 2
43,000 cu. yds.
Stage 1
200,000 cu. yds.
RIVER SIDE
El 205.6 Top of emergency levee
Grade El 210.0 (3 ft. above estimated future high water)
El 205.6 + 19.3 ft. W (highest of record)
Corresponds to 55.0 on Helena gage
Concrete Slab
RIVER SIDE
Emergency Levee
Existing Levee at Trotters Front (Feb. 1921)

FIG. 3. TYPICAL SECTIONS OF EMERGENCY AND EXISTING LEVEES

Occasionally the river rises above its banks in January; more often in February or March. This year, on Jan. 3, the stage at Cairo was about 20. The records show that in six years out of the last twenty Cairo reached 20 before Jan. 15 (including once late in December). On each of these six rises, Helena reached 37 (bank-full) before Feb. 20 (three times before Feb. 1). Three times, 47 at Helena was reached before Feb. 15. Evidently, then, if the main levee should be lost, only a few weeks could be confidently counted on for completing the emergency levee.

The consideration of speed in construction governed largely in the location. The line was placed far enough back to be safe for this season (probably longer). Inland from the adopted location the ground becomes lower; and to have lengthened the loop at either end would have increased the quantity of embankment, the length of haul and the borrow pit difficulties. The lower junction is protected by the permanent revetment. If necessary the two fleets could concentrate on the point opposite the upper junction and hold it. The caving was much lessened along the upper half of the threatened front after the river had risen sufficiently for a considerable volume to flow across the sandbar. As a result, very rapid caving occurred on the lower half.

The levee was built by team forces; 2-mule wheel scrapers and 4-mule dump wagons filled by traction-drawn loaders. The first force was moved to the site on Dec. 19 and began embankment work on Dec. 24. Prior to Jan. 3 comparatively little embankment had

been built; but progress had been made in clearing. On that date, at a conference of the chief engineer and consulting engineers of the district, it was decided that sufficient force must be employed to finish the levee by March 1, and that the work should be divided into two operations; the first being to build the entire line to an elevation 8 ft. below grade; the second, to complete it to grade. "Grade" is the top of the "topping." In this district the standard section has 10-ft. crown at grade, and any extension above this crown is regarded as a "topping" above grade. The banquette would be built afterward. If a pronounced rise should occur in the upper rivers, the entire line was to be rushed to grade-minus-eight at about half base width, and afterward widened. The borrow pits had been laid off, of liberal area, and drainage canals planned along their back side. One canal drains north and one south from about midway of the work. The south canal drains by gravity unless Willow Slough should rise. The north canal had to be pumped for every rain. It was decided to rush to completion the clearing of base and pits over the entire line, to employ as many teams as could be worked without congestion and to assign an engineer for the sole duty of keeping the borrow pits in such shape as always to drain promptly. All borrow pits were worked out beginning at the back. There were available two centrifugal pumps, total capacity 2,500 g.p.m. These were held for the south canal. For the north canal 3,000 g.p.m. pumping capacity was purchased (to handle 3-in. runoff per 24 hr.).

### Record Construction

It was estimated that during January and February 26 working days could be counted on; and that the force must be made adequate to complete the work within these months. All forces then in the district were moved to this work and all available forces for some fifty miles above and below the district were secured. About 40 per cent of the force was from other work within the district. All forces were paid by the day. The maximum force was at work on Jan. 22, and consisted of 184 wheel scrapers (with necessary "snap" and plow teams), and 116 'four-up" wagons. There were 1,040 mules working on the maximum day, or more than a mule to every 6 lin.ft. of levee. There were 7 tractors and loaders at work.

The two "wings," involving long haul, were assigned to wagon forces. On the "curtain," the embankment was divided among the scraper forces. For assigning the work so that all parts of the line would be completed at about the same time, so that in handling the distribution of forces there was no crowding nor confusion, and for handling the borrow pits so that work was always resumed the next day after a rain, much credit is due the chief engineer and resident engineer of the work. Stage 1 was completed, on the curtain, Feb. 6; on the wings Feb. 18. Stage 2 was completed, on the curtain, Feb. 15; on the wings, Feb. 24. Construction of stage 3 (the banquette) was then undertaken with a greatly reduced force.

The season was more favorable than was expected, resulting in the loss of fewer days from rain. The actual time was 27 working days for stage 1, and 7 for stage 2. At the rate of work accomplished per team, the full force would have built the entire line in 28 working days. The longer time resulted from the delay in building up the force to maximum.

W. M. Gardner, U. S. assistant engineer, had charge of the revetment work, under direction of Major J. N. Hodges, Corps of Engineers, U. S. A. W. J. Shackleford was superintendent of the revetment fleets and forces. Major T. G. Dabney is consulting engineer and W. L. Head, chief engineer of the Levee District. Mr. Head was immediately responsible for engaging, assembling and distributing the forces. A. T. Blythe was resident engineer in direct supervision of the levee construction. The writer was called in consultation by the consulting engineer and chief engineer of the district and was in close touch with the work throughout.

## Highways Policy in Britain

THE British Ministry of Transport has issued the tenth annual report of the road improvement fund covering the year to March 31, 1920. A grant was authorized in December, 1918, by the government to assist highway authorities to cover arrears in road and bridge work which had accumulated during the war. The fund devoted to the road and bridge program for 1919-20 amounted in all to £10,536,000, of which £10,000,000 was allocated to Great Britain and the remainder to Ireland.

Few authorities were able to complete their programs owing to the difficulty of obtaining materials. A large proportion of the money has gone toward the improvement of roads in and about London, the borough councils receiving roughly £1,000,000.

In the meantime the Road Improvement Association has criticised the ministry's delay in making grants to local authorities for road improvement and maintenance on the ground that, although nearly £8,000,000 has been gathered in motor taxation, none of this amount has so far been allocated. In reply the director-general of roads says that the financial year of the local authorities began on April 1, and that, as grants are only to be made quarterly and not in advance, the first payment is not due until July 1.

The system suggested on which payment should be made is that the certificates of expenditure of the local authorities, when passed by the Ministry of Transport, will be honored to 90 per cent, the remaining 10 per cent being paid at the end of the financial year.

A sum of £1,250,000 has been allocated to the arterial roads scheme, and £1,750,000 for main roads during the current year will be borrowed from the Treasury.

Some concern is felt for the future road policy in England. It is generally believed that the Ministry of Transport will cease to exist with the decontrol of the railways which is due next August. In some quarters it is suggested that the roads department be taken over by the Board of Trade, as the general policy of road construction is widely approved.

It is fast becoming evident that the growth of road transport has overtaken the existing highways, and it is urged that some authority must be created to control and pursue the laying out of new arterial roads, the co-ordination of road construction and repair and maintenance of roads on a national basis.

# Engineering Courses Should Be of Professional Grade

## Prof. Wm. H. Burr Argues that Technical Study Should Be Preceded by Three Years of General College Work

*As stated in the News Section of this journal last week, the leading feature of the annual meeting of the Society for the Promotion of Engineering Education was a paper by Prof. Wm. H. Burr, formerly professor of civil engineering in Columbia University, and now in consulting practice in New York, arraigning the society for neglecting its opportunities and urging that engineering education be put upon a "professional" basis, that is, that it be preceeded by three years of liberal study in college. The paper, printed here somewhat condensed, warrants close study and discussion by practicing engineers and by engineering educators. We should be glad to print their views in these columns.*—EDITOR.

One may reasonably be surprised, if not bewildered, in looking over the *Bulletins* issued by the Society for the Promotion of Engineering Education and the annual reports of the same body, to observe both the range and the quality of the observations made for the purpose of advancing the efficiency of engineering education. Indeed, both the scope and the range of subjects covered by these observations are so far-reaching and so varied that one wonders whether there is any point of stability in the whole field. The variety of suggestion and the range of subjects from the most fundamental and important to the inconsequential and commonplace seems to indicate that no two individuals, whether teachers or practicing engineers, have any substantial thing in common. In other words, the whole field of engineering education seems to be in a dynamic condition, or perhaps one may better put it as a state of violent ebullition without any surface evidence of having stable strata at any depth whatever.

### Professional Status

For some reason members of the principal engineering societies and associations of this country are deeply dissatisfied with their professional status as indicated by the failure of the public, as they claim, to give members of the profession proper consideration in their professional work. There have been many meetings, joint and individual, of these societies and associations, for the purpose of discussing this failure to receive sufficient professional recognition from the community at large. New organizations have been created recently to secure better professional recognition.

Doubtless much can be done to relieve this situation among experienced practitioners, but the greatest influence is that which can be exerted through suitable and effective professional educational training. If the Society for the Promotion of Engineering Education had had as a body a true vision as to what it could and should have done in developing wholesome and effective ideas of engineering education, it is not unreasonable to suppose that the present unsatisfactory and disappointing condition of the profession could have been prevented. This was the proper mission of this society and it has failed fundamentally in it. * * * This society owes to itself the recognition of an obligation to reform as far as it can the present conditions of engineering education and undertake the organization of some systematic effort to ascertain what engineering education really means so as to formulate an effective plan for rescuing it from the morass of technical confusion into which it has fallen.

At the present time, and therein lies the origin of all our difficulties, the colleges and the professional schools of engineering are made a hopeless jumble which has received the constant sanction and support throughout all these years of this society. A great majority of the engineering schools of the country are called "colleges of engineering." Obviously the mere name of an educational intsitution is of quite subordinate consequence in itself. "A rose by any other name would smell as sweet," as we know. In the present instance, however, calling a professional school an "engineering college" makes a course of study which ought to be thoroughly professional in character merely a scientific college course, and that is the fatal defect of a great majority of the engineering schools of this country. They are neither professional schools nor are they in reality colleges. They are a kind of hybrid that produces neither the broadly educated college man, nor the educationally trained professional man. Some of them have served well a transition purpose, but the type is far from that of a professional school.

More than seventy years ago the oldest engineering school in America, Rensselaer Polytechnic Institute, reorganized its professional course of study with a vision as to the future both wise and remarkable. It sought to establish a professional school of engineering and applied sciences by formulating a course of wholly professional study of three years' duration to which college graduates were invited to come for their professional engineering training. It was fully fifty years in advance of the time when such an effort could possibly succeed. The experiences of the first year of this course of professional study showed that it then had no prospect whatever of success. To remedy the difficulty a preparatory year of study was formulated so that non-college graduates could thus prepare to begin the three-year course of professional educational work, making four years in all. This was the origin of the prevailing four-year course of engineering study which has become so general throughout the United States. It would appear that the idea of basing professional engineeering educational training on a broad general schedule of study such as that afforded by the usual college course has somehow dropped out of all consideration whatever, except in a few rare cases. There is distinctly a feeling that something needful is not included in the present engineering courses even in the minds of those who administer and defend them, and their apprehension is too well founded. There is something of the utmost importance lacking. Both students and instructors of those institutions yield, although unconsciously, incontrovertible evidence of that fact. It is only necessary to glance over the *Bulletins* and annual reports of this organization to be convinced of this situation.

If the Society for the Promotion of Engineering Education should advocate a definite, well-considered plan of professional education for engineers and direct its support to such a plan through its annual meetings and publications, it would give confidence and inspiration to the professon and thus greatly influence its reception in at least the leading engineering schools of the country.

### Comparison With Law and Medicine

I am well aware that many engineering instructors and practicing engineers who are interested in engineering education argue that the engineering profession is in some way so different from the learned professions of the law and medicine in its character that the general type of educational training which they have adopted for entrance into

those professions, is not suitable for the educational training of young engineers. They now require in their best professional schools a broad general education acquired in the college on which to base the professional educational training. Anyone who is observant enough will find that a large proportion, and probably the majority, of those two professions who have reached the beginning of middle life, are men, broadly speaking, not only of technical ability and excellence but who possess what may be termed in the broad sense, cultivation. They can take their places with credit to themselves in any place in the community where they may be called. They possess individuality and those qualities of mind and character which demand and receive public recognition both in and out of their professions. It is not necessary to enlarge upon the lack of such acknowledged position in the community on the part of engineers for they themselves have set it forth within the past few years in clear and unmistakable terms. All such curative efforts made through engineering organizations, however, are bound to fail in large part as they have failed up to the present time, unless one fundamental condition is first fulfilled and that is, the engineer must have a full professional education as a basis for his professional career before he can properly demand or be accorded by the public, full professional standing. Indeed, if it were feasible to give every engineer in the country a suitable professional educational training the profession would in a short time attain to the high position which it covets and be accorded by the public every advantage which it is now striving to attain without any other aid whatever, just as the professions of law and medicine have done.

The high position and the great advantages reached by any profession are actually due to the acknowledged character and attainments of a majority whose capacity and character make them marked individuals and whose prestige gives standing to the entire profession.

### Introducing Six-Year Course

The four-year course of engineering study has served a purpose and served it well but, I believe it may be stated without being effectively controverted that by far the best results have been reached where the course of engineering study has been based upon the broad course of general educational training given by colleges. I know that the usual standard objection will be made that there are few young men in the community who have sufficient time and means to take seven or eight years for such a course of study. In the first place it may be flatly stated that young candidates for law and medicine find it feasible to devote sufficient time for the desired purpose and I know of no reason why young candidates for the engineering profession may not do the same thing if they have sufficient virility, resolution and, I hesitate to say, intelligence. In the second place, I can state from personal knowledge and experience that seven or eight years are not required. Six years are ample, three years in the college and three years in the engineering school. If our secondary schools were administered a little more intelligently it would be not only perfectly feasible but easy, as it has been in many cases, to give a young man this six-year engineering course of study and graduate him ready to begin his active practice at twenty-two years of age, which is a less age than that at which many and perhaps a majority of young men graduate from the standard four years' engineering course.

In the case of the four-year course, the student not having had any prior general education at a college or elsewhere, it is probably wise to introduce as much English instruction during the first year as is practicable. A similar observation can properly be made in reference to one prominent modern language such as French or Spanish. Such general cultural subjects, however, should be limited to the first of the four years, and as soon as the required development permits the installation of a prior general education in a college of cultural or liberal arts work these subjects should be confined to that part of the educational training, leaving to the professional school the entire time set apart for technical work. Doubtless in some or even many localities it may be a considerable period of years before it would be feasible to reach the full professisonal educational training consisting of a broad general education of not less than three years, leading to the professional school having a course not less than three years in length, but that is the end toward which all possible efforts should be directed. College courses taking no more than three years' time are now common. It has been demonstrated over and over again in some of the most prominent colleges in the country, and it has further been demonstrated by actual operations, that in that college course mathematical and and scientific studies may be taken to such an extent as to include all similar subjects found in the first year of the best four-year courses, thus completing in a three-year course in the professional school all the educational work now comprised in an engineering course of the highest grade. The complete educational training from college entrance to graduation from the professional school thus covers a period of six years only. Actual administration of such a course has already shown that it is entirely feasible to carry on at any educational establishment of the higher order the four-year course and the six-year course in parallel, so to speak, making it entirely feasible to maintain the full attendance of the four-year course in addition to students who are taking their educational training on the six-year basis. Naturally in such a case, as many legitimate attractions as is possible should be given to the administration of the six-year course so as to encourage the growth of that part of the professional school to the greatest extent practicable. In such a case it would not be necessary to drop the four-year course until such time in the future as the attendance on the six-year schedule would justify it.

It is no exaggeration to state that the hope of the future of the engineering profession in this country lies in the development of a proper professional engineering education which with exceedingly few exceptions has not yet been attained. There is no field in which this society could gain prestige or render greater service to the engineering profession and to engineering education than to take formal action in the encouragement of this development. The position of the legal and medical professions point the way with absolute clearness. The engineer must be made a man of cultivation as well as of technical excellence. In order that he may become the most useful citizen possible he must combine with his rather narrowing technical excellence those qualities which give him character and standing as an individual qualified to win the esteem and respect of those about him for his executive capacity wherever he is found to possess the executive quality. In other words, he must be a man entitled to receive the confidence of the community in which he practices.

## Co-operative Reconstruction in France

During the last year the co-operative movement in the devastated regions of France has made considerable progress; in fact, at the present time the greater part of reconstruction work is executed by such societies. Both the government and the population of the devastated localities have found these methods of the greatest practical value. Furthermore the government encourages their organization and development. Since the beginning of 1919, 203 co-operative societies have been organized in the Department of the Meurthe-et-Moselle. They have already obtained important results. On Dec. 31, 1920, urgent repairs had been made on approximately 12,000 buildings. The sums disbursed for these repairs amounted to 124,430,000 francs, or 81 per cent of the total sum paid out for this purpose in the Department. In 1920 the co-operative societies commenced the building of 621 farm buildings, or 88 per cent of the total in the Department. The sums disbursed for the above purposes amounted to 20,250,000 francs, or 95 per cent of the total.—*Commerce Reports.*

# Automatic Single Rope Cableway For Material Handling

AN AUTOMATIC single-rope cableway, requiring but one hoisting cable for its operation, and operating on a track cable stretched between two towers, is being used in the automobile manufacturing plant of the H. H. Franklin Manufacturing Co., Syracuse, N. Y., for storage and rehandling of coal.

The operation of this layout is essentially as follows: A track cable is stretched on a slope between two towers. Upon this cable rides a carriage to which a clamshell bucket is suspended by a bale. The hoisting line extends from the engine over a sheave at the top of the tall tower, commonly called head tower, beneath the track cable to the carriage, over a sheave

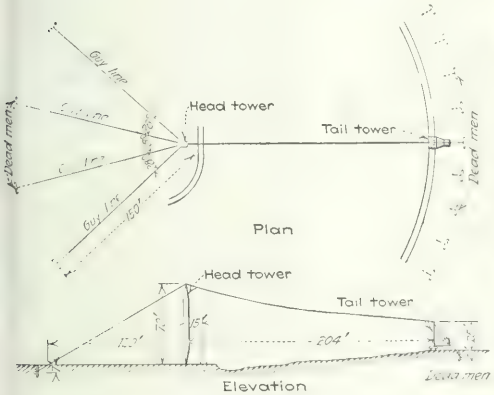



FIG. 1. GENERAL LAYOUT FOR INSTALLING AUTOMATIC SINGLE ROPE CABLEWAY

n the carriage, through the bucket and back to the carriage where it is made fast. When this line is paid out the carriage-carrying bucket suspended below is moved down the track cable until it reaches the lower stop.

When there, a latch on the end of the carriage automatically engages the stop, the bucket bale is released, and the bucket is lowered by further paying out of the line. A pulley upon the line closes the bucket and lifts it with a load of material. When the bucket bale enters the carriage it is locked thereto and the carriage is automatically released from the stop, so that it is free to move upward along the track cable until it encounters the upper stop. The line is then paid out, the carriage engaging itself to the upper stop and releasing the bucket which is lowered.

As in use in the Franklin plant, the tail tower is an A-frame mounted on a car which runs on a track that describes a circular arc about the head tower. A fan-shaped storage space for coal is then provided. The length of track cable between towers is 220 ft. A drawing showing the layout of this installation is shown in Fig. 1.

The bucket may grab a load beneath either stop, but it cannot leave the carriage between stops. To shift the point where the load is taken it is necessary to shift a stop. This is made an easy matter by providing hand lines from the stop reaching to the ground. When these are pulled the clamps that hold the stops from

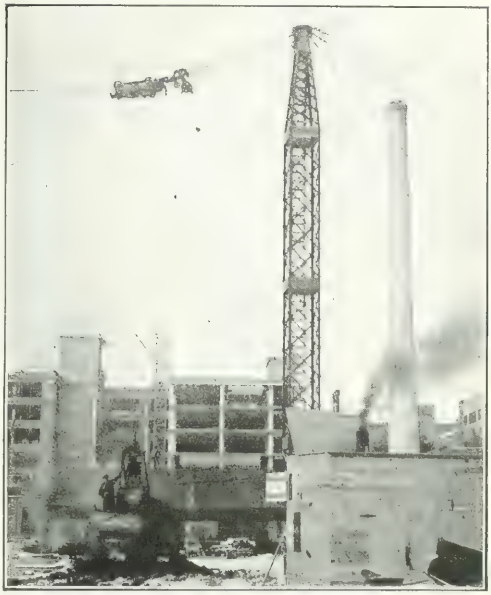


FIG. 2. DISCHARGING A BUCKET LOAD AT THE FRANKLIN PLANT

slipping along the track cable may be tightened or loosened.

Any hoisting engine or motor capable of lifting one-half of the weight of the load bucket may be used, but the speed of operation depends upon the size and speed of the engine, and if a new hoist is to be purchased for the installation it should be capable of high sped.

The information contained in this article is given by Blaw-Knox Co., Pittsburgh, manufacturer and distributor of the automatic single-rope cableway herein described.

## Formulating Tire Specifications for the Government

According to a statement issued by the Bureau of Standards, standardization and revision of the government specifications for rubber tires are in progress, under a procedure explained as follows: On April 8 a meeting was held at the invitation of the Motor Transport Corps, where the different tire companies as well as seven government department and four boards or commissions were represented. Ways and means for revising government tire specifications were discussed. Specifications prepared by the Bureau were submitted, and in discussion various changes were suggested. It was decided that a copy of the specifications together with the recommended changes should be sent to the Rubber Association of America for consideration and possible further revision. On return of the revised draft a second meeting is to be called for further consideration of the problem. It is understood that the Bureau will issue the final specifications as a desirable government standard for rubber tires when the views of all interested parties have been considered.

# Joint Committee's Tentative Concrete Specifications

**Preliminary Draft Differs From Earlier Reports Mainly in Leeway Allowed in Proportioning, Emphasis on Workability of Concrete and in Details of Column and Flat-Slab Design**

TENTATIVE specifications for concrete and reinforced concrete prepared by the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete have been submitted to the five contributing societies—the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the American Concrete Institute and the Portland Cement Association. This new Joint Committee was organized Feb. 11, 1920, and since that time has been having numerous meetings. The present tentative specifications are in printed form and are to be subject to discussion in each of the contributing societies, these discussions to be submitted to the committee for reference by June, 1922. After the discussions have been considered by the committee, which meantime is meeting regularly, it is expected that a final specification will be prepared for the approval of the constituent societies.

### Specifications

Preparation of specifications, was not considered a part of the duty of the Joint Committee that presented its final report in 1916. The present committee states in the preface to its report that it has "undertaken to prepare specifications covering the fundamentals to be observed in the general use of concrete and reinforced concrete. No attempt has been made to cover the details involved in the use of these materials in special structures. While the sections relating to design deal primarily with building construction, nevertheless the principles involved are in general applicable to structures of other types. It is expected that in using these specifications the necessary supplemental requirements will be added covering details." Furthermore, there are in the tentative specifications several alternative sections, which in some cases represent a difference of opinion on the part of the committee and in others represent equally good methods, any one of which may be used by the engineer using the specifications.

The specifications are prefaced by a list of definitions, which do not differ from accepted practice except possibly in the regular use of the adjective "portland" modifying cement wherever it is used in relation to concrete.

Under the heading, "Quality of Concrete" it is stated that "quality shall be expressed in terms of workability as determined by the slump test and of the compressive strength at 28 days as determined by concrete tests of the materials to be used as specified." The proportions required to produce concrete having the strength specified shall be determined in advance of the mixing of the concrete. No definite strengths, such as were in the earlier report of the committee, are given.

Under the heading, "Materials," portland cement is defined by the A. S. T. M. standard specifications. Fine aggregate has the same general definition as in the earlier report, but is recommended to be graded as follows: not less than 95 per cent through a No. 4 sieve; not more than 30 per cent through a No. 50 sieve, and not more than 3 per cent weight removed by decantation. Fine aggregate must show a compressive strength at 7 and 28 days not less than that of 1:3 standard Ottawa sand mortar of the same plasticity made with the same cement, but a new sentence is added which states that fine aggregate which fails to meet this requirement may be used, provided the proportions of cement, fine aggregate, coarse aggregate and water are such as to produce concrete of the strength specified. The Abrams-Harder colorimetric test for organic impurities in sand is specified but sand which shows a darker color than the standard color when tested according to that method may be used if the concrete made with the materials and in the proportions to be used on the work is shown by test to be of the required strength.

Coarse aggregate is defined as "crushed stone, gravel, or other approved inert materials," with the usual characteristics but a grading is submitted with blanks to be filled in, although a table gives desirable gradings for a coarse aggregate for certain maximum sizes.

Nothing radical is in the sections on "Rubble and Cyclopean Aggregate," "Storage of Aggregate," and "Water." The section on "Metal Reinforcement" allows both billet steel and rail steel bars as provided for in the specifications of the American Society for Testing Materials, except that the provision for machining deformed bars before testing is eliminated. A footnote gives preference to billet steel pins. Sizes and areas of reinforcement bars are specified according to the standards developed during the war and since then accepted by the American Concrete Institute. A sentence states that "an approved deformed bar shall be one that will develop a bond strength at least 25 per cent greater than that of a plain round bar of equivalent cross-sectional area," but a footnote reads "The committee has under consideration a specification for deformed bars but is not prepared at this time to make more definite recommendations." Structural shapes and cast iron used as a reinforcement have to follow the A. S. T. M. specifications.

### Mixing and Proportioning

Section V, on "Proportioning and Mixing Concrete," is new and different from anything that has been prepared in official specifications before. Provision is made for alternate measurements either by volume or weight, leaving it to the engineer to decide which one he will use. Three alternate methods are given for the proportioning of the mix. The first establishes the old quantitative mix such as 1:2:4, the exact proportions to be determined by the engineer from concrete tests of the materials to be used. The second specifies that the contractor shall use materials, so proportioned and mixed, as to produce concrete of a required workability and strength. The third specifies that the proportions shall be quantitative, but shall be selected from a table, which is given, similar to the well known Abrams table for proportions of any size of aggregate for certain slump values to give certain strengths.

There is a new paragraph on "Consistency," which requires that the engineer shall determine and specify the consistency of the concrete by the slump test as specified in the American Society for Testing Materials, and a blank table is included giving the maximum slump

for various kinds of concrete, though a footnote gives suggested values for these slumps.

Mixing provisions are not very different from established practice (1½ min. minimum time of mix) except possibly for the phrase "the mixer shall rotate at a peripheral speed of about 200 ft. per minute." Section VI is on "Depositing Concrete," which has nothing radically new, but there is a paragraph on "Compacting which provides for rodding, forcing, tapping or hammering the forms, and a sentence in the "Cold Weather" section which states that "salt, chemicals or other foreign materials shall not be used to prevent freezing." Under the head "Depositing Under Water" there is a footnote which recommends that this not be done unless absolutely necessary, and gives definite instructions as to how it should be placed when necessary. Alternate methods of the tremie, drop-bottom bucket, and bags of concrete are specified. Under the heading "Forms" there is little new matter, and the section VIII, "Details of Construction," which has a subhead "Metal Reinforcement," has little different from old standards, except possibly the paragraph "Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion."

### Protective Treatments

Under the subhead, "Concrete Covering over Metal," it is stated that metal reinforcement in fire-resistive construction shall be protected by not less than 1 in. of concrete in slabs and walls, and not less than 2 in. in beams, girders and columns, provided aggregate showing an expansion not materially greater than that of limestone or trap rock is used; when impracticable to obtain aggregate of this grade, the protective covering shall be 1 in. thicker and shall be reinforced with metal mesh not exceeding 3 in. in greatest dimensions, placed 1 in. from the finished surface. The metal reinforcement in structures containing incombustible materials and in bridges where the fire hazard is limited, shall be protected by not less than ¾ in. of concrete in slabs and walls and not less than 1½ in. in beams, girders and columns. Plaster finish on an exposed concrete surface may be allowed to reduce the thickness of concrete protection required above by one-half the thickness of the plaster, but the protection shall not be less than that specified above. Paragraphs in the subsection under "Joints" define construction joints in buildings and specify details of water-tight joints.

Under Section IX, "Waterproofing and Protective Treatment," a sentence reads "Integral compounds shall not be used," but membrane waterproofing is specified in "basements, pits, shafts, tunnels, bridge floors, retaining walls and similar structures, where an added protection is desired."

Subheadings "Oilproofing" and "Concrete in Sea Water" are very general. In the former it is stated that "a special coating" shall be applied. In the latter provision is made for a rich concrete; that is, "Plain concrete in sea water or exposed directly along the sea coast shall contain not less than 6 bags of portland cement per cubic yard in place; concrete from 2 ft. below low water to 2 ft. above high water, or from a plane below to a plane above wave action, shall be made of a mixture containing not less than 7 bags. Slag, broken brick, soft limestone, soft sandstone or other porous or weak aggregates shall not be used." It is specified that concrete shall not be deposited under sea water unless unavoidable; that metal reinforcement shall be placed at least 3 in. (4 in. at corners) from any surface. Where unusually severe conditions of abrasion are anticipated, the face of the concrete from 2 ft. below low water to 2 ft. above high water shall be protected by timber, brick, or stone. The final paragraph in this section is that "consistency shall be such as to produce concrete which for mass work shall give a slump of not more than 2 in., and for reinforced concrete a slump of not more than 4 in." Concrete for alkali soils or water shall contain not less than seven bags of portland cement per cubic yard in place, and shall have a slump of not more than 2 in., and for small members of not more than 6 in. Metal reinforcement shall be at least 2 in. from the face.

Section X is on surface finishes and wearing surfaces, and provides for the usual methods of finish, particularly for prevention of premature drying on surfaces that are subjected to wear.

### Design Provisions

Section XI is on design. It is apparently a compromise between the provisions of the Joint Committee's final report of 1916 and those of the Building Regulations for Concrete of the American Concrete Institute adopted in 1920, with additions due to later information. For ordinary beams and girders the usual moment formulas are given but there are additional formulas for beams in which exterior columns above and below are built into the beams. The formulas for T-beams are somewhat more elaborate than in either of the preceding reports. There are new provisions regarding the flange width of T-beams and provision for transverse reinforcement where the principal slab reinforcement is parallel to the beams. There is a lengthy section devoted to diagonal tension and shear, which specifies in detail the various methods of reinforcing a beam against shear and the allowable stresses for these different methods. These increase from 2 per cent of the 28-day compression concrete value in the case of beams without web reinforcement with the longitudinal bars not anchored to 12 per cent of the 28-day strength for beams with reinforcement with bars set up in a single plane and with longitudinal bars anchored. The values are given in the table of working stresses herewith.

The provisions for bond are somewhat more specific than in previous reports or specifications. They state that the reinforcement shall be so proportioned that bond stress between metal and concrete shall not exceed 4 per cent of the compression value for plain bars and 5 per cent for deformed bars, and state that in two-way reinforcement the value shall be reduced 25 per cent, and for each additional direction, 10 per cent. For bars anchored at both ends bond stresses may be one and one-half times the value specified.

### Flat Slab Design

Flat-slab provisions are about midway between those of the previous final report of the Joint Committee and the Building Regulations of the American Concrete Institute. The coefficient for the numerical sum of the positive and negative moments is given as not less than 0.09. The moments to be used in the design are shown in the accompanying table, but a tolerance of 0.03 $M_0$ is permitted in the sum of the maximum negative moments and of 0.01 $M_0$ in the sum of the maximum negative moments in the two column strips as well as

a tolerance of 0.01 $M_o$ in the middle strip. The total thickness of the dropped panel in inches or of the slab if a dropped panel is not used shall be not less than:

$$t_1 = 0.0382 \left(1 - 1.44 \frac{c}{l}\right) l \sqrt{Rw'} \frac{l_1}{b_1} + 1\tfrac{1}{2}$$

where $R$ = ratio of negative moment in the two column strips to $M_o$ and $w'$ = uniformly distributed dead and live load per unit of area of floor. For slabs with dropped panels the total thickness in inches at points away from the dropped panel shall not be less than $t_2 = 0.02\, l \sqrt{w'} + 1$, and not less than $l/32$ for floor slabs or $l/40$ for roof slabs for either $t_1$ or $t_2$, which is identical with the provisions of the 1916 J.C. report and with the general thickness provision in the A.C.I. report. The general point of inflection coefficient is $\frac{1}{5}$ instead of 0.2 in earlier reports. Formulas for figuring tension in the steel and compression in the concrete are given.

MOMENTS TO BE USED IN DESIGN OF FLAT SLABS

| Strip | Flat Slabs Without Dropped Panels | | Flat Slabs With Dropped Panels | |
|---|---|---|---|---|
| | Negative | Positive | Negative | Positive |
| Slabs with 2-way Reinforcement | | | | |
| Column strip | 0.23 $M_0$ | 0.11 $M_0$ | 0.25 $M_0$ | 0.10 $M_0$ |
| 2-Column strips | 0.46 $M_0$ | 0.22 $M_0$ | 0.50 $M_0$ | 0.20 $M_0$ |
| Middle strip | 0.16 $M_0$ | 0.16 $M_0$ | 0.15 $M_0$ | 0.15 $M_0$ |
| Slabs with 4-way Reinforcement | | | | |
| Column strip | 0.25 $M_0$ | 0.10 $M_0$ | 0.27 $M_0$ | 0.095 $M_0$ |
| 2-Column strips | 0.50 $M_0$ | 0.20 $M_0$ | 0.54 $M_0$ | 0.190 $M_0$ |
| Middle strip | 0.10 $M_0$ | 0.20 $M_0$ | 0.08 $M_0$ | 0.190 $M_0$ |

The shear provisions are that "the shearing unit stress shall not exceed the value of $v$ in the formula,

$$v = 0.02\, f'_c\, (1 + r)$$

nor in any case shall it exceed 0.03 $f'_c$. In no case shall $r$ (the proportional amount of reinforcement crossing the column capital or over the dropped panel) be less than 0.25."

## Columns

The section on columns is considerably more elaborate than either the previous report of the committee or the Building Regulations of the American Concrete Institute. If favors the former in that it continues to give credit for spiral steel by increasing the unit value for the inclosed concrete rather than by actual stress computation for the hooping as was done by the A.C.I. report, but the unit concrete stresses are determined for the spiral columns by a formula which involves the amount of vertical steel and not by direct proportion of the 28-day concrete strength. Length reduction formulas for slender columns, that is where the unsupported length is greater than forty times the least radius of gyration, are given. The principal columns in buildings are required to be not less than 12 in. in width and non-continuous posts not less than 6 in.

The unsupported length of columns for various types of construction is defined. The safe axial load on columns reinforced with longitudinal bars and closely spaced spirals inclosing a circular core are determined by the formula

$$P = A_c f_c + n f_s p A$$

where $A$ = area of the concrete core inclosed within the spiral; $P$ = total safe axial load on column whose $h/R$ is less than 40; $p$ = ratio of effective area of longitudinal reinforcement to area of the concrete core; and $A_c = A(1 - p)$ = net area of concrete core. The allowable value of $f_c$ for use in this type of column is determined for the formula: $f_c = 300 + (0.10 + 4p)\, f'_{c_2}$. Longitudinal reinforcement of columns is to consist of at least six bars of minimum diameter of $\frac{1}{2}$ in., and its effective cross-sectional area shall not be less than 1 per cent nor more than 5 per cent of that of the inclosed core.

Spiral reinforcement is not to be less in amount than one-fourth the volume of the longitudinal reinforcement, and consist of evenly spaced continuous spirals held firmly in place and true to line by at least three vertical spacer bars. The spacing of spirals is not to be greater than one-sixth of the diameter of the core and in no case more than 3 in. Reinforcement is protected everywhere by a covering of concrete cast monolithic with the core, which shall have a minimum thickness of $1\frac{1}{2}$ in. in square columns and 2 in. in round or octagonal columns.

For columns reinforced with longitudinal bars and separate lateral ties the value for $f_c$ shall not exceed 0.20 $f'_c$. The amount of longitudinal reinforcement considered in the calculation shall not be more than 2 per cent nor less than 0.5 per cent of the total area of the column. The longitudinal reinforcement shall consist of not less than 4 bars of minimum diameter of $\frac{1}{2}$ in., placed with clear distance from the face of the column not less than 2 in., and lateral ties are not to be less than $\frac{1}{4}$ in. in diameter, spaced not farther apart than 8 in.

Special paragraphs follow on columns subjected to bending stresses and on composite columns, being practically the same as those in the A.C.I. report.

## Footings

Footings are taken up much more elaborately than in any previous specifications. It is stated that the requirements for flexure and shear in the rest of the specifications shall govern the design of footings, except as provided otherwise; that the upward reaction per unit of area on the footing shall be taken as the column load divided by the area of the base; that footings carried on piles are to be treated in the same manner as those bearing directly on the soil, except that the reaction is to be considered as a series of concentrated loads applied at the pile centers. Sloped footings and stepped footings are defined, and the critical section for bending stated to be at the face of the column or pedestal. Where a concrete pedestal is used and where steel or cast-iron bases are used, the moment in the footing is to be calculated at the edge of the base and at the center. Formulas are given for square columns on square footings, and round columns on square footings.

Reinforcement necesary to resist bending moment is to be determined as for a reinforced-concrete beam; the effective depth of the footing shall be the depth from the top to the plane of reinforcement. Required area of reinforcement thus calculated is to be spaced uniformly across the footing, unless the footing width is greater than the side of the column or pedestal plus twice the effective depth of the footing, in which case the width over which the reinforcement is spread may be increased to include one-half the remaining width of the footing. Extreme fiber stress is to be kept within the limits shown in the table at the end of this abstract. Shearing and bond stresses are to be cared for as in other structures. Methods of distributing stress from the columns to the footings are noted and a formula is given for the permissible compressive unit stress under the column core.

The succeeding section is on "Reinforced-Concrete Retaining Walls." The sections on "Floor Slabs Sup-

ported on Four Sides" and on "Shrinkage and Temperature Stresses" the committee is not ready to report on.

A final section is "Summary of Working Stresses," which details the coefficients of the 28-day compressive strength used for each of the different kinds of stresses under different conditions. The comprehensive value $f_c$ is defined as "the ultimate compressive strength of concrete at age of 28 days, based on tests of 6 x 12-in. or 8 x 16-in. cylinders made and tested in accordance with standard methods of making and storing specimens of concrete in the field and the tentative methods of making compression tests of concrete," both standards of the American Society for Testing Materials. The values of the working stresses are tabulated as follows:

MAXIMUM DIRECT STRESSES IN CONCRETE

*Direct Compression.*
- (*a*) Columns whose length does not exceed 40 *R*:
  - (1) With spirals.....varies with amount of longitudinal reinforcement
  - (2) Without spirals .....$0.20 f'_c$
- (*b*) Long columns .....(by formula)
- (*c*) Piers and Pedestals:
  - (1) Without reinforcement .....$0.25 f'_c$

*Compression in Extreme Fiber.*
- (*a*) Extreme fiber stress in flexure.....$0.40 f'_c$
- (*b*) Extreme fiber stress adjacent to supports of continuous beams .....$0.45 f'_c$

*Bearing Compression.*
- Anchorage of reinforcement.....$0.50 f'_c$

*Tension.*
- All concrete members.....none

MAXIMUM SHEARING STRESSES IN CONCRETE

*Beams without Web Reinforcement.*
- (*a*) Longitudinal bars anchored.....$0.03 f'_c$
- (*b*) Longitudinal bars not anchored.....$0.02 f'_c$

*Beams with Reinforcement.*
- (*a*) Beams with stirrups.....special
- (*b*) Beams with bars bent up in several planes....special
- (*c*) Beams with bars bent up in a single plane:
  - (1) Longitudinal bars anchored.....$0.12 f'_c$
  - (2) Longitudinal bars not anchored.....$0.06 f'_c$

*Flat Slabs.*
- (*a*) Shear at distance *d* from capital or dropped panel .....$0.03 f'_c$

*Footings.*
- (*a*) Longitudinal bars anchored.....$0.03 f'_c$
- (*b*) Longitudinal bars not anchored.....$0.02 f'_c$

MAXIMUM STRESSES IN REINFORCEMENT

*Tension in Steel.*
- (*a*) Billet-steel bars:
  - (1) Structural steel grade.....16,000 lb. per sq.in.
  - (2) Intermediate grade .....18,000 " "
  - (3) Hard grade .....18,000 " "
- (*b*) Rail-steel bars .....16,000 " "
- (*c*) Structural steel .....16,000 " "
- (*d*) Cold-drawn steel wire:
  - (1) Spirals.....stress not calculated
  - (2) Elsewhere.....18,000 lb. per sq.in.

*Compression in Steel.*
- (*a*) Bars.....same as above
- (*b*) Structural steel core of composite column..18,000 lb. per sq.in., reduced for slenderness ratio
- (*c*) Structural steel column.....16,000 lb. per sq.in., reduced for slenderness ratio

*Compression in Cast Iron.*
- Composite columns with spirals.....10,000 lb. per sq.in.

MAXIMUM BOND BETWEEN CONCRETE AND STEEL

*Bond.*
- (*a*) Beams and slabs, plain bars.....$0.04 f'_c$
- (*b*) Beams and slabs, deformed bars.....$0.05 f'_c$
- (*c*) Footings, plain bars, one-way.....$0.04 f'_c$
- (*d*) Footings, deformed bars, one-way.....$0.05 f'_c$
- (*e*) Footings, two-way reinforcement.....(*c*) or (*d*) reduced by 25 per cent
- (*f*) Footings, each additional direction of reinforcement.....(*c*) or (*d*) reduced by 10 per cent

The personnel of the Joint Committee is at present:

*American Society of Civil Engineers.*—W. A. Slater, chairman; William K. Hatt, A. E. Lindau, Sanford E. Thompson, Franklin R. McMillan.

*American Society for Testing Materials.*—Richard L. Humphrey, chairman; Albert T. Goldbeck, Edward E. Hughes, Henry H. Quimby, Leon S. Moisseiff.

*American Railway Engineering Association.*—J. J. Yates, chairman; George E. Boyd, Frederick E. Schall, H. T. Welty, C. C. Westfall.

*American Concrete Institute.*—S. C. Hollister, chairman; Robert W. Lesley, Arthur R. Lord, Egbert J. Moore, Angus B. MacMillan.

*Portland Cement Association.*—Frederick W. Kelley, chairman; Duff A. Abrams, Ernest Ashton, Edward D. Boyer, J. E. Freeman.

Richard L. Humphrey is chairman, J. J. Yates, vice-chairman and Prof. Duff A. Abrams, secretary.

## Airplane Saved Large Sum in Railroad Reconnaissance Survey

PREDICTION that investigation by airplane will in a short time precede all railroad surveys through unknown country is made in a letter furnished to the *Engineering News-Record* by the Chief of the Air Service, United States Army, written by E. S. Piontkowski, chief engineer, Manila Railroad Co., who made the flight with members of the Third Aero Squadron, Camp Stotsenburg, Philippine Islands, which enabled him to determine which one of three general routes would be used for a new line. The flight was briefly noted in *Engineering News-Record*, Sept. 23, 1920, p. 593. The new line was projected by the Manila Railroad Co. as an extension of its line from Cabanatuan through parts of the provinces of Nueva Ecija and Nueva Vizcaya to Bayombong.

Mr. Piontkowski's letter, transmitted to the Chief of the Air Service of the Army, is in part as follows:

The flight was in the nature of a trial trip as I had never been up in the air before and had no idea whether any information of real value could be obtained or not. The trip was a revelation to me and I cannot understand why airplanes were never used before in reconnaissance surveys, for as much can be accomplished in one day with a plane as would take months of time and thousands of dollars to do by instrument surveys. The flight was taken at the beginning of the rainy season and shortly after our arrival at the pass the clouds came down and covered the summit rendering it impossible to obtain any idea of the other side of the range and the outlets thereto. However, I secured enough information on this side to demonstrate how much could be done by flights in the dry season. As it was, I can now eliminate two lines on this side that the engineers on survey would necessarily have had to try, and which would have taken many months and great expense.

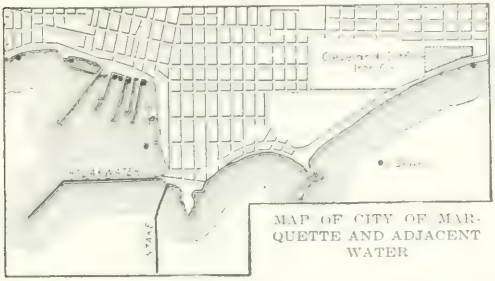
One definite benefit gained from this flight is shown: A line was decided upon, after instrument reconnaissance, as being the best for the final location, but after information gained in this flight was sent to the locating engineer, the line was changed and a much better location will be had both as to cost of construction and alignment.

There is no question but that in mountainous and heavily timbered country, of which no accurate maps exist, the saving that could be effected by several flights over proposed lines would be enormous, and I anticipate in a short time all railroad surveys through unknown country will be preceded by airplane investigation.

# Elimination of Tastes in Water at Marquette, Michigan

By W. C. Brockway
Assistant State Sanitary Engineer, Michigan Department of Health

ONLY one or possibly two of the many waste products from the manufacture of wood alcohol at Marquette, Mich., were found to be responsible for the offensive tastes and odors which have existed for a number of years in the municipal water supply. H. B. Hommon, associate sanitary engineer, United States Public Health Service, assisted by an engineer from the Michigan Department of Health conducted an investigation last March to determine the cause of these tastes and odors and to devise some method whereby they could be eliminated. The tastes were similar to those caused by excess chlorine and for this reason many of the water consumers believed the trouble to be due to the chlorine treatment of the city supply. There have been complaints of tastes in the water ever since the manufacture of wood alcohol was started in 1901, which was long before the hypochlorite plant was installed in 1910. Tastes are more persistent than the odors and are therefore much more objectionable. The company making



MAP OF CITY OF MARQUETTE AND ADJACENT WATER

wood alcohol has decided to try evaporating the most troublesome waste to 25 per cent of its volume and use the residue as liquid fuel.

The Marquette water supply (see map) is taken from Lake Superior, 3,000 ft. from shore, through a 30-in. steel intake pipe with three terminal inlets 12 ft. above lake bottom in about 65 ft. of water. Southwest of the intake there is a government breakwater about 4,500 ft. long. Seven outfall sewers discharge city sewage into Lake Superior west of the breakwater, on the side opposite the intake, so the breakwater acts as a huge baffle to keep sewage contamination from the intake. About two miles north of the intake wood alcohol wastes from the Cleveland-Cliffs Iron Co. are emptied into the lake. A small sanitary sewer also empties into the lake near this point.

The process of manufacturing wood alcohol consists of the destructive distillation of hardwood and the subsequent refining of the products. The distillate is called pyroligneous acid and contains the following ingredients: Methyl alcohol, acetone, methyl acetate, acetic acid, tar and small amounts of many other kinds of by-products. Pyroligneous acid is allowed to settle until all the tar capable of settling has been deposited in the bottom of tanks. This tar goes to the tar plant and is separated into pitch and cresote oils. The supernatant liquid is passed through triple effect evaporators so that practically all the remaining tar is left behind. This residue is wasted and is the product causing tastes in the city water supply. The distillate from the supernatant liquor is neutralized with lime and then distilled. The residue, acetate of lime in solution, is evaporated to dryness. The distillate, which contains the crude alcohol, is passed to the crude alcohol still where the very small amount of residual tar is removed with other by-products. This waste is next in importance to the tar wastes mentioned above. Discontinuous stills are used to remove various impurities from the distillates. Most of the wastes from these stills are of no particular importance as far as taste producting qualities are concerned.

The attitude of the company at first was: (1) That everything possible to eliminate objectionable wastes had been done by their own men and that there was nothing left to accomplish. (2) That evaporation, especially, was impossible because of the enormous cost. The assumption was that all of the chemical wastes would have to be evaporated. (3) That the chlorine used to treat the city water and not their chemical wastes was the cause of the tastes.

## Results of Tests for Chlorine

Excess chlorine was not the cause of the taste, as was demonstrated by about seventy qualitative starch-iodide tests for excess chlorine taken every hour day and night for two days at the three hospitals and at the city health office. All tests for chlorine were negative but tastes were frequently detected. At the pumping station, however, where the chlorine is added, the tests showed an excess.

Since the maximum variation of pumpage was less than 20 per cent from the average it was not considered necessary to adjust the chlorine dose for this difference. Experience showed that about 0.5 p.p.m. excess chlorine can be detected by taste in the Marquette water. A positive reaction with starch-iodide is obtained with an excess of only 0.05 p.p.m., one-tenth as much.

The compounds causing tastes are harmless in themselves but may affect health indirectly through the imagination. Women, children and persons with ill health complained very seriously about the water. There were great differences of opinion among the people as to the extent or degree of tastes. In any case, however, the condition was serious and demanded a remedy. Many stated that they drank as little water as they could get along with—which is not sufficient to meet the natural demands of the human system—or used water from wells and springs that in a number of cases did not furnish a water that compared favorably with the Treasury Department Standard.

Examinations of the individual waste products as discharged from the stills and other refining processes showed that there are three classes relative to taste producing qualities:

1. Tarry wastes are by far the most important. These gave the characteristic tastes found in the city water in direct dilutions of 1 c.c. in 1,300,000 c.c. of water. Experiments were also carried out in which fresh supplies of water in 2,000 c.c. quantities were added at several different times in the course of a week to 1 c.c. of the more insoluble tars. The taste would persist to the last change but became less perceptible each time. One experiment similar to these, in which the water was changed seven times in the course of a month, demonstrated that a very positive taste was still present at the

end of that time. The same result was obtained under like circumstances when a very small piece of tar deposit found along the beach was used. This waste is black in color, has a strong pungent odor of tar or creosote and is slightly viscous and dissolves very slowly in water. Relative to specific gravity there are three groups; one has a specific gravity equal to that of water; a second less and a third greater than that of water. These wastes, including the portions dissolved, are fixed, permanent and stable compounds not undergoing changes like sewage. The wastes amount to about 6,000 gal. They are probably responsible for practically the entire nuisance.

2. The waste next in importance is from the crude alcohol still. This contains a very small portion of tar but consists mainly of light oils. It is bright yellow in color, has a fairly strong tar odor and a brackish or bitter taste which can be detected in a direct dilution of about 1 in 2,000 and is probably not responsible for very much, if any, of the taste in the city water. The approximate discharge is about 6,000 gal. a day.

3. The remainder of the chemical wastes cause little or no tastes in dilutions up to 1 in 2,000.

The outfall from the plant discharges about 3 m.g.d., which includes surface drainage, cooling water, and about 50,000 to 60,000 gal. of chemical wastes. Each of the two most objectionable consist of about 6,000 gal. a day. The wastes affect the water supply particularly when there is a north or northwest wind which drives the wastes southward along the shore from the outfall to the vicinity of the city intake. Tastes disappear when south winds blow.

### Removing Tar Wastes

Previous investigations, all of which contributed valuable information, have been made by the following men: Prof. George A. Koenig, G. H. Benzenberg, Clarence Coleman, Dr. McCracken, Rudolph Hering and George A. Johnson. These investigators concluded that tastes were due to the tar wastes and that enormous dilutions provided the most satisfactory way of overcoming the tastes and odors. The intake was extended in 1911-12 from 700 to 3,100 ft. to its present location to afford this dilution and to offset the danger from sewage contamination. The breakwater was extended to its present location at about that time.

One investigator was very confident that filtration would remove the objectionable tar wastes. He said that "filtration is quick and perfect by mixing charcoal braise with the discharge and then throwing the whole upon a sand filter. The charcoal will attract the tiniest particles of tar and the tar and charcoal can then be used as fuel." Operation of this filter proved it to be a failure so after two years its use was abandoned. From the meagre information to be had concerning this filter, it appears that it was greatly overloaded.

The company decided entirely upon its own initiative at the time of the investigation that evaporation of the most objectionable of the wastes would be the best solution of the problem. Tar wastes are to be evaporated to 25 per cent of their original volume so that they can be used as liquid fuel. If the treatment of these wastes does not abate the nuisance evaporation of the second most objectionable waste will be started. The cost to do this, of course, is much greater than the value of the fuel produced. Since the tar wastes are discharged not much less fuel is required than otherwise. Acids must be distilled off in order to protect the boiler flues. Orders were placed in March for the necessary evaporators.

The situation in general hinged on the following: (1) The company had previously spent money on methods that were thought to be adequate to overcome the nuisance but in each case the process proved to be a failure. This made the company cautious and doubtful about other untried methods or schemes. (2) The corporation producing wastes was held to be entirely responsible for preventing them from causing a nuisance. (3) Efforts of all concerned were co-ordinated. (4) Even though the company was confident everything possible had been done to eliminate offensive tastes, yet it was found that something very practical had not been attempted. (5) The federal and state engineers were to remain at Marquette until the company had taken a definite step to abate the trouble by either retaining an expert sanitary engineer to study the problem or by ordering the necessary apparatus for treating the wastes.

After a few days of investigation it was evident that the removal of the trouble at its source was the only practical solution. Prevention is not only better than a cure but in this case prevention seemed to be the only practical possibility.

Evaporation of objectionable wastes as a method of disposal cannot fail to eliminate the nuisance if it is due entirely to freshly discharged chemical refuse. Offensive wastes, however, have been discharged into Lake Superior since 1901. As a result quantities of tar have been deposited. Tastes from such deposits may be so persistent and penetrating that they may be present in the city water supply for a long time to come though no more wastes are discharged into the lake.

## Dressings for Tar Macadam Roads

Many British motorists are complaining of the material used by the highway authorities for the surface dressing of macadam roads, especially of the coarseness of the material for gritting newly laid tar. Mr. Dryland, county surveyor of Middlesex, condemns the use of a large size aggregate as not only being harmful to motor tires but unsuitable for a tar-macadamized or other smooth surfaced road, though such an aggregate may be used with advantage on a rough surface. In a letter to the *Municipal Engineering and Sanitary Record*, Mr. Dryland says:

"Where traffic is light and the situation open, a coating of tar on a waterbound road, followed by a good dressing of coarse chippings, undoubtedly forms a thin carpet which has considerable durability as a wearing surface, but on heavily trafficked roads, especially if on a clay subsoil where damp hangs in the autumn and winter, such treatment is unsatisfactory, as it results in a pasty mud.

"Fine material, owing to its greater covering power, is, of course, much cheaper, and I am inclined to the view, after extensive opportunities for observation over larger areas for a number of years, that large aggregate is often used where smaller would be more beneficial and also cheaper."

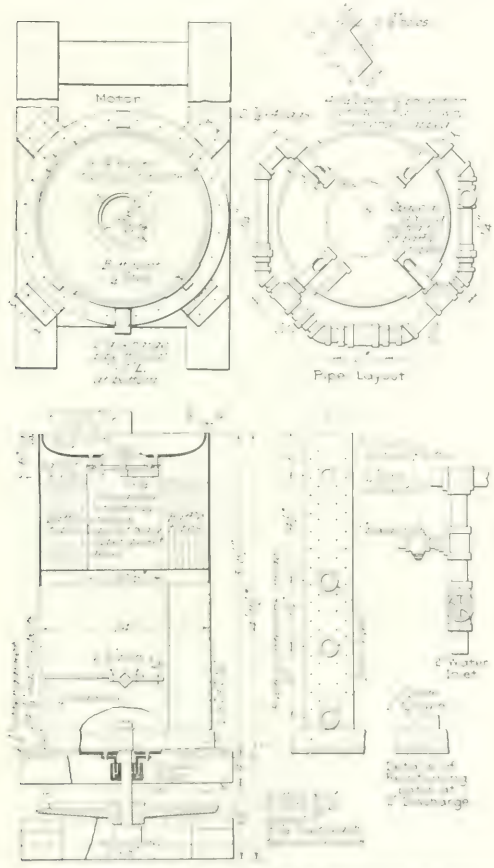
The County Surveyor of Kent, on the other hand, condemns the use of any aggregate smaller than ¾ in. to ½ in. gage. Clean chippings and grit of these sizes, though damaging to tires for a short period when newly laid, subsequently form a far more enduring and efficient surface.

# Experiences in Pressure Grouting Lead to Hydraulic Machine

## New Type Designed as Result of Several Large Grouting Jobs Is Used in Consolidating Foundations of Two Dams

By Shirley C. Hulse
Engineer, Bedford, Pa.

GROUTING, when properly done, is a process of sedimentation. A flow of grout resulting in the desired deposit of cement and expulsion of excess water is best accomplished by an inelastic driving medium. This is especially true where, as in rock foundations, there may be a great range and complication of crevices and surface leaks. It is easy indeed to squirt grout into a hole till no more will go in; it is a different matter to feel, when a hole refuses, that the last bit of cement which it could possibly have been made to take has been got into that hole. Ordinarily, the immediate proof of the success of a grouting operation is limited to the behavior of test holes or to the evidence disclosed by subsequent excavation. Results are dependent upon the experience, skill and imagination of the operator and there is plenty of scope for his talents without the added complication of an elastic treacherous driving medium behind the grout.




DETAILS OF THE HULSE HYDRAULIC GROUTING MACHINE

Since 1910 the writer has had almost continuously to do with pressure grouting; some of it experimental and most of it in connection with large structures where it played a vital part in their integrity. Early in this experience he became convinced that if water pressure could be directly used to expel the grout from the machine it would be infinitely preferable to compressed air and, after considerable experiment, he worked out a machine which accomplished the desired result. This machine has been patented and is being marketed but as it includes a number of novel features and the basis of its design is different from previous grouting devices, a description of its details and of its operation should have engineering interest.

### Design of the Machine

The considerations governing the design of the machine are as follows: (1) Mechanical mixing of the grout is essential. (2) Water pressure is inelastic and instantly controlled. It obviates entrained air and blowouts. (3) Compressed air is very useful for developing surface leaks and for cleaning openings before grouting but it is not a satisfactory driving medium because of its elasticity. (4) One hundred pounds pressure is frequently inadequate in grouting operations and higher pressures are to be had, on most work more readily and cheaply in water than in air. (5) Almost invariably water pressure proves to be more dependable than air pressure and less liable to interruption.

The machine shown in the drawing herewith consists of a vertical cylinder with a small two-bladed paddle motor driven, in the bottom. The cement is introduced through a self-sealing door in the center of the top and through the 10½-in. cylindrical opening into the water. The space between the outside of this cylinder and the main shell is filled with vertical tubes about 1 in. in diameter and 9 in. long, snugly nested together and forming a sort of honeycomb as viewed from above or below. The sole purpose of these tubes is to bring the water, used for expelling the grout, into contact with the upper surface of the grout in a smooth plane without cross currents or disturbance. Above the top of the baffle tubes are four inlet pipes whose openings are such that the water cannot leave them at any angle below the horizontal. The combined action of the inlets and the tubes is such that there is no tendency of the water, during the expulsion of the grout, to dilute or mix with the grout until the plane of contact is near the top of the paddles when it is time to shoot off and reload. If discharge be continued after the plane of contact has been broken by the paddles, the breakup will promptly diffuse the remaining cement through the overlying water to the bottom of the baffle tubes. This action and the descending clean cut line of demarcation between the water and the grout are clearly visible during operation, through the glass bull's-eyes in the side of the machine and these bull's-eyes give a certainty of control and an exact knowledge of the time to shut off and recharge that I have not found in any other grouting device.

The water below the baffle tubes is carried at about the speed of the paddles, 20 to 25 r.p.m., and the cement upon dropping into the water becomes instantly diffused

and is carried in suspension. When the clear water comes from above and forces the grout through the outlet at the bottom of the machine there is no tendency for the two liquids (grout and water) to mix until the line of separation is so close as to feel the mechanical disturbance of the paddles. The sole purpose of the baffle tubes is to straighten out the water which expels the grout. No cement goes through the tubes except what little enters them incidentally from below.

It is necessary to bleed the machine, after discharge, to make room for the next charge of cement. This may be done by putting the bleeder in the inlet line, letting the water overflow through the baffle tubes and the inlets as the cement is introduced. In fast work it is better to replace the top bull's-eye with a nipple and stopcock from which a piece of hose reaches the ground. The siphon action of this bleeder makes it very quick and with its use the action of the machine may be almost continuous and very much faster than that of an air machine where time is lost, after each discharge, in refilling with water. The amount of cement wasted in bleeding is so slight as to be negligible.

While primarily designed for water pressure this machine may be operated with air.

Three machines have been built and operated. The first was used on the foundations of the Alcoa Dam of the Aluminum Co. of America, at Alcoa, Tenn. The writer had direct charge of the grouting of these foundations for several months during the early part of which, and while the hydraulic pressure machine was being built, an air machine was in use. The work differed in no essential from a number of similar grouting jobs. There were the usual unavoidable interruptions due to low air pressure or to no air pressure which meant merely interruption to the rest of the work but which meant the difference between continuous good grouting and intermittent questionable grouting. On work of this magnitude the only safeguard is a tank of water always available at such pressure that a hole may be thoroughly washed out if the pressure fails for long enough to endanger the hole. It is a fact, sometimes easily to be accounted for, that a hole in which the work has been too long interrupted before refusal, will be closed upon resumption and must be abandoned with the certainty that territory connecting with that hole is not filled. It is also a fact that frequently a hole may be uninterruptedly grouted to refusal on two or three successive days, before final refusal and the certainty that every opening within its reach has been closed. During this part of the work there were also the unavoidable troubles due to entrained air with an occasional spectacular blowout through surface leaks.

It must not be inferred from the foregoing that the final results had with the air machine were not dependable. They were made dependable at the cost of wasted time and cement inherent in use of compressed air for this sort of work. We had an exceptionally competent foreman, a first-class crew and every facility and assistance at the command of I. G. Calderwood, general superintendent, was afforded the grouting work at all times. What troubles we had were due to compressed air—or to its lack—nothing else.

The latter part of the work at Alcoa was done with the hydraulic pressure machine and it more than filled expectations. Water pressure was much more dependable than air had been (as is usually the case) and interruptions were so few as to be almost negligible. Entrained air and blowouts were a thing of the past and in a short time one could turn one's back on the man at the valves without instinctively fearing a shower of grout from some surface leak. The discharge was under absolute control and the holes were much more rapidly and satisfactorily closed. This rapidity and certainty of action is a source of extra satisfaction when the grouting is barely keeping ahead of the concrete or other work.

The second and third machines were built for the Junction Dam in Michigan, Fargo Engineering Co. of Jackson, Mich., engineers, which work has been described in *Engineering News-Record*, July 18, 1918, p. 147. The writer did not visit this work until the grouting operations were well under way and he found upon arrival that it was desired to grout a cutoff in a stratum of sand underlying the hardpan upon which the dam rested. Grout will not penetrate sand because the resistance of the small passages is such that the grout is instantly slowed down to the point where the cement will not be carried in suspension and the sand plugs *immediately* where the grout started to enter. This particular sand was fine grained, it bore water under considerable artesian pressure and the temperature of the stratum was so low that grout which had been forced down the pipes remained liquid and flowed back to the surface several days after grouting. It

HYDRAULIC GROUTING MACHINE AT WORK ON JUNCTION DAM IN MICHIGAN

was decided to space the grout pipes rather closely along the line where the cutoff was wanted; to wash a channel from pipe to pipe in the sand beneath the hardpan; to fill this channel with grout and after the grout had set to drill through it and repeat the operation—thus forming successive layers downward.

Both water and air pressure were available on this work but it soon developed that lack of positive control and the action of entrained air worked against the desired result and a centrifugal pump developing 200 lb. pressure was installed especially for the grouting operations. From this time on the air was used merely to develop the few surface leaks, to test out the tightness of the work and occasionally in advance of the first batch of grout with the idea of perhaps forcing back the artesian water. The efficacy of this latter procedure is quite open to question. Water pressure did the grouting.

A steam line was run to the grouting machines and the grout was used hot. Under these conditions it was possible to drill through each day's grouting on the following morning. The drill washings and the chunks of solid material which came up from below were most illuminating. They showed that the grout penetrated and packed crevices in the hardpan, some of considerable thickness and others merely hair cracks. There was no evidence that loose sand had been penetrated and consolidated by the grout. The excess water, after the cement was deposited, was of course shoved back through whatever channels the artesian water reached the grout holes (the grouting pressure being far in excess of the artesian) and this made an ideal condition for the sedimentary action by which the cement was deposited.

The general efficacy of the work was shown by the fact that grout was driven out through every surface leak which had been developed by 100 lb. of air. A few of these leaks were at a considerable distance from the line of the cutoff and there is slight probability that all would have been closed by air driven grout. Sand was used in much of the grout on this work at a considerable saving of cement and the machine handled it as well as it did the all-cement mixtures.

## Earth Road Maintenance Costs in Nebraska

MAINTENANCE costs on about 1,100 miles of earth roads in 20 counties in southeastern Nebraska in 1920 are summarized in the accompanying table. These

| Item | Team | Truck | Tractor |
|---|---|---|---|
| Surface | $146 37 | $122 46 | $132 56 |
| Shoulders | 9 30 | 7 05 | 8 35 |
| Ditches | 21 95 | 10 29 | 15 86 |
| Culverts | 12 85 | 7 53 | 10 34 |
| [illegible] | 16 69 | 6 86 | 6 55 |
| [illegible] | 15 46 | 6 12 | 5 02 |
| [illegible] | 10 19 | 5 00 | 9 96 |
| [illegible] | 0 63 | 1 74 | 0 52 |
| [illegible] | 1 50 | 2 58 | 2 31 |
| [illegible] | 5 91 | 4 45 | 1 81 |
| [illegible] | 4 10 | 19 65 | 24 87 |
| Claims | 25 61 | 49 61 | 36 88 |
| [illegible] | 4 59 | 7 15 | 0 79 |
| [illegible] | | 3 74 | |
| [illegible] patrolled | 455 56 | 514 58 | 137 33 |
| Per mile per season | 275 09 | 254 22 | 255 83 |
| Per [illegible] per month | 34 63 | 28 25 | 30 11 |
| [illegible] | 6 33 | 13 91 | 15 26 |
| [illegible] patrol | 72 | 37 | 9 |

costs do not include purchase or depreciation of equipment, patrol stations nor heavy gang work. The costs are listed separately for the three types of patrol employed.

## British Labor Railroad Bill—Progress in Consolidations

*(London Correspondence)*

A BILL to effect the transfer of all the railway undertakings in England to the Ministry of Transport is to be introduced into Parliament by the Labor party. The bill makes provision for the purchase by the State of all the railway undertakings in Great Britain and for their subsequent management in the public interest by the Minister of Transport.

Clauses in the bill provide that:

1. Six months after the passing of the act all the property of the railway companies and the Railway Clearing House shall vest in the Minister without any formal conveyance being necessary.

2. The purchase shall be carried through by the issue to the railway stock and share holders direct (and not through the intervention of the companies), on the surrender for cancellation of the railway stock and share certificates which they hold, of a specially created railway stock charged on the State railway undertaking and the Consolidated Fund, which shall bear such a rate of interest as would enable it at the time of issue to be realized at par. The purchase price would be calculated on the basis of the pre-war market price of the existing railway stocks, but be subject to a reduction relative to the amount by which securities generally have depreciated in value in consequence of the war.

3. The reduction in view of the general depreciation of the value of securities should be made at the rate of 30 per cent.

4. The Minister be formally authorized to carry on and develop the railway business, to acquire land for the purposes of development and extensions, and to be provided by the Treasury with any advances which may be necessary during the transition period.

5. The general direction of the railway business be devolved upon seven commissioners, whilst the Minister will be responsible to Parliament. It is intended that of the first commissioners the chairman and two others shall be appointed by the Minister, one by the Treasury, and three by the Minister on nominations submitted by the recognized railway trade unions, and that any vacancies shall be filled in like manner, as to six by the Minister and one by the Treasury. It is provided that the commissioners shall devote their whole time to the duties of their office; shall each be paid the same salary, and shall have continuity of office subject to removal by the Crown.

6. The Minister be authorized to acquire privately owned railway stock.

7. The Minister shall set up, in conjunction with the three railway trade unions, machinery for adjusting disputes as to salaries, wages and conditions of the service.

8. The existing State control and financial guarantee of the railways shall be continued until the appointed day.

An important step toward the grouping of English railways into a limited number of large systems is the recent amalgamation of the London & Northwestern Ry. and the Lancashire & Yorkshire Ry. into a system of 2,667 miles, the former being one of the largest

individual lines and the latter serving a large industrial district. The step has been taken by private agreement and requires only formal ratification by the stockholders. The government project for consolidating the railways into a few systems grouped geographically, as approved in principle but not in detail by the railway companies, was noted in *Engineering News-Record* of Feb. 24, p. 341.

Both railways have electrified suburban lines, and both of them own and operate docks, canals, hotels, and steamship lines (to Irish and North Sea ports). A summary of their capital and 1920 traffic is as follows:

| | L. & N.W. Ry. | L. & Y. Ry |
|---|---|---|
| Passengers | 113,873,294 | 92,407,792 |
| Freight, tons | 33,730,516 | 14,744,422 |
| Train-miles | 41,027,566 | 16,238,954 |
| Capital, at normal exchange | $639,426,485 | $361,159,650 |

The London & Northwestern Ry. extends diagonally from London to Birmingham and Liverpool (198 miles) and north to Carlile (300 miles), with numerous lines through the central industrial section and into Wales. It owns 1,806 miles of line and leases or operates 260, making a total of 2,066 miles, of which 1,577 miles are double track and a considerable proportion has three or more tracks, the total trackage being 5,824 miles, including sidings. Its main tracks are laid with 95-lb. bull-head rails in 60-ft. lengths. The equipment comprises 3,261 locomotives, 9,550 cars in passenger service and 84,000 in freight and company service, besides gasoline and electric rail motor cars.

The Lancashire & Yorkshire Ry. extends between the west port of Liverpool and the east ports of Goole and Hull, with a network of lines in the coal and manufacturing districts traversed. It owns 533 miles and operates a total of 601 miles, of which 557 miles are double track, the total trackage being 2,270 miles inclusive of sidings. There are 1,650 locomotives, 4,360 cars in passenger service and 37,780 in freight and company service.

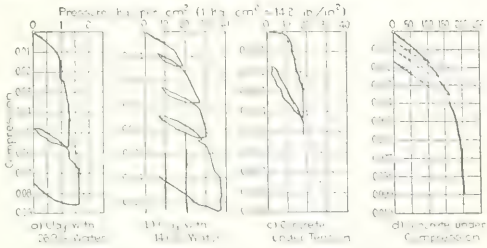
# LETTERS TO THE EDITOR

***If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.***

## Foundation Problems and Laboratory Research

Sir—In his paper "Distribution of Soil Pressure as Related to Foundations," *Engineering News-Record* Mar. 3, 1921, p. 366, Daniel E. Moran arrives at the conclusion that a surcharge equal to half the diameter of a circular footing would be sufficient to prevent a "stress producing uplift of the sand." Thorough experimental investigations concerning this point were carried out by Strohschneider in 1911 ("Elastische Druckverteilung und Drucküberschreitung in Schüttungen," Sitz. d. kais. Akad. d. Wiss., Math. nat. Klasse, Feb., 1912), but no conclusions similar to those of Mr. Moran could be drawn from the results. The same author published, in the paper mentioned, the soil-pressure curves (Fig. 3 in Mr. Moran's paper) obtained by a very sensitive apparatus for measuring the vertical pressure, and he modified Boussinesq's formula so as to describe almost perfectly the observed phenomena.

The lateral escape of the sand due to the presence of a concentrated load was theoretically investigated by Pauker,



STRESS-STRAIN CURVES OF CLAY AND CONCRETE

Jankowsky and Kjurdümoff. Kjurdümoff published in addition photographs showing the movement of the sand grains which is produced by the application of a single load on the horizontal surface of a bed of sand (*Der Zivilingenieur*, St. Petersburg, 1891.) Engesser ("Zur Theorie des Baugrundes," Zentrbl. d. Bauverw, 1893) discussed the phenomena of unequal settlement of a homogenous soil and furnished an approximative theory of the unequal distribution of the soil pressure over the bearing surface of foundation girders which support concentrated loads.

Under the impression of these investigations I undertook in 1911 to design the foundation of a five-story reinforced-concrete building covering an area of about 25,000 sq.ft. of bad ground, on the assumption that the soil pressures are at a maximum immediately underneath the columns and that their intensity decreases with the distance therefrom. The foundation consisted of a continuous slab reinforced by a grillage of heavy reinforced-concrete beams. The empirical coefficients required for the computation of the distribution of the pressures were obtained by loading tests made on a rather large scale within the foundation pit. As the method proved to be a complete success in spite of the serious objections made by the local building department, it was accepted for the design of a number of other foundations. The idea that the assumption of uniform stress-distribution in the material underlying the footing would be untenable has therefore already quite a historical record.

The essential facts required for the purpose of properly designing a foundation as mentioned above are the stress-strain relations for the soil in question. My investigations concerning these facts have led to the result that the stress-strain diagrams of sand, clays in any state of dryness or humidity and of concrete are almost identical provided the scale for plotting stress and strain are properly chosen. The group of diagrams herewith shows the similarity; the close relationship between them and the interesting diagrams published in Fig. 3 of Lazarus White's paper ("Earth in Foundations Considered as an Elastic Solid," *Engineering News-Record*, Dec. 30, 1920) is obvious. The modulus of elasticity of sand increases in direct proportion with the depth below the surface. The modulus of elasticity of clays stands in a definite relation to their water content, which in turn is again a function of the pressure (capillary or external pressure.) The diagrams demonstrate that the stress-strain relations in earth masses exist not merely by highly artificial mechanisms as George Paaswell says in his paper "Effect of Practical Factors on Earth-pressure Theory," *Engineering News-Record*, Apr. 21, 1921, p. 682, but that they are in every detail comparable with those of solid granular bodies. The intimate relationship includes even elastic after-effect and hysteresis. The diagrams show, furthermore, that one cannot possibly speak of a definite ratio between total and elastic compression (Moran, in his paper mentioned above, p. 369), because this ratio increases rapidly with the pressure.

The "pre-test" system of White must be considered as an ingenious application of our knowledge concerning the compressibility of the sand. Due to the similarity of the stress-strain diagrams of various kinds of sand the ratio between the total compression and the "rebound" can be considered as an indicator of the degree of safety of the pile, and due to this fact it seems that one can entirely

overcome the necessity of pre-testing the pile for any load which is appreciably in excess of the one the pile has finally to carry.

Unfortunately the application of the pre-test system seems to be confined to those cases where the subsoil consists of sand. Such beds of sand can be considered as being in equilibrium before the load is applied, and the coefficient of internal friction is variable within rather narrow limits only (with a few exceptions). On the other hand, beds of clay are rarely in a state of final equilibrium, due to the low rate of drainage and evaporation, which complicates the conditions considerably. A short time ago I had an opportunity to investigate closely a case where loading tests, piledriving tests and borings gave fully satisfactory results, while the building as a whole suffered unequal settlments of more than 1 ft. in the course of a few years. An analysis of the samples furnished by the borings showed that the percentage of sand (grains >0.06 mm.) contained in the muddy substrata ranged between the limits of 42 and 73 per cent, while with the naked eye no difference could be detected between the various samples and the subsoil was considered as being of the same character throughout.

This and similar experiences naturally call our attention to the composition of the various kinds of soil. The results of a wet mechanical analysis of a sample, supplemented by the physical characteristics of the components (limits of plastic state and of liquid state according to Atterberg) are the least one must require. No such data were communicated for instance in the article "Plastic-Fill Method Cuts Costs of Earth Dike," *Engineering News-Record*, Aug. 5, 1920, p. 268. It is therefore impossible to identify a soil suitable for the successful application of the interesting method, and one has to take the risk of failure over and over again.

How misleading the general statements concerning the character of the soil may be is clearly demonstrated by the case of the hydraulic-fill dam. Scores of engineers have claimed that the cores of these dams consist of clay, until Allen Hazen showed that for the sake of stability the effective size of grains of the core-material ought to be not smaller than about 0.01 mm. As the term "clay" must be confined to particles smaller than 0.002 mm., the clay content of such cores is almost negligible. Everybody who has experimented with clay solutions knows that a sediment rich in clay remains forever in a semi-liquid state, unless it is compacted either by evaporation, capillary pressure, or an external pressure (surcharge) amounting to several atmospheres. The history of our knowledge concerning hydraulic-fill dams shows how many years of actual experience and of expensive failures it takes before the fundamental facts emerge from the jungle of non-essentials. It seems therefore to be more economical to search for these elecentary facts in the laboratory first, instead of discovering afterward how easily these facts can be demonstrated on experimental scale.

DR. CHARLES TERZAGHI.

Constantinople, June 1.

## Drafting Room Kinks

Sir—In connection with the note on "Drafting Room Kinks," *Engineering News-Record*, June 23, p. 1077, for many years I have been using almost the same method as Mr. McCurdy has. Instead of attaching the paper with mucilage, I found that strips of tracing cloth about 1 in. wide pasted about one-half on the drawing paper and one-half on the surface paper, worked admirably. They not only hold the paper in place but can very easily be stripped off and be used time after time.

WILLIAM H. WAITE,
The Browning Co.

New York City, June 27.

## Protection of River Banks with Spur Dikes

Sir — Experience on the Rio Grande River may throw some light on the letter of inquiry of Enrique Ramirez, *Engineering News-Record*, May 26, 1921, p. 909, in regard to the protection of river banks with spur dikes. There is no way to calculate or predetermine, graphically or analytically, the distances between proposed dikes. Moreover, it is assumed that current is deflected at right angles to the axis of the spur dike.

The only way to determine the proper location of each dike is to build one at a time, starting at the upstream end of the threatened territory. After a dike is completed,

CURRENT DEFLECTED BY DIKE

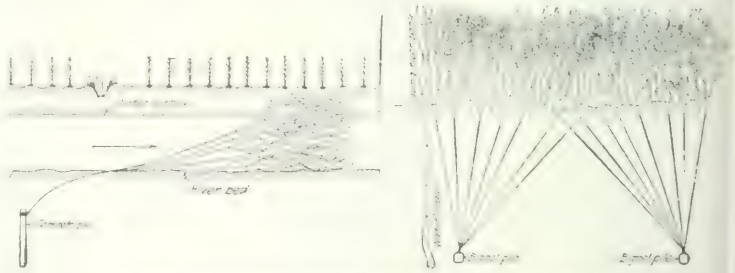
the change in current shows very plainly to what extent the bank below is protected, indicating the exact spot where the next jetty should be located. The proper position of a dike is with its nose pointing downstream, since (1) the current of a river flows in a series of reversed curves and (2) it is the outer edge of the curve where the centrifugal force of the stream cuts or endangers banks.

With a dike placed at right angles, as in Fig. 1, current is deflected toward the opposite bank with a comparatively short radius. The reverse curve strikes back at the threatened bank in a shorter interval and with greater centrifugal force than current flowing in a curve of longer radius. The current of the stream is deflected in the curve of longer radius by a dike pointing downstream as in Fig. 2. The dike in Fig. 1 acts also as an abrupt impediment to the current, which is converted into whirlpools, while the dike in Fig. 2 gives an easy transition to the current. Pointing the dikes downstream also reduces the number, because the flatter the reverse curve, the greater is the distance between dikes.

PHILIP FLITMAN,
Superintendent of Construction, U. S. Indian Irrigation Service.

Cochiti, N. M., June 11.

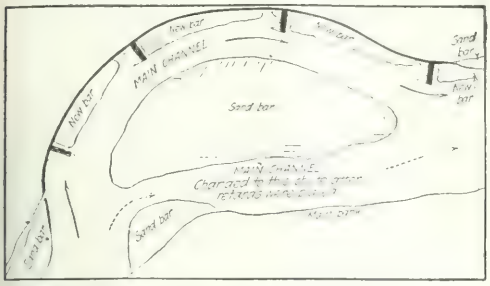
Sir—Letters to the Editor have appeared in *Engineering News-Record*, May 26, p. 909, and June 16, 1921, p. 1047,




DIKE OF UNTRIMMED TREES ANCHORED BY CONCRETE PILES

with regard to spur dike river bank protection, and it is thought that a method recently developed on the Missouri River would be of interest.

It has long been recognized that almost any permeable dike which would permit the passage of a sufficient portion of the current to prevent formation of eddies would efficiently protect a river bank by the formation of bars as indicated in Mr. Chester's letter published June 16. This result is accomplished in the so-called "retard system" by building the dikes of untrimmed trees. These trees are made up in sections on a barge fastened together with cable and then fastened by anchor cables to a concrete pile which is sunk in the river bed to a point where its head is from 10 to 15 ft. below the bottom of the river. The depth to which this pile can be sunk places it beyond any chance




CHANNEL DIVERTED BY PLACING BRUSH RETARDS

of erosion and the surplus strength in the cables has been found ample to prevent destruction of the dike. It soon buries itself in the sand which it causes the river to deposit. In one case at Rulo, Neb., a fill of 9 ft. was secured in one week, so it can be seen that the dike is rapidly buried.

This method of protection is much cheaper than mattress revetment and fully as cheap and much more stable than pile dikes. Several successful pieces of work have been done for the C. B. & Q. Railroad and one for the Illinois Central, for the protection of revetment.

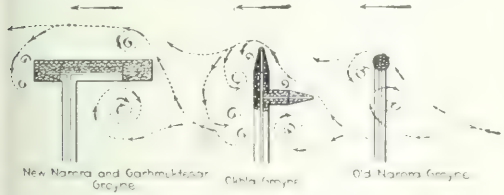
WILLIAM G. ATWOOD,
Manager St. Louis District, Woods Brothers Construction Co.

St. Louis,
June 20.

Sir—With reference to the current discussion on the protection of river banks with spur dikes, the Indian practice of building spur dikes, or groynes, as they are commonly called in India, may be interesting.

The Indian rivers have a tendency to shift their courses and raise their beds by the deposit of silt. On account of these conditions severe inundations often occur and sweep out over all low lying ground. The destruction of villages and crops are a result along such unprotected rivers.

The object of training works is to protect cities, farms and engineering works. The methods ordinarily employed to influence river current direction or action are:




FORMS OF GROYNE HEADS

(1) By levees or "bunds" (which in the vernacular means a closing or shutting off).

(2) By cuts changing the position of the stream.

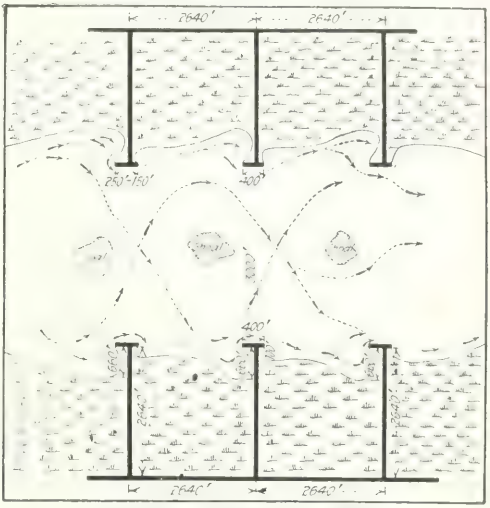
(3) Subsiding aprons, causing or limiting scour.

(4) Permeable spurs, partially obstructing or directing the stream.

(5) Impermeable spurs, or groynes, influencing or directing the stream.

The function of the groyne or spur is not of itself directly to oppose the current, but to hold up a great mass of dead water and thus protect the banks. A very slow motion of the dead water is an advantage, because it may lead to the formation of a bed of hard clay on the bank of the river above the groyne, on account of a slow deposit of silt. The engineer should realize that if the original material of the bed and banks remain unchanged, and the river gradient is not in any part artificially absorbed, the channel will regain its original length, in some way or other. The training works should be designed to preserve the natural regimen of the river, and furthermore they should be permanent if

The following extracts are from notes made by P. Denehy, an authority on Indian river training works:




ACTION OF HOODS ON GROYNE

(1) The result of a series of groynes at half mile intervals is to straighten the river out and to cause silt to deposit in between them, but there is always a loop cut out above and below each groyne, the greatest depth of the loop observed in 20 years is 660 ft., or exactly ¼ of the distance between the groynes.

(2) The whole length of the groyne should if possible be in a straight line.

(3) The groyne heads should be parallel to the river, and at right angles to their embankments, the whole groyne being again at right angles to the marginal "bund," or other work, which has to be protected.

(4) The faces of the groyne heads should be perfectly free from any irregularities or projections, such as trees, cribs or small spurs, all such projections create swirls and eddies which tend to undermine the groyne heads.

(5) All diversions of rivers and spill channels should be made inside or at the land side of the groyne head, for if they are put into the river they offer obstructions and tend to injure the structure.

(6) If the head of the groyne has to be built where there is deep scour, do not alter the position of the groyne to avoid expense of filling up the hole, as a great deal depends upon the alignment of the groyne; and do not fill up the hole with solid material, which is a useless expense, and in fact is injurious to the structure as it would cause irregularities in the currents. The best thing to do is to fill up with sand to low water level and build the groyne head on top of the made sand platform. Should the velocity at the site of the head be too great to admit of sand filling, it may be necessary to make a coffer-dam, with brushwood or other perishable material, and if rubble or broken bricks has to be resorted to, care should be taken that no solid material projects outside the groyne head.

(7) The proper method of closing or diverting a channel which may happen to lie inside the alignment of a proposed groyne head is to first raise an embankment at both sides of the channel, so as to prevent the water from spilling over the banks when the channel is being closed; having thus secured both the flanks from erosion, collect a sufficient quantity of material close at hand to close the channel in as short a time as possible. Have sufficient boats to form a gangway right across the channel. Material should be placed on both flanks. A crowd of men should be put on to place the material which should be laid right across the full width of the channel in 2 ft. layers. If this is done there will be little or no scour, as the bed gets gradually the results are to be permanent.

paved.

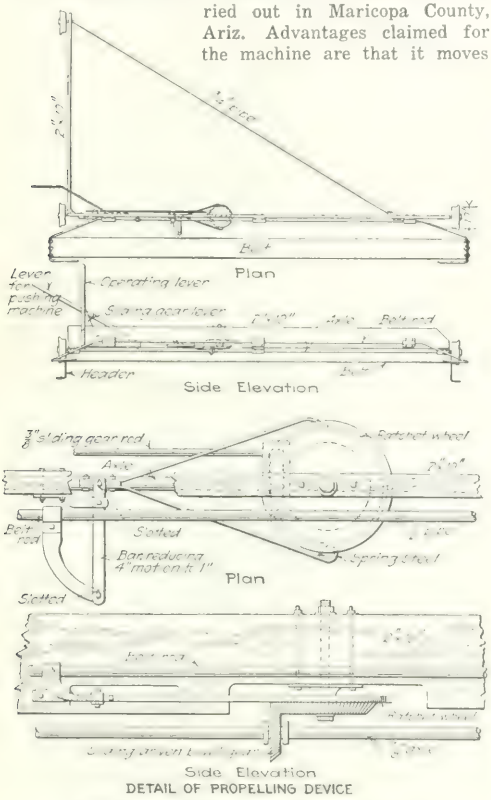
H. L. THACKWELL,
Hydraulic Engineer.

Denver, July 3.

# HINTS FOR THE CONTRACTOR

## Hand Belting Machine for Pavement Has Propelling Device

A HAND-BELTING machine with a device for automatically moving it forward as its belt is operated back and forth across the pavement, has been developed on the extensive road construction job now being carried out in Maricopa County, Ariz. Advantages claimed for the machine are that it moves




DETAIL OF PROPELLING DEVICE

DETAILS OF THE DRIVING MECHANISM

forward at a uniform rate and hence the uniformity of the belting does not depend on the proper advance of the machine by the operator.

The framework of the machine is made up either of timber or pipe and is arranged to be carried by three wheels operating on the header boards. The belt is operated in the usual way by a hand lever. The length of the handle and its mounting are such that a 14-in. throw of the end of the handle (considered most efficient for the average operator) gives the belt a 4-in. movement in a transverse direction and moves the machine forward 1 in. The forward motion is obtained by means of a ratchet wheel operated by a lever from the belt rod, the ratchet wheel being arranged to drive a bevel gear attached to the axle of the machine.

When it is desired to disconnect the driving mechanism, a lever draws the driving bevel gear away from its mate. When desired the machine can carry a bridge enabling workmen to cross the freshly poured pavement.

## Concrete Blocks Hold Swelling Bottom in Brick Sewer

IN AN 11½-ft. sewer tunnel in Detroit clay, occasional slight swelling of the invert cut when it is trimmed for the brickwork, has been successfully checked by substituting 8 x 12 x 12-in. precast concrete blocks for the bottom course of brick. The area of the blocks enables the swelling bottom to be quickly covered and their weight holds the earth down until the ring of blocks can be keyed and the joints cemented. This cementing is done by sifting dry cement into the joints and pouring water on them. The day cement takes up this water and moisture from the bottom and quickly forms a joint strong enough to resist slight swelling. Contractors employing this method claim that a stock of precast blocks for the occasional emergency of holding a swelling bottom is an insurance against delays which sewer masons can well afford.

## Protecting Hose From Vehicles

BY C. W. GEIGER
San Francisco, Cal

A DEVICE for protecting hose where it crosses a roadway is shown in the accompanying illustration. It consists of two parallel pieces of metal held together at the desired angle by five metal straps riveted in place.

MEANS OF PROTECTING HOSE ACROSS ROADWAY

By using fairly heavy metal, cross pieces on the bottom are unnecessary, hence the device can be laid down over a hose without interrupting the flow of water wherever it is desired to provide a vehicle crossing.

# NEWS OF THE WEEK

New York, July 14, 1921

### No Action on Highway Bills

No action was taken last week on the highway legislation before Congress. Senator Townsend, chairman of the committee on postoffices and post roads, was unable to be in Washington during the week; his absence precluded any action on either the Townsend bill or the bill passed by the House. Both bills now are in the hands of the Senate committee.

### Colorado River Lengthened by Congressional Action

The Senate on July 8 passed the bill already approved by the House changing the name of the Grand River in Colorado and Utah to the Colorado River. This insures the change, as there is no doubt as to the President's signing the measure. This gives the river one name from its source to its mouth. Sixty per cent of the water in the Colorado River has its source in the state of Colorado, it was declared during the discussion of the bill.

### New Proviso Inserted in Permits for Dam Construction

So as not establish a precedent which might interfere with the future use of water for power purposes, the Senate committee on commerce has worked out a proviso which is to be made a part of future authorizations for the construction of dams for non-power purposes. The proviso reads as follows:

"That the consent hereby given shall terminate and be at an end from and after 30 days' notice from the Federal Power Commission or other authorized agency of the United States to said company or its successors that desirable water-power development will be interfered with by the existence of said dam; and any grantee or licensee of the United States proposing to develop a power project at or near said dam shall have authority to remove, submerge, or utilize said dam under such conditions as said commission or other agency may determine, but such conditions shall not include compensation for the removal, submergence, or utilization of said dam if the water level to be maintained in said power project is higher than the level of the crest of said dam."

The proviso was made a part of the bill giving authority to the Trumbull Steel Co. to construct a dam across the Mahoning River near Warren, Ohio. With that proviso, no further objection was offered to the measure, and it was passed. The House accepted the amendment. A similar bill authorizing the construction of a dam across the Wabash River at Huntington, Indiana, also has been approved by both Houses.

### Fire Destroys 30th St. Bridge in Pittsburgh

A fire of unknown origin on July 8 wrecked a large part of the 30th St. bridge, which crossed the Allegheny River at Herrs Island. The bridge was a steel truss structure with wooden floor, built in 1888 for a private company and acquired by the public (Allegheny County) in 1911. The northerly part of the bridge, from Herrs Island to the north bank, was built at a later date by the Pennsylvania R. R., but is maintained by the city.

The fire was discovered shortly before 1 p.m., the first warning being a small cloud of smoke noticed by an automobile driver crossing the bridge. Before the occupants of the automobile could return with a fire extinguisher the "entire structure burst into flames," as local reports describe it, and less than three-quarters of an hour later two spans collapsed, within a few minutes of each other. The longer of the two was about 200 ft. in length. Some coal barges below the bridge were ignited by flying brands and were destroyed.

Wires and pipes supported under the bridge hampered the fire-fighting efforts; however, reports that a gas main which broke when the first span fell increased the intensity of the fire, are not supported by facts now at hand.

### National Office of Roads in France Is Proposed

A proposal has been brought before the French Chamber to constitute a National Office of Roads, since the roads in France have been allowed to fall into an exceedingly bad state. This authority, if constituted, will be an entirely autonomous body and not in any way connected with the Ministry of Public Works.

### Plan Again for Building Code for Pennsylvania

A new movement has been started at Harrisburg for the preparation of a state-wide building code to be submitted to the Pennsylvania legislature. Such a code was prepared by a broadly representative committee for submission to the last session of the legislature, but it failed of passage under pressure of legislative work in the closing days of the session.

### Damages for Broken Water Main

Damages to the amount of $3,000 for property flooded by a broken water main have been awarded against the city of Montreal, Que., by the Superior Court of that city.

### Los Angeles Accepts Hog Feeding Method of Garbage Disposal

A majority of the Los Angeles city council on June 30 voted to enter into a ten-year contract for the sale of the city's garbage to G. W. Whitman, a contractor who proposes to feed the garbage to hogs. The bid was 96c. per ton and the plan, according to press reports, is to locate the hog farm near Montebello. Under the terms of the contract the city will deliver the garbage to a loading station probably near the present plant of the Pacific Reduction Co. whence the contractor would be required to remove it to a point at least 3 mi. outside the city limits.

The vote of the council was made over the protest of its president, and vigorous opposition in carrying out the proposed plan is expected from interested citizens. In opposing the measure, the president of the council said: "By approving this bid we are terminating our contract with the Pacific Reduction Co., and in case these contractors are unable to secure a permit from the county, or are unable for any other reason to handle the garbage, the city will be in a terrible situation."

The county health department stated that the successful bidder had not applied for a permit to operate a hog farm in the county and if adjacent property owners protested, it was doubtful whether such a permit could be secured.

#### An Alternative Proposal

The city council and board of public works have had under advisement a proposal by C. D. Crouch, builder of the plant operated by the Pacific Reduction Co., which is now handling the city's garbage, that the city should lease the reduction plant for a year with an option to purchase. This would afford a loading station for use in carrying out the hog-feeding plan and would retain for the city a means for disposal in case the hog-feeding plan should fail or be stopped by legal procedure.

Mr. Crouch has also submitted a plan whereby he proposes that the city screen the sewage in a screening plant (built near the present garbage reduction works) and add to the present garbage plant equipment for drying the screenings so they could be used for fertilizer. A considerable portion of the garbage, he said, could be put through the same process and disposed of in the same way. Experiments made in drying screenings show that they can be converted into a dry practically odorless product, he stated, which could be sold in sacks for a good price.

An average of about 250 tons of garbage is now collected daily and sold for 51 cents per ton to the Pacific Reduction Co. Of late with the declining value of grease, the chief product of the reduction works, the plant has been offered for sale to the city for $450,000. It has been in operation for about six years.

## Position of Power Administrator in California Abolished

The position of power administrator has been abolished and the power administration department of the California State Railroad Commission was discontinued June 30. The office was created in June, 1918, as a war emergency measure and the power administrator was given authority to regulate the power resources of the state so as to pool all available electrical energy. In discontinuing this department the commission recommended that the work of co-ordination of power uses might well be continued with advantage by the various power companies.

## American Engineers Receive Foreign Honors

With the presentation of the John Fritz medal to Eugene Schneider, head of the famous Creusot Works, in Paris, July 8, by a mission of American Engineers, came cable advices from London to the American Society of Mechanical Engineers announcing that more foreign honors had been conferred upon Americans distinguished in the engineering profession. The cable message, addressed to Secretary Calvin W. Rice, stated that Ambrose Swasey, of Cleveland, sponsor of the Engineering Foundation and past-president of the American Society of Mechanical Engineers, had been elected to honorary membership in the British Institution of Mechanical Engineers, in the British Institution of Mining and Metallurgy and in the British Institution of Mining Engineers.

Charles F. Rand of New York, it was stated, had been elected an honorary member of the Institution of Mining and Metallurgy, and of the Institution of Mining Engineers. Mr. Rand, who is chairman of the executive board of the Engineering Foundation, has just been made an honorary member of the British Iron and Steel Institute.

Other elections announced by cable were those of Col. Arthur S. Dwight of New York and William Kelly of Vulcan, Mich. to honorary membership in the Institution of Mining Engineers. This group of honors is believed to be without precedent in engineering and was described by Mr. Rice, who has been active in promoting closer relations between American and British engineers as an important step in bringing about world solidarity in the engineering profession. A movement, it was said, has been started in the direction of federating the engineering societies of the British Empire according to the plan of the Federated American Engineering Societies.

## Boston Invites Bids for Garbage and Refuse Disposal

Bids for the disposal of garbage and refuse, either singly or combined, are wanted by the City of Boston until Sept. 6. The contract will be for ten years from July 1, 1922. The city will deliver the garbage at three wharves and the refuse either at two wharves or at a dump or dumps provided by the contractor at a distance of not over three-fourth mile from one of the wharves. Garbage is defined as including both food and its containers and refuse as nearly everything else ever covered by that term except sewage, but including street sweepings and material removed from catch basins.

The city not only holds itself free from liability for garbage or refuse withheld by producers but also reserves to itself the right to dispose of part or all of the refuse, without holding the contractor or itself in anyway liable therefor. The bids are to be on a lump-sum yearly basis. The city reserves the right to deliver any or all of the garbage to the contractor in sealed receptacles, provided by it, in which case the contractor must take the receptacles to the plant unsealed, empty them, clean them and return them to the city. The price for this extra service, in case of disagreement between the city and the contractor, is to be determined by arbitration.

## Contractors Bid on Jersey Shafts of Vehicle Tunnel

With the award of contract 2 for the construction of the ventilating shafts at the Jersey end of the Hudson River vehicular tunnel, bids for which were received by the New York-New Jersey tunnel commissions July 12, work will be in progress on both sides of the river, and it is expected that before Sept. 1 the two commissions will be in a position to call for bids for constructing the twin tubes of cast iron underneath the river. Work on the Jersey end of the project has been delayed by a controversy involving the widening streets in Jersey City and the adjustment of certain real estate matters with the Erie R.R. These differences have been composed and the way is now open for the award of the tunnel contracts as soon as the shaft work on the Jersey side has progressed far enough.

While certain property rights involved in the tunnel construction are still under adjustment, it is understood that the engineering plans and specifications for the twin tubes are now completed, so that a call for bids will find everything in readiness. Experiments are still under way to determine upon final details of ventilating the tunnels, but the cross-section and type of construction by the shield method have been definitely determined and as far as the engineering department is concerned the work is ready to be placed under contract.

Aug. 3 is the date which has been fixed for the ceremony of breaking ground for the Jersey end of the tubes.

## Prouty's Death Will Not Halt Valuation Work

Charles A. Prouty, director of valuation of the Interstate Commerce Commission, died at his home in Newport, Vermont, July 8. The death of Mr. Prouty, according to a statement by the commission, will not interfere with nor have any effect upon its valuation work for the reason that for months during his illness, Division 1 and the associate director have had and will continue to have entire control of the valuation work.

## Start New Water Power Development in Vermont

The New England Power Co. has started construction work on a 4,500-kw. hydro-electric power plant at Searsburg, Vt. This plant is located on the Deerfield River about 4 mi. from Wilmington. The company has in operation six plants below Searsburg, on the Deerfield, which utilize a total head of about 525 ft. The Searsburg plant will have a gross head of about 235 ft., or a net operating head of 215 ft. The company also has in operation a storage reservoir of 2,500,000,000 cu.ft. capacity about 5 mi. above the Searsburg plant so that the Searsburg development will increase the value of its storage water about 45 per cent.

The development includes a low earth dam of about 50,000 cu.yd. across the bed of the river with a concrete spillway located on ledge to one side of the present river bed. From the dam the water will be carried in an 8-ft. diameter wood stave pipe about 18,000 ft. along the west side of the river to a surge tank. From the surge tank the water will be carried to the power house in a 6½-ft. diameter steel penstock. The power house will be a concrete substructure with steel and brick superstructure and will contain one 4,500-kw. unit. Aside from the switchboard the principal electrical apparatus will be located outdoors, including the 2,300/66,000-volt transformers.

The power from this plant will be handled over new transmission lines extending to plant No. 5 of the company near Hoosac Tunnel, Mass., and to the Vernon plant below Brattleboro. In all, there is about thirty-six miles of this transmission line which will be constructed as 66,000-volt single-circuit line.

The development is being designed and the work carried out by the Power Construction Co., Worcester, Mass.

## Banker Optimistic On Irrigation

Irrigation development in the West is awaiting a turn in financial conditions to reach enormous proportions, says J. W. Harrison, chairman, Anglo and London-Paris National Bank, San Francisco, in the June *Bulletin* of the Investment Bankers Association. Projects proposed in California alone will require financing to the extent of $400,000,000 and other western states are alive to their own requirements.

## Recommend Tube and Bridge for San Francisco Bay

A preliminary report by J. Vipond Davies and Ralph Modjeski on the proposed San Francisco Bay crossing was announced on July 7. The two engineers were retained by the San Francisco Motor Car Dealers' Association to report on the general question of improved means of crossing the bay. The leading features of the plan which they recommend are as follows:

Starting on the San Francisco side somewhere between Mission Rock and Potrero Point, a tunnel extends out under the bay about 3,000 ft., connecting with 12,000 ft. of bridge followed by concrete pile causeway, followed in turn by permanent fill extending to a point near the south end of the proposed naval base site in Alameda. The bridge section of the crossing is composed of 300-ft. cantilever spans.

As outlined the project would cost $40,000,000, including preliminary surveys, engineering, administration cost, and interest during construction. Two railroad tracks and a 20-ft. roadway are provided in the tunnel section, while on the bridge the roadway is widened to 40 ft. The tunnel would consist of three parallel tubes, one for each track and one for the roadway. The engineers estimate that the structure can be completed in three years and eight months from the time it is decided to start.

In its general lines this project is similar to that developed by J. G. Little and C. H. Snyder, as described in *Engineering News-Record* of July 7, p. 17.

## More Rail Valuations Completed

The Interstate Commerce Commission has completed its tentative valuation of the property of the Pacific & Idaho Northern Ry., as of June 30, 1916. The investment in road and equipment, including land, on the date of valuation is stated in the books of the carrier to be $5,534,163.83, the report shows. Of this amount, $4,600,438.56 represents the par value of securities issued in payment for the road and equipment. The cost of reproduction new and the cost of reproduction less depreciation of all common-carrier property, other than land, wholly owned and used by the carrier are held to be $2,302,826 and $1,932,897, respectively. The carrier owns and uses for its purposes land having a present value of $125,716.68. The commission values the property of the road at $2,100,176.

A tentative valuation also has been made of the property of the Intermountain Ry. Co., an Idaho corporation. The value of the property of that carrier was found to be $991,127. The investment in road and equipment, including land, is stated in the books of the carrier to be $915,298.05. The cost of reproduction new and the cost of reproduction less depreciation of all common carrier property, other than land owned and used by the carrier, are reported to be $1,006,073 and $951,396, respectively.

Another valuation report covers the Fourche River Valley & Indian Territory Ry. Co., of Arkansas. The value of the property owned and used by that carrier was set at $250,000.

## Diamond Drilling Starts on Columbia River Dam Site

Contract for diamond drill exploration of a dam site on the Columbia River near the head of Grand Coulee in the state of Washington was let in June and drilling was to start the first week in July. The work is being done by the state department of conservation and development, which is conducting the Columbia Basin survey. Drilling at this point is being undertaken on the recommendation of the federal reviewing board of engineers which passed on the Columbia Basin irrigation project. A resumé of this project appeared in *Engineering News-Record*, Nov. 11, 1920, p. 944. In case granite bedrock is found to be more than 150 ft. below the boulders and glacial deposit the site will be abandoned. If sound bedrock is found nearer the surface the entire site is to be drilled and mapped.

This work is not being done in accordance with the report of the Columbia Basin Survey Commission, which was adverse to the construction of a dam at this point on the ground that it would require a pumping plant to work against a head of 615 ft. and would require 990,000 hp.

Six bids on the diamond drilling were received. The contract was awarded to the International Diamond Drill Contracting Co., whose proposal was that the state should pay all costs plus a rental on equipment supplied by the company of $19 per day of two eight-hour shifts with option permitting the state at the end of any month to designate that the succeeding work should be paid for at cost plus from $1 to $1.50 per ft. drilled, the rate depending upon the progress in the preceding months.

## Move Bridge to New Piers

The Des Moines River Bridge of the Atchison, Topeka & Santa Fe R.R. at Dumas, Mo., is to have new piers built 42 ft. east of the present piers, the six 150-ft. deck truss spans being then shifted 42 ft. longitudinally. One of the spans will be shortened by two panels. The old piers were built of a local sandstone which has deteriorated to such an extent as to render reconstruction necessary, but the abutments are in good condition. It is planned to build the new piers long enough for double track, the single track spans being reinforced at some later time for the E-65 loading and a second track being added. Plans for the work are being prepared and it is expected that contracts will be let this summer. As this bridge is over a navigable stream the work has been authorized by an act of Congress approved in June.

## John F. Wallace

John F. Wallace, consulting engineer of New York City, whose death in Washington, D. C., on July 3 was announced in last week's issue of this journal, was most widely known as the chief engineer in 1904 of the Panama Canal, although his professional experience covered a number of other important engineering works, particularly in the Mississippi Valley, where his achievements in the railway field first won for him the recognition which led eventually to his appointment as chief engineer and general manager of the Illinois Central R.R. He was recipient in 1900 of the highest honor within the power of his professional associates to bestow—the presidency of the American Society of Civil Engineers—having served the society as treasurer in 1913-14 and as vice-president in 1897-98. One of his most recent professional engagements was as chairman of the Chicago Railway Terminal Commission.

JOHN F. WALLACE

Mr. Wallace was born in Fall River, Mass., in 1852 and after graduation in 1871 from Monmouth College in Illinois, he became a U. S. assistant engineer on Mississippi River improvements, his early work being at the Rock Island rapids, above Hampton, Ill., where he designed and built special machinery for excavating a steamboat channel through the St. Louis chain of rocks.

In 1879 he engaged in railway work as chief engineer of the Burlington, Monmouth & Illinois River R.R., becoming superintendent when the road was completed, and master of trains after it was consolidated with the Iowa Central. At the same time he served as engineer on various improvements under construction. In 1886, as assistant engineer for the Union Pacific Ry., he was in charge of surveys in the Rocky Mountains and the next year was appointed bridge engineer of the Santa Fe., under Octave Chanute, consulting engineer of the company. In that capacity, he had charge of the building of the Missouri River bridge at Sibley, Mo.

The Illinois Central R.R. retained Mr. Wallace in 1891 and his time was devoted largely to the transportation problems in connection with the World's Fair and to the general improvement of the railway company's Chicago terminals. In 1892 he was appointed chief engineer of the Illinois Central and in that capacity directed the track elevation and lake-front improvements in Chicago, extensive terminal work at New Orleans, East St. Louis, Louisville and Memphis. In 1898 he became assistant second vice-president, in 1901 assistant general manager and, one year later, general manager.

Mr. Wallace was chosen chief engineer of the Isthmian Canal Commission in 1904. Leaving the work at Panama in 1905 he was appointed consulting engineer on the Chicago terminal of the Chicago & Northwestern Ry., and in 1906 was elected president of Westinghouse, Church, Kerr & Co., New York, serving with this company for eleven years during which time he became chairman of the board. He remained in that capacity until the recent consolidation of that company with other interests. He maintained an office in New York City as consultant to large corporations and also served as chairman of the Chicago Railway Terminal Commission.

Mr. Wallace was elected president of the American Society of Civil Engineers in 1900. He was also a past-president of the Western Society of Engineers and of the American Railway Engineering Association.

At the time of his death, Mr. Wallace was in Washington attending hearings of the Senate committee on interstate commerce.

## Permit Granted for Large Power Project on Coosa River

On June 27 the Federal Power Commission, acting under the federal water power act, issued a license to the Alabama Power Co. for a 120,000-hp. water power development on the Coosa River in Alabama, at a location known as Duncan's Riffle. Work has already started on the project which will comprise a concrete, gravity type dam 1,200 ft. long, to develop a head of 68 ft. The initial installation will be two 24,000-hp. vertical units with turbines of single runner type, directly connected to the generators and with provision for the installation of three additional units as the demand from the market may require. The transmission line will connect with the existing line of the company, about 12 miles distant.

An announcement by the Federal Power Commission states that the company plans to introduce two noteworthy departures from previous design of similar plants. One of these is the location of the units on the upstream side of the dam, each in a separate inclosure and upon its own concrete foundation. The other improvement is in the draft tubes which will reduce loss of head during periods of high water by discharging upward at the toe of the dam. O. G. Thurlo, chief engineer of the Alabama Power Co., has designed the spillway and the tailwater channel so as to keep the standing wave downstream from the draft tube outlets at all stages of discharge.

The reservoir created by the dam will have an area of about 6,000 acres. The license issued to the company provides that whenever a definite project is adopted for the improvement of this section of the river by the federal government the company will install the necessary locks and channels for navigation.

## A. A. E. Board Names Committee to Confer with F. A. E. S.

Business transacted by the board of directors of the American Association of Engineers at the quarterly meeting held June 24 and 25 included the following: (1) The country was divided into 12 districts for the purpose of representation on the board. (2) Provision was made for continuing the Washington office. (3) Kenneth Talbot was appointed head of a committee to draft a plan for financing an enlarged employment service. (4) An invitation is to be issued to all engineers to submit questions on ethics for reference to the practice committee; after a sufficient number have been passed on they will be published. (5) No general membership drive is to be undertaken, but a student membership campaign was authorized to be conducted in the fall months. (6) The committee on services and fees, headed by Langdon Pearce, was authorized to hold a national conference of practicing engineers. (7) H. O. Garman, president; A. N. Johnson, first vice president and C. E. Drayer, secretary, were appointed as the committee to meet with a similar committee from the executive board of the American Engineering Council of the Federated American Engineering Societies, to study relations and co-operation, (8) Dean G. M. Butler, Prof. Frederic Bass and Dean A. N. Johnson, were named as the committee authorized by the Buffalo convention to classify engineering schools.

Fourteen of the fifteen directors were present at the meeting.

## Port Development Plans Wanted

An international competition for port development plans has been called by the harbor board of the city of Trelleborg, Sweden. The plans are required by Nov. 1, 1921. Three prizes are offered, of 20,000, 15,000, and 8,000 kroner, and it is provided that plans not awarded a prize may be purchased by the board for 2,000 kroner.

## Permanent Engineering Board for Delaware River Bridge

On June 30 the Delaware River Bridge joint commission adopted a plan for the organization of a permanent engineering force for the construction of the Philadelphia-Camden bridge, and reappointed the board of engineers which prepared the report submitted June 9 and adopted by the commission two weeks later. The organization of the board has been modified, however. Ralph Modjeski is chairman and chief engineer at a salary of $2,500 a month, to include traveling expenses. George S. Webster and Lawrence A. Ball, the other two members of the board, will receive $1,000 a month each.

In accordance with the report of the commission's engineering committee, the chief engineer and chairman is to be in complete charge of design and erection of the structure, is to organize a staff subject to the commission's approval, prepare designs and specifications, assist the commission in letting contracts, direct the work in office and in field, have power to dismiss subordinates and fill vacancies, call meetings of the board of engineers and consult with the members of the board on all phases of the work, make monthly reports to the commission, call on experts for temporary service, when advisable, approve and sign requisitions, and prepare and sign estimates. The board is to advise the commission on all matters pertaining to the project, hold weekly meetings and approve in writing contract drawings and specifications. Differences arising in the board shall be reported to the commission in writing. A complete record of the proceedings of the board is to be kept for reference of the commission, and monthly reports shall be made. The plan outlined by the committee also provides for an inspection department, an assistant to the chairman and chief engineer, an engineer of designs for the approaches, an engineer of design for the main bridge, and 3 engineers of construction.

NEW OFFICERS AND BOARD OF DIRECTORS OF AMERICAN ASSOCIATION OF ENGINEERS

Top row, left to right—Directors: Charles A. Ender, Pittsburgh; L. E. Ayres, Ann Arbor; W. C. Bolin, Chicago; G. M. Butler, Tucson; E. F. Ayres, Boise; B. A. Bertel, Law, Cincinnati.

Middle row—Directors: W. L. Benham, Kansas City; Morris Bien, Washington; Frederic Bass, Minneapolis; W. E. Vogelback (proxy for Garrison Babcock, Everett, Wash.), Chicago.

Lower row—W. B. McKeen, director, Omaha; Henry W. Clausen, treasurer, Chicago; C. E. Drayer, secretary, Chicago; H.O. Garman, president, Indianapolis; A. N. Johnson, first vice-president, College Park, Md.; A. S. Morris, second vice-president, Chicago.

### New Dry-Feed Chemical Device

A dry-feed chemical apparatus—the Booth dry feeder—adapted to the application of chemicals in water treatment and for other purposes has recently been placed on the market by Wallace & Tiernan. A conical-shaped feed hopper discharges onto a table rotated by a ½-hp. motor at 1¼ to 8½ r.p.m. The chemical is scraped off the table into a flushing hopper or, in the case of water treatment, directly into the water supply. In addition to speed regulation of the rotating table the rate of feed may be changed by an adjustable collar around the feed spout. Within the conical hopper is a shaft carrying two agitator arms and a chain to prevent packing or arching of the chemical.

## PERSONAL NOTES

JOHN HORRIDGE has been appointed supervising engineer in the division of street cleaning, department of public works, Philadelphia, Pa.

GEORGE W. GREEN has been appointed municipal engineer of the Canal Zone by Governor Jay J. Morrow to fill the vacancy caused by the resignation of D. E. Wright.

O. FROSETH, formerly assistant engineer with the Miami Conservancy District, Dayton, Ohio, is now in the office of the chief engineer of the Illinois Central R.R., Chicago, Ill.

HERMAN H. SMITH has been recommended by the chief engineer of the Board of Estimate and Apportionment, New York City, for the position of deputy chief engineer.

CHARLES F. RAND, chairman of the executive board of Engineering Foundation and one of the leaders of post-war research in American industry, has been elected an honorary member of the Iron and Steel Institute of Great Britain. Mr. Rand is a member of the engineer mission which has gone to France to bestow the John Fritz medal on Eugene Schneider, head of the Creusot works.

H. F. ANDERSON, resident engineer of Mecosta County, Mich., has been appointed road engineer of Mecosta County.

FRANK F. SINKS, at one time a member of the firm of Condron & Sinks of Chicago and in recent years connected with various engineering works in the Northwest, has opened an office in Seattle for the practice of industrial and structural engineering.

PROF. ARTHUR M. GREENE of Rensselaer Polytechnic Institute has accepted the call of the trustees of Princeton University to become dean of the engineering school and professor of mechanical engineering. He will take up his new duties in September, 1922. Prof. Greene is a graduate of the University of Pennsylvania and also holds an honorary degree of D.Sc. conferred in 1916. He has taught mechanical engineering at Drexel Institute, at the Universities of Pennsylvania and Missouri and at Rensselaer, and has been prominent in the American Society of Mechanical Engineers as manager and vice-president and at present is chairman of the society's research committee.

E. E. SOURS, formerly road engineer of Mecosta County, Mich., has been appointed road engineer for Allegan County, Mich.

HERBERT S. CROCKER, formerly acting secretary of the American Society of Civil Engineers, has re-opened his office in Denver, Col., to specialize in design and superintendence of construction of bridges, buildings, foundations and public utilities. Attention will also be given to investigations, reports, valuations, and special engineering problems.

VIRGIL W. SAMMS, formerly city engineer of Pocatello, Idaho, and later connected with the construction department of the Oregon Short Line R.R., has been appointed surveyor general for the state of Idaho.

EDWARD MOSHER, formerly township engineer, Cranford, N. J., has been appointed town engineer, Westfield, N. J., in charge of the construction and maintenance of roads and sewers and the operation of the sewage disposal works.

ELWIN QUINNEY, formerly county highway superintendent, Beadle County, S. D., is now resident engineer with the South Dakota state highway commission in charge of the construction of state and federal aid roads in Codington and Deuel counties with headquarters at Watertown.

F. E. ROSS, recently with the Missouri highway department, has been appointed city engineer of Jefferson City, Mo.

W. O. HINKLEY has obtained a leave of absence from the Union Pacific R.R. as instrumentman on maintenance-of-way and is at present engineer with the Stanley Consolidated Mines of Idaho Springs, Col., engaged in underground surveying and the design of small structures.

CHARLES M. BINFORD has opened an office in Beckley, W. Va., as civil and mining engineer to specialize in examinations and reports of coal lands and properties, the design and construction of coal plants, the improvement of existing plants to increase their capacity, town planning and building, suburban development and supervision of construction.

R. W. DOWNIE, recently with the Canadian Inspection and Testing Co., Ltd., has been appointed tester of building materials for the Welland Ship Canal with laboratories and office at Merritton, Ont.

HERSCHEL C. SMITH, formerly deputy state highway engineer of Oklahoma, has been appointed professor of highway engineering and highway transport at the University of Michigan from which institution he graduated in 1913. Last October he was elected Roy D. Chapin fellow in highway transport at the university.

BERNARD J. FALLON, assistant general manager and formerly engineer maintenance-of-way of the Chicago elevated railway system, has been appointed general manager.

## OBITUARY

JAMES OWEN, for about 45 years engineer of Essex County, N. J., and for 17 years town engineer of Montclair, N. J., died in Bayhead, N. J., July 5. He was born in London, England, in 1845 and was educated in private schools and at King's College, London. He was apprenticed at the age of 15 to G. K. Radford, civil engineer. In 1864 Mr. Radford came to the United States and became chief engineer on the construction of the Indiana Southern Ry.; about a year later Mr. Owen joined Mr. Radford as assistant. In 1867 Mr. Owen was appointed assistant engineer to the Brooklyn Park Board then engaged in laying out Prospect Park. The following year he was appointed engineer of the Essex County (N. J.) public road board and later in 1868 he was named county engineer of Essex County, which position he held with slight interruptions until 1913, when he retired to engage in consulting practice. During his official connection with Essex County and while serving Montclair and other communities as engineer, Mr. Owen played a considerable part in both the pioneer and the later work which gave New Jersey its system of improved highways. He also did a large amount of other municipal work, having been connected with the construction and early operation of the plant of the Montclair Water Co., and with the sewerage and sewage disposal works.

PROF. FRANCIS B. CROCKER, electrical engineer, founder in 1886 with C. G. Curtis of the C. & C. Electric Motor Co. and, two years later with Dr. S. S. Wheeler, of the Crocker-Wheeler Electric Co., died in New York City, July 9. He was born in New York City in 1861 and was graduated from the school of mines, Columbia University, in 1882 and received the degree of Ph.D. in 1894. In 1886 he was head of the department of electrical engineering of Columbia University and about eleven years later he became the chairman of the first standardization committee of the American Institute of Electrical Engineers. He served the A. I. E. E. as president and manager and vice-president. He was considered one of the best informed men in the industry on electrical patents. His most important contribution to the electrical industry was the development of standards of design for a wide variety of electrical equipment.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

### Lumber Production Costs

The committee on statistics of the American Wholesale Lumber Association advises that the manufacturing costs among the southern lumber manufacturers for January was $27.58 per thousand ft.b.m. In February this figure had been reduced to $24.22 and in March $22.43. The interesting situation in some mills was found that no expense was entailed in shipping and selling departments, while the maximum expense of any mill reporting was $3.43 per thousand ft.b.m. The average of all the companies, including those that showed no expense for shipping and selling, in January reported an average cost of $1.95, and in February $1.79 per thousand ft.b.m.

### Net Operating Income of Railroads $37,246,000 in May

The railroads of the United States had a net operating income in May of $37,246,000, which was approximately $7,997,000 more than it was in April, according to reports just filed by the carriers with the Interstate Commerce Commission. This is the largest amount earned by the railroads since last November when their net operating income was $54,343,793. Comparisons show that eighty railroads—twenty-eight in the eastern, nineteen in the southern and thirty-three in the western districts—had operating deficits in May while in April the total was 91.

On the basis of the tentative valuation fixed by the Interstate Commerce Commission for rate making purposes under the Transportation Act, the amount earned in May would be at the annual rate of return of 2.41 per cent compared with 2.2 per cent the previous month. The reports show, however, that the carriers fell short $55,490,000 or 59.8 per cent of earning the amount contemplated by the Act.

The tabulations are based on reports from 201 Class One railroads representing a total mileage of 235,450 miles.

### Highway Work in California Totals $6,000,000

How important a part state highway work has played in solving the problem of unemployment in California is indicated by contracts let for state highways since the beginning of the year. In all thirty-five new contracts calling for an expenditure of approximately $6,000,000 have been let by the California Highway Commission during the first six months of 1921.

This work was distributed all over California and in addition to other work under way constitutes a large factor in relieving unemployment conditions in California. Bids on other sections are being asked and a large highway program is well under way.

### Building in Manhattan Borough

According to the report of the bureau of buildings for the Borough of Manhattan, New York City, for the first six months of 1921 plans were filed for the construction of 421 new buildings estimated to cost in excess of $53,000,000, as compared with plans filed for 434 buildings to cost $67,000,000 for the first six months of 1920. The number of dwellings planned for 1921 is six times that for which plans were filed during 1920, though the average cost of the 1921 dwelling is about one-half of the 1920 cost.

Proposed new tenement houses have increased in number from fifteen to forty-two, and the total estimated cost from $7,925,000 to $9,660,000. The average number of apartments in a Manhattan tenement house is about forty. A fact to be noted in connection with house construction is that, while only 15 per cent of the residence buildings proposed in the first half of 1920 were actually started in the same period, over 75 per cent of the proposed residences for the first half of 1920 have been started in that period.

Business buildings, not including those that are devoted entirely to office purposes, increased in number about 67 per cent. The estimated cost of 1921 building of this class is about two and a half times what it was for the same period of 1920. Office buildings, on the other hand, show a decided falling off, the decrease in number being 25 per cent and about 45 per cent in estimated cost. There was a decrease in estimated cost of nearly 20 per cent in the number of proposed stables and garages, and about 45 per cent in the estimated cost of alterations.

### Brooklyn Building Breaks Record

The total value of new buildings and alterations, miscellaneous structures and plumbing permits for which plans were filed during the first six months of 1921 in Brooklyn, N. Y., was $71,131,073. The total for the first half of 1920 was $50,670,901. The total of new building plans filed at Brooklyn, including dwellings, apartment houses, theatres, offices, factories and stores, was $63,808,055. Plans were filed in Queensboro during the first half of 1921 for new buildings to cost $28,438,521 as compared with structures to cost $22,510,246 in the corresponding six months of 1920. The total of new buildings for Bronx during the first six months of 1921 was 1,192 to cost $26,404,450 as compared with 630 buildings for the first half of 1920, costing $11,750,180.

In the entire city of New York, plans were filed during the first six months of 1921 calling for an expenditure in excess of $184,000,000 a gain for the first six months of 1921 over the first half of 1920 of $30,000,000.

### Steel Seeks a Basic Level

The announcement by the Bethlehem Steel Co. of a general decrease in prices effective July 5 was followed by a similar announcement by the United States Steel Corporation, effective July 6. Thus, for the second time in three months the Steel Corporation has met the market created by the independents. The dealers are doing their part to make steel an attractive purchase as early as possible. Responding to the mill decrease, they have lowered warehouse prices by 20c. per 100 lb. on beams, channels, angles and tees, the new quotation being $3.03. It is the opinion of the trade that there will be no further price changes for the next two months at least. Both Bethlehem and the Steel Corporation report improvement in smaller orders, but it is too soon to predict whether the present scale will stimluate large construction. Some believe that structural shapes must go to $1.75 before there will be a satisfactory response from the large buyers. The average price just before the war was $1.50, with a minimum of $1.08 in the latter part of 1914. One thing is certain, steel in moving towards the old normal figure is leading the other construction materials.

### New York Cement Prices Unstable

For some weeks the price of cement in New York has been $2.80 delivered, exclusive of bags, but at present keen competition among the dealers has created a market ranging from $2.60 to $2.80. In fact, a quotation as low as $2.50 net has been heard. The average market appears to be $2.60 net or $3 per barrel including bags. When it is considered that handling charges amount to 23.8c. per barrel and that cement costs the dealer $2.80 (with bags) alongside dock, it is apparent that if the price is to go much lower, the manufacturer will have to take the matter in hand. It appears, however, that the price will not be reduced until the fall.

### Freight Rate Reductions

Since June, 1920, the Western Trunk Line Committee, an association of railway officials which has been hearing applications for reduction in freight rates, has considered 1,200 subjects, over 90 per cent of which were reductions and nearly all affected rates increased last year. The reductions concerned particularly crushed rock, gravel, building materials, as well as coal, lumber, and other commodities.

The reductions ranged from 5 to 70 per cent. Among the applications on which reductions were approved were twenty-four for brick, cement and lime, and fifteen on iron and steel rails structural iron, and ferro-manganese.

## 'exas Highway Work Underway Totals $26,955,348

There are now under construction in e state of Texas 192 state and Fed- al-aid projects, involving the building 2,301 miles of highway for which the tal contract cost is $26,955,348. Of is amount, $9,260,986 is Federal-aid ney which has actually been grante the 2,301 miles under constr ao .7 miles are being paved with te, 421 miles with bituminous types 65 miles with gravel. Although the naining mileage is surfaced with a aper class of material, all drainage uctures will be permanent. There seventeen projects totaling 144 les not yet under contract but upon ich plans have been approved and ich are estimated to cost in excess of 500,000. Of other work proposed, ject statements have been approved sixty-five projects, 653 miles long l estimated to cost approximately ,000,000, for the construction of ich $2,500,000 of Federal aid and re than $1,000,000 of state aid have eady been allotted.

There are now a total of 414 projects ler the supervision of the state high- y department either being main- ned, constructed or proposed, involv- more than 4,000 miles, for which total estimated expenditure is roximately $49,000,000.

## St. Louis County to Let Road Work Worth $2,000,000

n July 22 the county commissioners St. Louis County, Minn., propose t contracts for the construction and rovement of certain highways which involve the expenditure of $2,000,- The work will include 56 miles of ling work and 28 miles of paving. contracts for $1,500,000, awarded ng 1920, will be practically com- ed this year. The new work to be on July 22 will be scheduled for pletion by the fall of 1922.

## mber Surplus Cars Decreases

he demand for freight cars con- es to increase according to reports ived from the rail carriers of the try by the car service division of American Railway Association. se show that on June 30, there were 791 surplus freight cars or a de- se of 4,059 compared with the total une 23.

he total number of box cars in- ing ventilated, automobile and fur- re cars, in excess of current freight irements was 146,298 which was ecrease within a week of 6,335. ecrease of 1,445 coal cars was also rted, the total on June 30 being 537 compared with 163,982 on June Surplus stock cars numbered 18,- compared with 20,029 one week re or a reduction of 1,859. These ictions, however, were in part teracted by an increase of more 6,200 in the number of surplus of miscellaneous classes.

## Forest Service to Establish New Experiment Station

The U. S. Forest Service has announced that a new experiment station will be established this month at Asheville, N. C., to be known as the Appalachian station. Steady depletion of the southern Appalachian timber supply is responsible for the location of this station. Its chief object will be to obtain information needed for determining the best methods of handling forest lands in the southern mountains.

For many years the United States has depended for a large part of its hardwood timber on North Carolina, Virginia, West Virginia, Kentucky, Tennessee, Alabama, Georgia and South Carolina. The crest of hardwood production in this region, with a cut of approximately 4,000,000 000 ft. was reached in 1909. By 1918 the production had fallen nearly 60 per cent.

The country as a whole will, in the future, have to depend on the mountain slopes of the Southern Appalachians for a very large percentage of its high-grade hardwood, the bulk of which is now in the lower Mississippi valley.

The general timber situation is exceedingly serious official foresters say. Three-fifths of the original timber stand has been destroyed or utilized and a considerable percentage of the remaining two-fifths is made up of inferior second growth. One half of the timber left is in the three Pacific Coast States, Washington, Oregon and California.

## Concern Builds Steel Houses

Making small houses almost entirely of steel has been undertaken on a large scale by the International Housing Corporation, a New York concern. Most of the main framing in these houses is of lumber, but the siding, roofing, eaves and gutters are of interlocking steel strips, first galvanized and then painted. The interior finish is of insulated wall and ceiling boards. Roof sheets are bolted to the eaves and ridges on all four sides and firmly fastened with hangers and tie rods from the ridges to cross T-bars so that the roof and four outer walls form a rigid unit.

The houses are of several sizes, all of one story. The largest now being built is 20 ft. by 36 ft., outside dimensions.

It is understood that the company plans a large development in the construction of these steel houses on Long Island where it recently acquired a large amount of property.

Because of the insulation of the wall and ceiling board it is said that these steel houses are practically sound proof.

## Production of Southern Pine Falls

Production of lumber for week ending July 1 reported by the Southern Pine Association was 25.6 per cent below normal. Shipments were 17.9 per cent below normal production and orders 20.8 per cent. Orders were 6.5 per cent above production and 3.6 per cent below shipments for the week.

## National Bodies Begin Joint Clay-Products Research

The chairmen of the respective research committees of the American Face Brick Association, the Common Brick Manufacturers Association, the Hollow Building Tile Association and the National Paving Brick Manufacturers Association, together with the secretaries of these associations, representatives of the federal government, universities and the American Ceramic Society, met in Chicago on June 16 to perfect an organization through which the co-operation of the association may be made effective in clay-products research.

A plan of research proposed by the technical committee and accepted by the executive committee in behalf of the four associations, contemplates the investigation of commercial kilns, represented by the up-draft and the down-draft kiln, the continuous kiln of the straight tunnel type, the compartment continuous kiln and the tunnel car kiln, as the first consideration. The second part of the research work will deal with the study of the water smoking and de-hydration process by the Bureau of Standards; the study of steam absorption throughout all the burning stages by the ceramic department of the University of Illinois; the study of oxidation and burning stages by the Bureau of Mines, and experiments and study of combustion and transmission of heat in a semi-commercial kiln by the Bureau of Mines at Columbus.

Funds with which to carry on the research work will be furnished by the joint research committee and by the various federal bureaus making investigations. Out of the $10,000 fund of the joint research committee recommendation was made by the technical committee and approved by the executive committee that $7,500 be placed to the credit of the Bureau of Mines and $2,500 to the credit of the Bureau of Standards. Each of these bureaus will then with its own funds augment the joint committee funds and it is expected that three times that much money will be available during the year.

A. V. Bleininger, of the Homer Laughlin Pottery Company, is the chairman of the technical committee. The other members are R. H. Bates, U. S. Bureau of Standards, Washington; R. C. Purdy, American Ceramic Society, Columbus; R. T. Stull, United States Bureau of Mines, Columbus, and E. W. Washburn, University of Illinois.

## Great Sale of Wooden Ships by U. S. Government

Bids are called by the U. S. Shipping Board for the sale of a large fleet of wooden ships built for the board during the war. No less than 285 ships are to be disposed of; they are of eleven different types, ranging from 2,500 to 2,900 deadweight tons. Over half of the vessels (180) are of the Ferris

type. These are 286 ft. long, 42 ft. 2 in. in beam, 26 ft. deep, and are equipped with triple-expansion engines of 1,400 hp. and two standard water-tube boilers. With a bunker capacity of 477 tons, these vessels have a steaming radius of 3,954 miles at 8 knots. The details of the other ships differ slightly.

Bids are to be opened July 30 at 10:30 a.m. in the office of the Shipping Board, Washington, D. C. The call states that bids will be received from all nations in the world, and that the board will recognize accepted bids from foreign countries as providing for the transfer of flag privilege. A sale commission of 5 per cent will be paid brokers making accepted bids.

## New York Employers Propose Wage Cut

The Building Trades Employers Association of New York City has asked that the Building Trades Council meet the employers to discuss the proposition of reducing the general scale of wages now being paid building trades mechanics. The proposed meeting is the culmination of a proposal made more than a week ago by the various building trade associations to their respective unions that the unions consent to a $1 a day decrease. The unions asserted that the question of wages was in the hands of the central council, to which body the matter has been referred by the constituent unions.

## Contract Value of Past Wee Is Third Highest of Year

Contracts let during the past w as reported in *Engineering N Record*, had a total value of $32,265, more than $12,000,000 in excess of contract value for the correspon week of 1920—$19,776,015. The fi of the past week is well above weekly average for 1921, and is third highest figure yet recorded the year. That is remarkable in t usually, after the spring peak has reached, the total value of contract falls off. The past week's report ca news of the letting of the Bethle bridge contract — $2,568,000 — an $1,602,892 government dredging pro

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and f important cities. The last complete list will be in the issue of July 7, the next, on August 4.

| | New York | Atlanta | Dallas | Chicago | Minne-apolis | Denver | San Francisco | Seattle | Mon |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products:** | | | | | | | | | |
| Structural shapes, 100 lb | —$3.03 | $4.00 | $4.50 | —$2.93 | —$3.31 | $4.65 | —$4.25 | $4.60 | $5. |
| Structural rivets, 100 lb | —4.40 | 5.25 | 5.75 | 4.88 | —5.20 | —6.00 | —6.00 | 5.50 | 8. |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.93 | 3.25 | 3.75 | 3.00 | 3.53½ | —3.77½ | 2.35 | 4.00 | 4 |
| Steel pipe, black, 3½ to 6 in. lap discount | —51% | 50 65–5% | 45% | 58½% | 51.9–5% | —36% | 49.80 | 47½% | 5 |
| Cast-iron pipe, 6 in. and over, ton | —49.10 | 59.22 | 65 00 | —49.10 | —57.80 | 70.00 | 80.00 | 65.00 | 75. |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | —2.60@ | 2.80(del.) | —2.50 | 2.80 | 2.17 2.46 | 3.10 | 3.09 | 3.10 | 4 |
| Gravel, ¼ in., cu.yd | 2.50 | 2.35 | 3.00 | 2.25 | 2.00 | 2.50 | 2.25 | 1.50 | 1. |
| Sand, cu.yd | 1.25 | 1.40 | 2.50 | 2.25 | 1.00 | 1.10 | 1.50 | 1.50 | 1. |
| Crushed stone, ¾ in., cu.yd | 2.15 | 2.25 | 2.80 | 2.50 | 2.25 | 3.50 | 2.25 | 3.50 | 2. |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 47.00 | 40.00 | 35.00 | 55.00 | 36.00 | 47.00 | 27.00 | 28.50+120 | |
| Lime, finishing, hydrated, ton | 21.00 | —20.50 | 25.00 | 20.00 | 29 00 | 32 00 | 25 40 | 24.00 | 30 |
| Lime common, lump, 200 lb. bbl | 3.30 | —1.45 | 2 75 | 1.65 | 1 50 | 3 10 | 2 25 | 2.75 | 15 |
| Common brick, delivered, 1,000 | 18.40 | +11.50 | 12 50 | 12.00 | 17 00 | 14.00 | 18.00 | 16.00 | 18 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .13 | —.09475 | .092 | .09 | .12½ | .11 | — |
| Hollow partition tile 4x12x12, block | .1232 | .15 | .13 | —.07410 | .092 | .10 | .14½ | .12 | .. |
| Linseed oil, raw, 5 bbl. lots, gal | .76 | —.78 | .98 | —.84 | —.88 | .95 | .96 | .79 | |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 1.00 | .50 | .50@.63½ | .81¼ | .75 | .. |
| Common labor, non-union, hour | ..... | .25 | .35@.45 | .45 | .50 | 37½@.50 | .50@.55 | .50 | —. |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45–5% means a discount of 45 and 5 per cent. 45@50 means a range of 45 to 50 per cent. Charge of 15c per 100 lb for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quote at pit. Common labor not organized. **Denver** quotes cement "on trucks", gravel and sand at pit, stone on cars, lime brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ 11½. Prices are all f.o.b. warehouses C. I. pipe, which is mill price plus f to railway depot at any terminal. La prices are delivered "at ship tackle Francisco ex mill." **Seattle** quot Douglas fir instead of pine; and on l paper bags. **Montreal** quotes sand gravel and lump lime per ton. Ce lime and tile are delivered; sand, and stone, on siding; brick f.o.b. steel and pipe at warehouse. No orga common labor in Montreal.

## Changes Since Last Week

The readjustment by the Bethlehem Steel Co. and the U. S. Steel Corporation, effective July 5 and 6, respectively, is already reflected in lower prices at warehouses throughout the country. New York and Minneapolis dealers report a decrease of 20c. per hundred pounds. Shapes are down 10c. in San Francisco, while rivets can be bought for $6 as against the recent quotation of $6.40. Reinforcing bars that cost $5 during the 1920 peak, can now be purchased delivered in New York for $2.93. Bars are down 55c. in Denver. Steel pipe is down in New York and Denver, while cast-iron pipe is $5 lower in Chicago and Minneapolis, $5.90 in San Francisco.

The cement situation in New York is explained elsewhere in this section. Atlanta reports a 10c. decrease on cement, and a 50c. drop on hydrated lime, and 5c. per bbl. on lump lime.

The wholesale price of Southern pine in New York is $42. The cost to contractors, on lighters or cars, is about $5 additional. Hollow building tile is cheaper in Chicago and Montreal.

Common labor is obtainable in treat at 30c. per hour. In the Ch controversy the arbitrator's decisi still deferred. The carpenters finally agreed to accept this de when rendered, pending a refere Minneapolis reports that while bu operations are more active in th than at this time a year ago, con tion is slowing up. Home build in heavier proportion than other of construction, but there is a m feeling that heating and plumbin terials and hardware will drop in

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 87 — NEW YORK, JULY 21, 1921 — Number 3

## A Fact for Port Boomers

FIGURES just given out show that the three leading grain export cities in the United States for the United States for the fiscal year just ended were Galveston, with 86 million bushels, New York with 51 million and Baltimore with 32 million. A stranger to this country might assume from this that Galveston is a large and prosperous city. The fact is that it is still under 50,000 in population and is increasing more slowly than the average industrial city of the same size. There is a lesson here for those local enthusiasts who see ruin or prosperity, as the case may be, in the degree of bulk transshipment business at any port.

## Truck Mortality in Road Construction

INFORMATION of unusual interest, because verified data are exceedingly rare, is given in the article in this issue on the life of light trucks hauling dry batches for concrete road construction. After the first few days, only 80 per cent of the trucks were in condition for service and at the end of the season 80 per cent of all had so deteriorated that they were practically useless for further hard service. On its face, this record seems to condemn the one-ton truck as an economic method of hauling concrete materials over ordinarily bad country roads. This conclusion is not true. The trucks broke down because they were carelessly driven and inadequately maintained. No machine will give constant service nor will it endure, under such conditions. Throughout the work described the trucks were abused in operation by careless boy drivers employed because they would work for wages which experienced drivers would not accept. Under the conditions of labor shortage which existed, perhaps the contractors cannot be severely criticized for employing the help he could obtain most easily at the lowest wages, but the lesson is nevertheless very plain. Truck service and endurance depend directly upon maintenance and maintenance upon skilled drivers.

## Road Bill Prospects

THIS week's news from Washington offers little cause for enthusiasm among the supporters of amendments to the present federal highway law and an appropriation of funds for federal aid at the rate of $100,000,000 yearly. It is possible that the proposed highway legislation embodied in the Townsend and the Phipps-Dowell bills may go the way of the soldiers' bonus bill in the general campaign for economy which is being carried on at the national capital. Irrespective of worthiness of the cause, increased appropriations are not meeting with much favor now on the part of Congress. It is true that there still remains a sizable slice of federal funds available for use in state highway construction, but this sum, substantial as it may appear, represents an amount which is awaiting use by those states which have been slowest in carrying out their construction programs. The progressive states, on the other hand, have, as a general rule, absorbed all of their federal allotments, so that failure by the present Congress to make available additional federal money for road work will disrupt the road-building program and the engineering organizations in those states which have been most active in road building. It is misleading, therefore, to cite as an argument against further appropriations the fact that all of the money previously made available has not been used. If further federal-aid appropriations are withheld by Congress, such action will be justified only by the need for the most drastic economy in the conduct of the Government's business and not because, apparently, a certain amount of federal money for road construction still remains to be absorbed.

## Engineers in South Africa

IT IS interesting to learn from the presidential address of R. W. Newman, before the South African Society of Civil Engineers, that the profession there is giving thought to the same questions which are occupying the minds of American engineers. There is complaint that the engineer has received tardy recognition in that country, and there is coupled with it a demand that the views of civil engineers be given consideration when public matters of an engineering character are at issue. It is also of interest to note the emphasis which Mr. Newman places, particularly in addressing the younger members of the society, upon the need for close study, by the engineer, of the financial features of the projects on which he is engaged as of the engineering. "The civil engineer," he says, "must create more production by keeping the cost of his designs and his construction within the limits of a dividend earning line," and he applies the rule not merely to private enterprises but to public works as well, the dividends on the latter being, obviously, in terms of service to the community. The reading of the address cannot but help strike a responsive chord in the hearts of American engineers.

## Road Roller Charges Cut

HIGHWAY engineers and contractors are informed in this week's news section of a reduction in rental charges for the patented light roller which has found such an extended use in the finishing of concrete roads. A considerable amount of dissatisfaction had been expressed of late at what were regarded as excessive charges for the use of the method and the device and at least one state highway department had about reached the point of altering its specifications so as to substitute some other form of surface finishing than the one involving the concrete roller. The Macon company has acted wisely in presenting its schedule of lowered charges. The light roller is a convenient and effective tool in the production of good pavements and it would have been short-sighted to provoke a boycott.

## Should Consulting Engineers Be "Fired"?

AMONG engineers of New York's metropolitan district the case of the "dismissal" of the board of consulting engineers for the Hudson River vehicle tunnel has occasioned widespread comment. Eliminating the various local aspects of the controversy, two broad general issues seem to be involved: First, the justification for discharging a group of distinguished professional advisers without substantial reasons therefor and without the opportunity of a hearing—as an office boy might be "fired"—and, second, the propriety of acceptance by other engineers of appointments to positions made vacant under such circumstances. It is these issues which form the subject of an opinion by a committee of the New York Chapter of the American Association of Engineers, which has just concluded an investigation and report on the vehicle tunnel controversy, as set forth in the news section of this week's issue. Approved by the association's board of directors, the findings of Messrs. Lavis, Sanborn, and Hogan are to the effect that the New Jersey tunnel commission has acted in a manner prejudicial to the tunnel enterprise and to the public welfare, and that the two engineers who accepted positions as technical advisers to the Jersey body, after the members of the consulting board had been hastily ousted, displayed poor taste and a lack of a fine appreciation of professional courtesy and ethics.

It would be ridiculous, of course, to contend that an individual or a public body should not be able to dismiss its technical consultants if the latter prove incompetent or undesirable for other good and sufficient reasons. In the present case, however, the Jersey commission has not come out into the open with any specific charges, but attempts to justify its action by a veiled accusation of failure on the part of the consulting board to give the tunnel project "full and proper consideration." It should be emphasized, also, that the New York commission, which is vested with authority equal to that of the New Jersey body in the administration of the tunnel project, has vigorously opposed the Jersey commission's action, and that the chairman of the Jersey commission, on every occasion when a call for legal opinion on the case was made at its meetings, studiously prevented such opinion being given, although the commission's counsel sat at his elbow. During the investigations of the A. A. E. committee the Jersey commission refused to give any information, and throughout the controversy its tactics have not been such as to inspire confidence in its motives. The fact that no vouchers for the payment of Jersey's two new technical advisers have been approved is a further indication of the doubt surrounding the legality of its dismissal action.

In view of these conditions the two new technical advisers used poor judgment in accepting the New Jersey appointments. Unquestionably they acted within their legal rights but it would have been far more gracious on their part to have withheld acceptance until the legality of the dismissal of their predecessors had been definitely established. The question of the professional ethics in the case is a nice one. The A. A. E. committee has answered it in a reasonable, fair-minded and discriminating manner. If its report will serve to speed up action in deciding the status of the consultants, it will have done valuable service.

## Exceptional Conditions

FOR fullest instructional value the record of the Susitna bridge on another page of this issue would be more complete did it contain a specific analysis of the difficulties to be overcome and the alternative possibilities as to solution. Not a few structural engineers have been inclined to a feeling of wonder or even question why so large a span was necessary for crossing a stream of moderate size, merely in order to avoid ice danger to intermediate piers. The statement made, that the longer span was cheaper than two shorter spans with a channel pier, is direct and unqualified yet in view of the various possibilities of arrangement of the crossing even this point would have been covered in a more informing way by a frank discussion of the possibilities and their comparative merits.

While one may feel somewhat regretful over the lack of fuller explanation, it is necessary to bear in mind that data for estimating the destructive power of ice shove in definite figures are scanty and that their applicability to the Susitna crossing is questionable. Where ice-thrust danger is combined with the chance of active scour, the prudent engineer may well conclude that even at large extra cost it is wisest to avoid the risk. The frequency of bridge foundation failures argues effectively against taking unnecessary risks with foundations exposed to severe attack.

It is to be presumed in the absence of a discussion of this point, that the site is such as to remove the piers of the large span from all major exposure to ice and scour, and at the same time that nothing short of a 504-ft. span would have given comparable security. Otherwise a comparison of the relative safety of alternative layouts would be bound to take into account the risk of destruction of the main span piers, not merely the risk to which a channel pier would be exposed. In ordinary streams, where scour in its erratic occurrence may attack a pier near the bank almost as readily as a mid-channel pier, and where ice pressure is by no means restricted to the center of the stream, a layout like that of the Susitna bridge would not often prove desirable. The conditions, if fully stated, might well prove to be so exceptional as to be entirely individual to the one stream and crossing involved.

## A Fundamental Research

PIONEER data are made available to the structural engineer in this issue through R. E. Wilson's analysis of test data on the fire resistance of bare and protected columns. In compact, digestible form are set forth the principal results of an investigation that stands quite without precedent.

Fire conditions control the design of buildings, yet in most of its details this control has hitherto been of rather impressionistic kind; engineer and architect *believed* that a particular amount and kind of fireproofing was adequate, without tangible reason for holding this belief. Now, for the first time, specific data on the value of column fireproofing are to hand. They affect very large expenditures of money—a considerable fraction of the whole cost of industrial and city building construction. Safety as well as economy is served.

In studying these tests, the engineer will not fail to observe that the results are qualitative, rather than quantitative. This represents a limitation upon their

applicability. They establish the relative rank of two forms of fireproofing, but do not directly enable the engineer to proportion his construction to the intended service of a particular building. They tell him that a given form of column protection will resist the standard test-fire for, say, three hours, but they do not tell whether that form of column protection is suitable for use in a paper warehouse or a department store in the heart of a city. Ultimately the fire protection specialists should give him this specific information.

The major value of the present tests lies in the fact that they establish an efficiency grading of different methods and types of fireproofing. A glance at the diagrammed results shows that there are wide differences of value between forms of fireproofing that have heretofore been considered of substantially equal efficiency. The tests thus make it possible to avoid waste of money on inefficient constructions. In addition they point the way to improvement of all types of fireproofing to full efficiency, since they reveal the causes of premature failure.

Some quantitative use of the present test results may be found possible in addition to their use for comparisons. Correlating the behavior of fireproofing in the tests with observations on actual buildings in severe fires may enable the engineer to arrive at some estimate of the amount of fire protection that should be provided in a particular type of building. Such individual estimates will be of value, so far as they go. The ultimate objective, however, is a complete co-ordination of building service and fire protection to the end that the designer may be enabled to provide full protection at minimum expense.

## Specifying Concrete Quality

FIVE years ago when the final report of the Joint Committee on Concrete and Reinforced Concrete was presented the criticism was made that it overemphasized design. That document was colorless in so far as the manufacture of concrete was concerned; it contained merely a platitudinous digest of the common knowledge of concrete the material, a digest which itself might have been abstracted in some such words as "use good materials and mix and place them in workmanlike manner." Design, on the other hand, was most elaborately detailed, though, except for the section on flat-slabs, it was merely a repetition of long established practice set forth in the text books. In the main that report reflected current ideas. In spite of the fact that few concrete failures could be attributed to deficiencies in design and that the manufacture of the concrete itself was notoriously variable and its strength and wear uncertain, most engineers were satisfied with vague generalities regarding the material itself and were prepared to accept specific and limited stipulation regarding design. In effect, they were content to let a foreman control the future of a structure in which they figured the coefficients of design to the last hundredth. Today their attitude is very different, and the tentative draft of the new report gives expression to this changed view.

Since the earlier final report was issued there has been great activity in the study of concrete, the material. It has been recognized that variations in proportioning, mixing and placing may vitiate all of the refinements of design and that these variations involve elements beyond mere rule-of-thumb methods or so-called practical knowledge. In proportioning alone, in the establishment of the proper grading and amount of the aggregate and the amount of the water, we are in the beginnings of a new art, with several schools of investigators feeling their way along different roads to what is probably the same goal of determinate proportioning. Control of the concrete is on the way to becoming as precise as its design has long been.

Recognition of this development in concrete is the outstanding feature of the tentative specification of the new Joint Committee which has just been submitted for discussion, and which was digested on p. 68 of our last issue. To be sure, design still forms the major part of the specification, and refinements in stress analysis, based on elaborate studies of the rapidly multiplying number of tests, are greater than ever, but at the very beginning of the specification the strength capacity of any given concrete is based on the behavior of that particular concrete and not on some average value that a group of approximately similar concretes reached.

The novelty of this method of approach is reflected in the specification, for while the design provisions, even those which are new, are single and definite, the quality provisions are alternative, in the effort to meet the various schemes put forward. The committee quite rightly is not prepared to accept any one scheme for predetermining strength, and so with one exception falls back on the actual test of the concrete to be used, and even goes so far as to offer an alternative clause whereby the engineer will merely require the contractor to produce concrete of the required short-time test-specimen strength, regardless of proportions, though presumably the general specifications as to quality and composition of the aggregate and of the cement must be observed. The one exception noted is the presentation of a tabular list of strengths for various mixes, which gives undue emphasis to the results obtained in one laboratory. The criticism may also be made that consistency, a now recognized element in strength, is specified by the not too well authenticated slump test, although this is probably offered for lack of a better measure.

It is evident that while these quality provisions of the specification form a great and radical step forward from the old report, they are still of the most tentative nature and subject to many revisions in the next few years. The design clauses, from their very nature, are more precise, and while they may be subject to discussion, they are based on mathematical truths in the interpretation of which there is opportunity only for slight difference of opinion. The recognition of column bending and of continuous deformation of reinforcement under load is new and will provoke discussion; the distribution of moments in the flat-slab within limits must remain arbitrary and the committee had to settle on some values though they may not be universally acceptable. Shear is still a debatable subject. After all, within the year allowed for discussion the provisions of design may approach unanimous acceptance.

The study of quality, on the other hand, and the fine points of mixing and placing are still in a state of flux and the specifications in the treatment of these subjects can hardly hope to be final even a year from now. But the joint and expert recognition of the peculiarities of the material concrete is a milepost in the art of construction.

# The Susitna River Bridge: Alaska Government Railway

## Steel Channel Span 504 Ft. Avoids Ice Jams—Timber Flanking Spans—Concreting Done at 12 Degrees and Riveting at 42 Degrees Below Zero

THE longest bridge span on the United States Government Railway in Alaska is the new steel 504-ft. through-truss channel span of the Susitna River bridge, which was completed in February, 1921. The crossing of the Susitna includes two 121-ft. combination Howe-truss flanking spans and two 70-ft. combination pony Howe-truss end spans, with 392 ft. of trestle at the southern approach and 28 ft. at the northern approach, making a total length of 1,322 ft. It is located 150 miles north of Anchorage, the ocean port of the line, and 264 miles north of the terminus at Seward.

In a study of the river under summer and winter

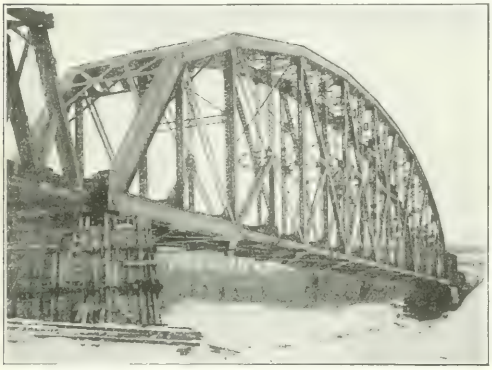


FIG. 1. SUSITNA RIVER BRIDGE IN ALASKA; U. S. GOVERNMENT RAILWAY

conditions as a preliminary to the design of the bridge, high-water marks and ice scars on trees indicated the elevation reached by the ice while in motion. The spring break-up occurs usually before the ice has become soft, and in passing downstream massive pieces jam against the islands and bars and against the shore at points where the river takes a sharp turn, the water then rising until its pressure breaks the dams. It appeared evident that such rushes of accumulated water and ice would carry out any timber pier and that a concrete pier would be exposed not only to the tremendous pressure of the ice jam but also to undermining by the scour that would result from the creation of an ice dam against the pier. A comparative estimate for the structure over the main channel to consist of two 250-ft. steel spans on three concrete piers (with one pier near the center of the channel) or a single 504-ft. steel span on two concrete shore piers, slightly favored the long span, which therefore was adopted.

The combination of steel trusses and timber trusses in the same bridge is considered to be justified by the high price of bridge steel and concrete work at the time of construction, it being cheaper to build all approach spans of timber and to make provision for possible renewal with steel and concrete when the life of the timber has reached its limit. For this reason the main piers were designed to support 200-ft. steel flanking spans at some future time, each to replace the present 121-ft. and 70-ft. spans.

The Cooper E60 loading was adopted for the 504-ft. span, E50 for the timber and E44 for the trestling, which has 14-ft. spans. In the design of the steel span the 1910 specifications of the American Railway Engineering Association were followed mainly. Wind loading was an exception to this; the bottom lateral system was designed for 40 lb. per sq.ft. on the area of train and floor in elevation, and on 1½ times the area of truss members of one truss not covered by train and floor, while the top laterals were designed for 500 lb. per lin.ft. of span.

### Pier Foundations and Construction

Test holes 60 to 75 ft. deep to determine the character of foundation for the concrete piers disclosed compact sand, gravel and large boulders in layers of varying thicknesses, suitable for carrying pier loading without foundation piles.

Pier construction started in May, 1920, when the head of track was 22 miles south of the bridge site. Supplies were freighted by sleds on the ice until the river broke and then by boats and wagons. Transportation difficul-

FIG. 2. ERECTION OF 504-FT. SPAN (NOV. 29, 1920)

ties were practically overcome when the track reached the river in September, 1920. At that time excavation for the south pier was complete and that for the north pier had been begun. A temporary trestle 100 ft. downstream from the bridge site permitted tracklaying to proceed and facilitated erection of the bridge without interference to traffic and to other construction work north of the river. Piles for the trestle bents, piers and abutments had been driven and the falsework for the steel span had been started from the north end before the track reached the site.

An open caisson was used for the north pier excavation, and a cofferdam of Wakefield triple-lap sheet piling for the south pier. Excavation was started in the wet with orangepeel buckets operated by two stiff-leg derricks until hard material was struck; then the holes were pumped out and work was continued by laborers

with pick and shovel filling dump boxes operated by the derricks. For both foundations, excavation was carried to an average depth of 25 ft. below the ground. Drain ditches about 12 in. deep were maintained around the edges, being sloped to carry seepage water to a sump at the downstream end of the pit where one 5-in. and two

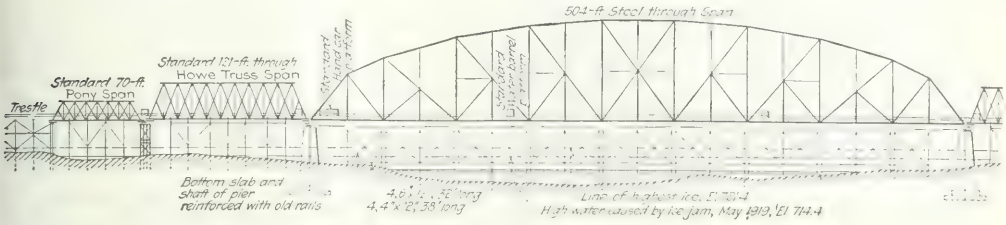

504-ft. Steel through Span
Standard 121-ft. through Howe Truss Span
Standard 70-ft. Pony Span
Trestle
Bottom slab and shaft of pier reinforced with old rails
4,6"x 12", 52' long
4,4"x 12", 38' long
Line of highest ice, El. 781.4
High water caused by ice jam, May 1919, El. 774.4

FIG. 3. CHANNEL SPAN AND FALSEWORK

8-in. pulsometer pumps operated continuously in the lower levels of the work.

*Concrete Work.*—Considerable difficulty was encountered in finding sand and gravel suitable for the concrete piers. Aggregate taken from pits in the vicinity of the bridge was not satisfactory, as samples showed humus. Several deposits along the railway line all showed the presence of this constituent in various amounts, except samples from a pit in a glacial moraine in front of Spencer Glacier, 56 miles north of Seward. This deposit tested clear and was used; 7 per cent of sand was added to the bank aggregate, which was deficient in this respect.

After a partial failure in one of the piers during September, 1920, caused by poor cement, the presence of humus in the aggregate and the low temperature of the air and water, special measures were resorted to in placing concrete in main piers.

When the cofferdam was unwatered, the bottom of the enclosure was under a 22-ft. head of water from the river, and owing to the porous nature of the boulder and gravel formation considerable water was forced through the floor of the pit. The enclosure was 33 x 69 ft. and it was found impracticable to partition it off and place and hold concrete in the dry against the flow of water. As the low temperature of the water (35 deg. F. in November) and the large area (2,277 sq.ft.) made it impracticable to place concrete under water by bucket or pipe methods, the following plan was devised to meet the conditions of cold running water and low air temperature. A large sheet of canvas was prepared in one piece, sufficient to entirely cover the bottom area and extend about 6 ft. up the sides of the enclosure. This canvas was "formed-in" by wooden forms along the sides and ends, to provide a runway for water around the edges. Steam coils were placed around the sides of the pit

inclosure and the entire space was housed in and made warm. Sand and gravel delivered on cars were heated by being dumped on a platform holding perforated steam pipe coils, and hot water was used in mixing.

Concrete was poured at the south pier, containing 1,456 cu.yd., from Oct. 24 to Nov. 11, 1920, during which time temperature readings ranged from —2 deg. to +48 deg. F. At the north pier, containing 1,520 cu.yd., the pouring was from Dec. 1 to Dec. 18, 1920, when temperatures ranged from —12 deg. to +34 deg. F. The pit was kept unwatered, and the concrete was placed from chutes and pipes leading from mixer to pier. All concrete was given sufficient time to set before allowing cold water to come in contact with it.

## Erection of Steel Channel Span

To hasten erection of the 504-ft. span, it was necessary to proceed without waiting for completion of the piers. Falsework for this span, as mentioned, had been driven from the north end. The north approach trestle, piers and falsework for timber spans were driven and a temporary deck laid. One of the 70-ft. pony spans was used temporarily to span the excavation for the north pier, thus permitting the construction of this foundation.

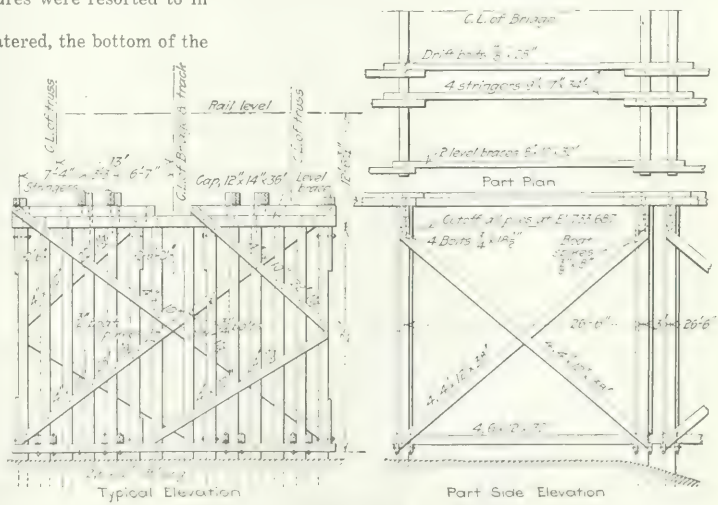



FIG. 4. FALSEWORK FOR 504-FT. SPAN

Erection of steel started Nov. 8, 1920, from the north end at panel point No. 2, a yard having been constructed on the north side of the river which was reached by

means of the temporary trestle. Erection was continued to the south end and all steel except for the two north panels was assembled by Dec. 15, 1920. Steel in these two panels which did not interfere with the 70-ft. pony span was placed after Dec. 25. As soon as this temporary span was removed, the rest of the steel was placed, completing the erection on Jan. 8, 1921.

A 100-ton locomotive crane with a boom having extensions to make a total length of 85 ft. was used for the erection, being supplemented in the yard by a 35-ton locomotive crane with 50-ft. boom. The total weight of steel in the span is 1,803 tons. Only a little riveting was done until after Dec. 20, 1920, when over 90 per cent of the span was in place, but the work was then pushed until completion on Feb. 9, 1921, during which time temperatures ranged from —42 to +34 deg. F. On some cold and windy days the riveters did not work; but on one occasion rivets were driven when it was —42 deg. in the morning and —12 deg. at quitting time. Rivets driven during very low temperatures were retested several times later in warmer weather and showed firstclass work. The total number of field rivets was about 42,200.

The span was swung Feb. 2, 1921, and the first train passed over on Feb. 6. The work of erecting the timber spans and finishing the trestle progressed simultaneously with the steel erection, so that the bridge was entirely completed and ready for service on Feb. 16.

General supervision of the work was under Col. F. Mears, chairman and chief engineer of the Alaskan Engineering Commission. The preliminary design of the 504-ft. steel span and the design and details of the timber spans and foundation work were made by W. J. H. Fogelstrom, former bridge engineer for the Commission, assisted by F. H. Chapin, assistant bridge engineer. Final design and details of the 504-ft. steel span were made by the American Bridge Co., which also fabricated and erected the steel. All designs and detail plans of steel work were checked and approved by Modjeski & Angier, consulting engineers, Chicago; Hildreth & Co., Chicago, performed the inspection of steel at mill and shop.

### Tensile Properties of Paint Films Measured

In a series of tension tests of paint films carried out by H. A. Nelson in the laboratory of the New Jersey Zinc Co., as reported by him before the American Society for Testing Materials recently, a distinct difference was found between normally oxidized film of paint and varnish, and thin sheets of rubber. Peculiarly enough, high-grade spar varnishes followed the law of deformation of the rubber. Ordinary paint films deform according to a parabolic law, the deformation being proportional to a fixed power of the stress (the exponent is different for each different material). In the case of rubber and spar varnish films the rate of elongation decreases after a certain stress has been reached, the stress-strain curve bending away from the elongation axis. All the tests were made under a constant rate of application of load per unit cross-section of paint film per minute, as it was found that speed of loading had a profound influence on the results. The exponent of the stress ranged, for the different materials tested, from 1.0 to 2.2, being lowest for kettle bodied oil and highest for enamel, highly oxidized paint and varnish. However, the coefficient of the exponential term is by far the lowest for these latter materials.

## State Treaty Settlement of Interstate Water Controversies

By A. Lincoln Fellows
Denver, Colo.

THE legislatures of the states including the Colorado River Drainage Basin have, during their recent sessions, enacted certain laws of unusual interest, with a view to settling, or attempting to settle present and future controversies relating to the use and distribution of the waters of that stream by interstate agreement, along the lines proposed in the resolutions that were adopted by the League of the Southwest at its Denver meeting described in *Engineering News-Record*, Sept. 2, 1920, p. 477.

In particular, the State of Colorado, in making its so-called Water Defense Appropriation, has extended the provisions of the Act to as to include all necessary expense incident to interstate adjustment respecting any of the five streams concerning which treaty measures have been passed, viz., the Colorado, La Plata, Arkansas, South Platte and Laramie Rivers. Delph E. Carpenter, an attorney specializing in irrigation law, who has for a number of years been engaged by the state as counsel in interstate water litigation, and who is thoroughly conversant with both the legal and the engineering problems involved, has been appointed commissioner to represent the state on all of these streams.

This procedure is also along the lines suggested in the article by R. I. Meeker, on "Interstate Water Conflicts and Possible Solution," in *Engineering News-Record*, Jan. 27, p. 157. The plan is based upon the theory that the states involved should endeavor to settle their differences amicably before taking them to the Supreme Court of the United States, just as nations ought to arbitrate before declaring war. It is claimed that this course is possible for the reason that while, by the constitution of the United States, the states surrendered certain of their powers to the central government, they still retained the power of entering into treaties among themselves with the consent of Congress. For example, the treaty powers of the states have frequently and successfully been invoked in the settlement of disputed boundaries through interstate compacts, ratified and approved by Congress.

In line with these views and at the request of Governor Campbell of Arizona, president of the League of the Southwest, bills were drawn for submission to the legislatures of the seven states represented in the League and forwarded to the state representatives in January, 1921. These measures provide for the appointment of a joint high commission made up of representatives of the seven states and the United States for the purpose of negotiating and entering into a treaty or compact respecting the future use of the waters of Colorado.

In harmony with this action, special bills were also prepared for interstate commissions on four other streams rising and flowing for long distances within the State of Colorado, the Arkansas, South Platte, La Plata and Laramie, involving Colorado and the states of Kansas, Nebraska, New Mexico and Wyoming, respectively. The commissioner for Colorado on the Colorado River Commission is to serve as commissioner regarding the other rivers also.

The series of treaty bills introduced before the Colorado Legislature passed without a dissenting vote. It

is understood that New Mexico has agreed to join Colorado in submitting questions relating to La Plata River to the consideration of an interstate commission and that Kansas and Nebraska have signified their willingness to consider similarly problems respecting the Arkansas and South Platte Rivers. Also that Wyoming and the rest of the Colorado River states have enacted similar legislation and commissioners have been appointed in most of these states. The outcome of these negotiations will be awaited with interest.

## Valve Closing Trucks Employed by Detroit Water-Works

MOTOR trucks with a valve closing mechanism give excellent service in Detroit, Mich., when broken mains or other emergencies require large gate valves to be quickly closed. A small Buick truck equipped with a makesift mechanism in 1913 had given good service. Therefore, in 1918, a definite study was undertaken with the engineers of the Packard Motor Car Co., to plan a truck for closing valves. Two were built and are now in service, in conjunction with a repair truck hauling a tool-box trailer, making emergency repairs.

Packard trucks have a power take-off shaft from the transmission case for operating mechanical devices on the truck. The device for valve closing, as is indicated by Fig. 1, is located at the left of the driver's seat, and consists of a vertical shaft actuated by the power take-off shaft through a succession of gears and chain drives. The vertical shaft may be raised and lowered by a hand wheel. It can be operated in reverse to open valves and there is a counter which registers the number of turns in either direction and has a set back to zero. There is a spot light on the dash to illuminate the ground and valve box for night work and a siren and bell to warn traffic when an emergency run is being made.

As indicated by Fig. 2 the lower end of the shaft has a square key-head, and all valves have an extension stem with a square key-head. With an assortment of double-end socket-wrenches the operating shaft on the truck is keyed to the valve stem. In operation the truck is spotted over the street box by means of the pointer shown by Fig. 2, the operating shaft is lowered, the proper wrench is inserted and the power is thrown on. A table attached to the front end of the truck body, back of the operating shaft, indicates the number of turns required to close the valve. About 220 turns are required to close a 48-in. valve and the shaft makes about 25 turns a minute. Formerly by hand it required 25 minutes for four men to close a 48-in. valve. In machine closing, the only precaution necessary is to slow down the speed as the valve is nearly closed. Two men operate the truck, but in emergency, and in a little more time, one man can perform the task. Wrenches, lanterns, rubber boots, valve location books and other paraphernalia required

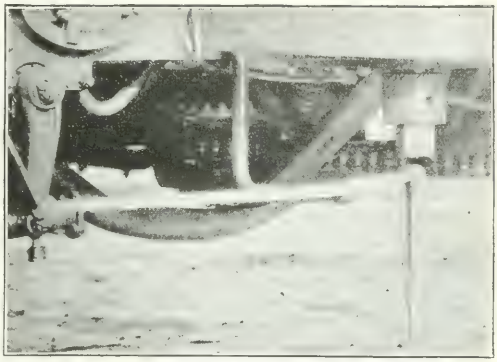


FIG. 2. POINTER FOR SPOTTING TRUCK OVER STREET BOX

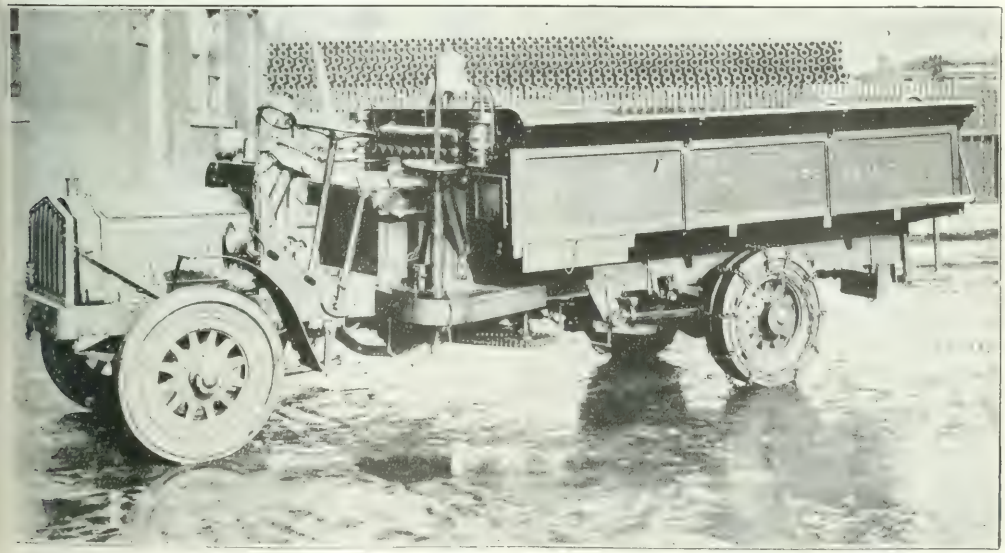


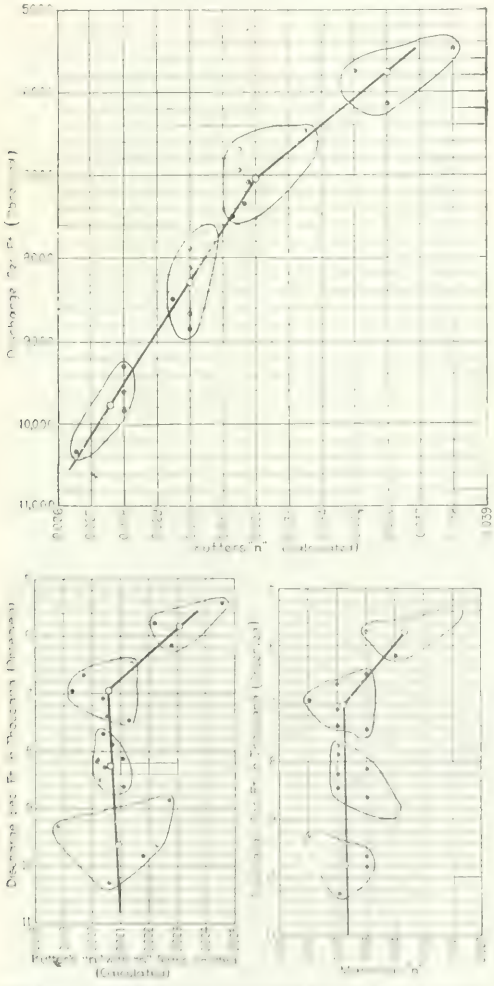
FIG. 1. MOTOR TRUCK WITH VALVE CLOSING MECHANISM, DETROIT WATER WORKS

are carried in lockers in the truck body. Another truck with a repair gang and tool box trailer follows the valve closing truck.

George H. Fenkell is superintendent and general manager for the Detroit Board of Water Commissioners and W. M. Mitchell is assistant superintendent.

## Manning's Formula Better Than Kutter's

IN A RESUME of four years' intermittent gagings of the flow through the main channel of the Sanitary District of Chicago, contributed to the *Journal* of the Western Society of Engineers, for Sept. 5, 1920, Murray Blanchard, formerly with the Sanitary District, now hydraulic engineer, Illinois State Division of Waterways, Chicago, who made the study, concludes that Kutter's formula to obtain the value of $c$ in the Chezy formula $V = c\sqrt{RS}$ will not apply. The value of $n$, computed and tabulated from measured discharges ranging from 5,000 to 11,000 sec.-ft. is not a constant but increases in value with the decrease in discharge, as shown in Fig. 1.



FIGS. 1, 2 AND 3. COMPARISON OF VALUES OF $n$ CALCULATED FROM OBSERVED DISCHARGE IN MAIN CHANNEL OF SANITARY DISTRICT OF CHICAGO

Similar computation for $n$ with Manning's formula, which for $c$ in the Chezy formula gives the following

$$c = \frac{1.486\,R^{\cdot}}{n}$$

shows that $n$ comes out a fairly constant value of 0.022 for all except the low discharge, as shown by Fig. 2.

H. W. King, professor of hydraulic engineering, University of Michigan, in commenting on Mr. Blanchard's work, suggests that an abbreviated form of the Kutter's equation, eliminating the $s$ or slope terms, will give far more consistent results. Fig. 3, based on the Sanitary District records, gives for $n$ a value somewhat less than 0.021. Professor King states further that for some time he has been of the opinion that Kutter's formula will give just as satisfactory results without the $s$ terms. It is his opinion that the Kutter formula has been used satisfactorily for many years because, in most cases, channels are constructed with slopes so great that the value of $c$ is not generally affected by the inclusion of the slope terms.

## What Can Happen to a Steam Shovel

BY GALE DIXON
Chief Engineer, Barnum Waterworks Improvement, Akron

THE accompanying photograph shows an accident to a steam shovel which occurred on our work at Akron several weeks ago. The shovel was working on a heavy timber mat over a trench for a 48-in. cast-iron pipe line, excavating the trench ahead of the mat and lowering the pipe into the trench behind it. The shovel rolled backward and as the wheel left the mat, the boom swung over onto the cab.

DEMOLISHED STEAM SHOVEL IN PIPE LINE DITCH

At the time of the accident the shovel was working at the head end of the trench, with six men in the trench immediately behind the mat. No one was hurt.

# Nine Years' Operation of the Baltimore Sewage-Works

## Plant Comprises Bar Screens, Venturi Meters, Hydrolytic and Separate Sludge Digestion Tanks, Imhoff Tanks, Sludge Drying Beds, Revolving Screens for Tank Effluents and Sprinkling Filters—Sludge Sold

By Theodore C. Schaetzle
Principal Sanitary Chemist of Sewage-Works, Baltimore, Md.

(Concluded from Last Week's Issue)

HERE at Baltimore, as well as at practically all disposal works, sludge disposal is of primary importance. As first designed three square digestion anks of 609,000 cu.ft. capacity were provided. In 1914 sixteen additional tanks of the circular type, with a volume of 330,000 cu.ft., were built. A considerable addition to the sand bed area was likewise provided. However, the sludge has continued to accumulate at a faster rate than it has been disposed of, so that an addition to the digestion tanks is now under construction, while more beds will be provided in the near future.

Although troublesome at times, our sludge operation experience has been interesting. In the first years of plant operation there was plenty of storage capacity so that sufficient time could be allowed to produce well-digested sludge for disposal upon the sand beds. This sludge drained readily, dried and cracked well. During digestion the scum on the tanks formed from a few inches to approximately 2 ft. in thickness, but at no time prevented the normal operation of these tanks, which was as follows: The undigested sludge was pumped from the hydrolytic tanks into the digestion tanks, being delivered at one side and just beneath the surface. The digestion tank receiving the sludge would then lie undisturbed over night, during which period the water, which had been added to the undigested sludge during the pumping, would separate from the sludge and rise to a place just beneath the scum. From here the water was drawn off by means of a channel near the top of these digestion tanks and was disposed of in the idle hydrolytic tank or the one which had been in service the longest. This tank would then be ready to receive more undigested sludge or for the removal of some of the digested. The digested sludge was removed by opening one of the three well gates on the side opposite the incoming sludge. The sludge was drawn from the sloping bottom through any one of the three drain channels to a collecting well and from there through a drain to the pump well, from which place it was delivered to the sand beds.

It was noticed that certain parts of these tanks remained dead because there were only three draw-off points. To remedy this two of the tanks were emptied entirely and the drain channels covered with concrete slabs. Four lift gates were placed across the tank on each channel, making 12 in all for each tank. The idea was to raise by a chain that gate serving the part of the tank from which it was desired to draw the sludge. After the tanks were full and in operation unfortunately the gates could not be lifted by less than two men and, when once raised, it is doubtful whether they closed again.

In 1914 the scum had started to form from 2 to 2½ ft. in thickness and a hose was played upon the surface to break it up. This was unsuccessful as the area was so large that the force of the water was spent by the time it reached the center of the tanks. Sludge was continuing to form at an increasing rate and weather conditions prevented rapid drying on the limited sand bed area, so that when the new circular tanks and sand beds were completed in 1915 they were immediately pressed into service. In spite of this the sludge continued to accumulate and by the latter part of 1916 there was again need of more storage capacity. This seemed preferable to more sand bed area since the weather conditions regulate to a great extent the rate at which the beds can be cleaned and because the area then in use was about sufficient for the available laboring force even when the sludge was drying satisfactorily. Table II gives an idea of the sludge situation as it shows the total sewage flow for each year, the digested sludge produced and disposed of and the quantity in the tanks at the end of each year. The column of sludge disposed of gives the total, which includes that placed on sand beds, sold to farmers and placed on other areas.

TABLE II. DIGESTED SLUDGE PRODUCTION AND DISPOSAL AT BALTIMORE SEWAGE-WORKS

| Year | Sewage Flow, M. G. per Year | Produced per M. G. (Based on Soundings) | Produced per Year | Disposed of per Year | In Tanks at End of Year |
|---|---|---|---|---|---|
| | | Cubic Yards of 90 per Cent Moisture Digested Sludge | | | |
| 1912 | 4,320 85 | 1 52 | 6,568 | No record | No record |
| 1913 | 6 597 48 | 1 72 | 11,348 | No record | No record |
| 1914 | 8,372 09 | 3 85 | 32,233 | 24,981 | 15,168 |
| 1915 | 11,607 41 | 4 05 | 47 010 | 49,856 | 12,322 |
| 1916 | 14,374 00 | 3 69 | 53,040 | 45,760 | 19,602 |
| 1917 | 16,199 83 | 3 15 | 51,029 | 29,616 | 41,015 |
| 1918 | 19,284 78 | 3 32 | 64,025 | 39,103 | 65,937 |
| 1919 | 20,096 08 | 2 98 | 59 886 | 65,617 | 60,206 |
| 1920 | 19,074 23 | 3.00 | 57,223 | 57,214 | 60,215 |

More sludge was produced during the years 1916 to 1918 than was disposed of, and in consequence the quantity remaining in the tanks at the end of each year grew larger. The ultimate result has been a gradual change in the moisture content of the sludge. As previously stated, at first well-digested sludge was sufficiently watery to run freely from the tanks, while the scum formation varied from a few inches to approximately 2 ft. By 1914 the scum had reached 2 to 2½ ft. in thickness but it was still possible to remove well-digested sludge without the addition of water. By 1917 the surface scum, 1½ ft. thick, had dried to a moisture content of 69.9 per cent, with the next 2½ ft. below containing 75.9 per cent water and the remaining depth sufficiently watery to run. However, the best digested sludge seemed to be in these top 4 ft., so that in order to place the best digested sludge upon the sand beds a 2-in. hose working under a 128-ft. head was used to break the surface up and mix it with the more liquid sludge. This gradual loss of water continued until the worst conditions for the large square digestion tanks was reached in October, 1918, whereas the circular tanks present their most difficult operation conditions at the present time. In fact the scum in some of the circular tanks is as much as 11 ft. thick. In October, 1918, soundings and analyses showed the moisture content of the top 2 ft. of the square digestion tanks to be 62.4 per cent, while the balance of the depth, or 11½ ft., except for small pockets of water, contained 78 per cent of water.

To relieve these conditions various available areas have been utilized by filling with sludge cut up with water. It was felt that more rapid progress could be made by removing the sludge without the addition of water. With this end in view a paddle conveyor, electrically driven, was put in service in April, 1918. For part of the time this removed the heavy sludge to the area adjacent to the square digestion tanks, from which place it was hauled away by the farmers, and for the balance of the time placed it directly into cars for hauling to the rotary drier plant.

In 1919 more sludge was disposed of than produced when the area between the filter beds and hydrolytic tanks was filled, thereby not only helping the sludge situation but improving the appearance of the grounds. The effect of this was noted in the soundings and analyses made in the large digestion tanks in October, 1919, when the scum moisture had increased from 62.4 to 69.8 per cent and the sludge beneath had increased from 78 to 79.9 per cent. During 1920, when the same amount of sludge was disposed of as produced, the moisture content of the scum and of the sludge beneath was further increased, so that on Oct. 1, 1920, the figures were 72.4 and 81.4 per cent respectively.

Since early in 1918 one of the most annoying features of the digestion tank operation has been the appearance of undigested sludge at the outlet end of the tanks. This has been accounted for by the fact that the raw sludge, as pumped into the digestion tanks at one side, found its way under the scum or through the heavy sludge, much as water does through a clay bank. However, the well-digested scum, when broken up and mixed with undigested sludge, has enabled the placing of at least partly digested material upon the sand beds at all times. For this purpose a 3½-in. fire-hose has been substituted for the former 2-in. one and is proving very satisfactory.

The operating force feels that when the excess sludge has been disposed of and sufficient storage capacity and sand beds have been provided for the current accumulation, so that the tanks can be kept with a scum not more than 2 ft. thick and the sludge with not less than 89 per cent water, the results will be very satisfactory, because past experience has shown that sludge digests well in the separate tanks.

One of the interesting features of the well-digested sludge is that it now contains 57 per cent volatile matter as compared to 44.2 per cent in 1914, when the tanks were operating normally and well. This change is probably due in part to the fact that in the early days of operation considerable mineral matter entered the sewers, due to the construction work then in progress.

The sludge as produced at this plant must be considered under four headings; namely, raw, separate digestion tank, Imhoff tank, and final settling basin sludge. An average analysis of these types is presented in Table III.

TABLE III. AVERAGE ANALYSES OF SLUDGE FROM DIFFERENT TANKS AT BALTIMORE

| | Wet Sludge | | Per Cent of Dry Residue | | | | |
|---|---|---|---|---|---|---|---|
| | Per Cent Water | Specific Gravity | Volatile | Fats | Nitrogen | Total Phosphoric Acid as $P_2O_5$ | Potash as $K_2O$ |
| Digestion tank sludge | 91 86 | 1 021 | 66 21 | 4 02 | 2 45 | 0 52 | 0 17 |
| Imhoff tank sludge | 92 18 | 1 017 | 62 74 | .... | 2 75 | 0 58 | 0 19 |
| Raw sludge* | 79 16 | ..... | 73 84 | 9 00 | 2 64 | .... | .... |
| Settling basin sludge | 92.37 | ..... | 57.98 | .... | 3.19 | .... | .... |

* Analysis as sludge exists in tanks before the addition of water for cleaning. As the raw sludge is being pumped into the digestion tanks, the moisture content is 91 56 per cent and the specific gravity 1.020

*Sand Beds*—The sludge is run onto the sand beds to a depth of 12 in. and when well digested cracks and drys rapidly in the summer, provided it is not an abnormally wet season. Ordinarily the beds drain well, but when one works to the contrary either of two methods is used to relieve the water. A man walks through the bed stirring up the entire mass or a small pipe is inserted at one or more corners of the bed to drain the water to the adjacent area. Then when the bed is empty the sand is loosened by raking.

In the years 1915 to 1920 inclusive 91,369 cu.yd. of dried sludge were taken from the beds and the beds were cleaned and refilled, on an average of 3¾ times a year. Calculating from the average of 3,326 cu.yd. per 1,000,000 gal. of 90 per cent digested sludge produced and 30,615 cu.yd. of 90 per cent sludge handled on the digestion-tanks sand beds yearly they have cared for the production of sludge from 9,205,000,000 gal. of sewage. At 100 gal. per capita daily, which is approximately our average, a yearly average of 252,192 people have been served by 5.06 acres of sand bed area during this five-year period. In other words, each person has required 0.874 sq.ft. of sand bed area per year.

Table III shows that the sludge from the digestion tanks as placed on the sand beds contains an average of 91.86 per cent water. The range of moisture, however, is from 86.6 to 96.4 per cent. That run from the Imhoff tanks ranges from 85.7 to 94.8 per cent moisture. When removed from the beds, the water content of the sludge ranges from 48.6 to 78.3 per cent, with an average of 68.7 per cent. In removing the sludge it is shoveled into cars and dumped in front of the Heineken Reduction Co.'s drying plant. From the beginning of operation to April, 1916, this material was placed in piles for future use in leveling off the grounds or for sale to the farmers. But on Feb. 1, 1916, a five-year contract was made for all sand-bed dried sludge so that since then the sludge has been dumped on this company's storage pile. The cars were formerly filled level full, removed from the beds by hand and then drawn by a mule to the dumping ground. The first part of this year a 22-hp. power gasoline engine was purchased for hauling. Now the cars are heaped and the engine hauls them directly from the beds, thereby giving a greater daily sludge removal.

Owing to the adherence of sand or gravel to the under side of the sludge when the latter is being removed the 4-in. beds need a renewal of the sand layer. A small amount of sand has been added from time to time, but it is fair to say that a total of 3 in. has been lost by all beds since 1915. The adhesion of sand or gravel to the sludge is a matter of considerable importance at the Baltimore sewage works because the sand bed dried sludge is sold under the above-mentioned five-year contract on the basis of its nitrogen content. If the sludge after passing through this company's rotary drier contains 2 per cent nitrogen as equivalent ammonia on the 10 per cent moisture basis, the city receives 81c. per ton, weighed with the water content ranging from 10 to 15 per cent. There have been times when the sludge has fallen below the required nitrogen content, the reason for which can be readily seen when it is realized that the mineral matter, principally sand, has run as high as 39.6 per cent. To overcome this difficulty one of the beds was partially covered with a slotted wooden

platform. This has been in service since 1916 and is still in good condition. It accomplished the purpose for which it was installed and the sludge disposed of upon it has acted very similar to that placed upon the sand direct. The present contractor for the sand-bed dried sludge does not seem disposed to renew his contract on the basis referred to above because he claims to have lost money during the past five years. Therefore efforts are now being made to form a new contract.

As removed from the beds the sludge has a specific gravity of 1.098 per cent, contains 70.67 per cent water, 4.83 per cent volatile matter, and 2.264 per cent nitrogen on the dry basis, whereas if analyzed at the time of removal, avoiding the sand, the figures are: Specific gravity, 1.077 per cent; water, 70.42; volatile matter, 1.76; nitrogen, 2.596 per cent on the dry basis.

Although the drying plant is not a part of the sewage-works proper regular analyses have been made of the moisture and nitrogen content of the sludge after drying. In brief, the process of drying is to feed the wet sludge into that end of the rotary drier at which the furnace is located. The heated air and sludge pass through the drier together and discharge into a dust box. From here the sludge passes to an elevated revolving screen which removes match sticks, corks, etc., and from here down through a chute, at the end of which it is bagged. An average of all the analyses made upon this material from April, 1916, when the contract started, to Dec. 31, 1920, is water 15.81 per cent and nitrogen on the dry basis 1.862 per cent. It is of interest to know whether there is any appreciable loss of nitrogen in passing through the drier. For this purpose a run was made in 1916 with the following result: Before passing through drier 72.50 per cent water and 1.111 per cent nitrogen on dry basis; after passing through drier 18.89 per cent water and 2.075 per cent nitrogen on dry basis.

*Costs and Revenue*—Excluding the cost of grounds, consulting engineers' charges and a proportion of the chief engineer's salary, the total construction cost of the Baltimore sewage works was $2,500,000, in round numbers. This does not include the cost of the alterations now being made to the Imhoff tanks.

The actual expenditures for maintenance and operation, exclusive of interest on investment and depreciation, have shown a gradual decrease in the unit cost of treatment for each year from 1912 to 1917. In the latter year, due to increased costs of material and labor, this price rose. Table IV and Fig. 3 show the average and maximum daily rate of flow for each year as well as the cost per million gallons for treatment. No maximum daily rates are available previous to 1914 and it might be said that the absolute maximum treated has been 106,090,000 gallons.

The Imhoff tanks began operating in August, 1915, and continued until June, 1917. They were idle, as previously stated, until May, 1919, when two were restarted experimentally. These two have been operating since and in addition 16 others were added during 1920.

The comparative cost of treating sewage in the Imhoff and in the hydrolytic tanks with sludge digestion in separate tanks is shown by Table V.

The large sum of $5,403 for the Imhoff tanks in 1919 is attributed to the fact that but two tanks were in operation and, being run experimentally, had more time applied to them per unit volume of sewage treated than would be the case under normal conditions. The additional increase for 1920 is caused by the increases given the laborers, to falling off in total flow and the necessity of disposing of a good proportion of the sludge both in the tanks and on the sand beds which had resulted from the period of operation in 1916 and 1917.

TABLE IV. MILLIONS OF GALLONS OF BALTIMORE SEWAGE TREATED DAILY AND COST PER MILLION GALLONS

| Year | Average Daily Rate | Average Maximum Daily Rate | Cost of Treatment per Million Gallons |
|---|---|---|---|
| 1912 | 11 80 | ..... | $4 860 |
| 1913 | 18 10 | ..... | 4 800 |
| 1914 | 22 94 | 32.96 | 4 500 |
| 1915 | 31 80 | 42.90 | 3 450 |
| 1916 | 39 27 | 52 10 | 2 594 |
| 1917 | 44 38 | 59 15 | 2 882 |
| 1918 | 52 84 | 68 48 | 2 862 |
| 1919 | 55 06 | 71 83 | 3 389 |
| 1920 | 52 12* | 69.97 | 3 902** |

* The falling off in flow is due to the decrease in water consumption brought about by a campaign for conservation because of the danger of a water shortage.
** The increase in cost is due to the increase in labor costs and decrease in sewage flow.

TABLE V. COST PER MILLION GALLONS OF TWO METHODS OF TANK TREATMENT AT BALTIMORE

| Year | Imhoff Tanks | Hydrolytic and Separate Sludge Digestion Tanks |
|---|---|---|
| 1916 | $3 630 | $2 439 |
| 1917 | 3 933 | 2 841 |
| 1918 | Imhoff Tanks Not in Operation | |
| 1919 | 5 403 | 3 337 |
| 1920 | 6 897 | 3 738 |

TABLE VI. REVENUE FROM SEWAGE SLUDGE AT BALTIMORE

| Year | From Farmers | From Drying Plant (By Contract) | Total |
|---|---|---|---|
| 1914 | $1 931 33 | ..... | $1 931 33 |
| 1915 | 2 242 75 | ..... | 2 242 75 |
| 1916 | 1,098 15 | $1,591 79 | 2,689 94 |
| 1917 | 346 40 | 28 07 | 374 47 |
| 1918 | 344 80 | 2,322 51 | 2,667 31 |
| 1919 | 309 00 | 1 557 61 | 1 866 61 |
| 1920 | 233 00 | 1 275 07 | 1,508 07 |

The cost per cubic yard of sludge removed from the sand beds with an average haul of 1,000 ft. was $0.292 in 1915, $0.292 in 1916, $0.374 in 1917, $0.382 in 1918, $0.454 in 1919, and $0.442 in 1920. In 1919, with the electrically-driven conveyor loading the cars at the digestion tanks and conveying the sludge direct to the dump, with a haul of 2,400 ft., the cost was $0.643 per cubic yard.

There has always been a small revenue from rentals of land and buildings, which will average approximately $900 yearly.

Since 1914 the bar screenings and sludge have been sold. The sludge has been sold both wet and dry; that is, in the same condition as when placed on the sand beds and as taken from storage piles after being removed from these beds. The price has been 25c. per load, except for a short interval, when it sold for 35c. This price was again reduced to 25c. per load after a falling off in sales proved that the farmers were unwilling to pay the 10c. increase. The wet sludge was removed in tank wagons holding approximately 250 gal., whereas the dried material has been sold by the load, one to two tons constituting a load.

In 1916 the sale of sludge to farmers was curtailed because the contract for sand-bed dried sludge began in the spring of this year. In 1917 it was still further curtailed by stopping the sale of wet sludge to those farmers who hauled over the main roads. Table VI shows revenue from the sale of sludge to the farmers and under contract.

In 1917 the revenue dropped exceptionally low, due to the fact that the drying plant burned down and practically all of the sludge which was dried ran below the

TABLE VII TO XI. AVERAGE MONTHLY ANALYSES OF BALTIMORE SEWAGE BEFORE, DURING AND AFTER TREATMENT. JANUARY, 1912, TO DECEMBER, 1920, INCLUSIVE

VII. RAW SEWAGE

| Months | Suspended Solids | Settling Solids | Biochemical Oxygen Demand | Nitrates | Relative Stability Per Cent | Chemical Determinations P.P.M. | Bacteria per C.C. Total on Plain Agar | Bacteria per C.C. Acid Forming |
|---|---|---|---|---|---|---|---|---|
| January | 144 | 89 | 97 | | | | 380,000 | 41,500 |
| February | 164 | 88 | 94 | | | | 850,000 | 47,000 |
| March | 168 | 88 | 84 | | | | 550,000 | 37,500 |
| April | 182 | 87 | 93 | | | | 900,000 | 66,000 |
| May | 183 | 134 | 112 | | | | 1,400,000 | 190,000 |
| June | 181 | 127 | 128 | | | | 1,800,000 | 180,000 |
| July | 158 | 110 | 126 | | | | 2,200,000 | 270,000 |
| August | 223 | 109 | 125 | | | | 2,600,000 | 290,000 |
| September | 220 | 78 | 135 | | | | 4,100,000 | 650,000 |
| October | 148 | 80 | 135 | | | | 2,100,000 | 250,000 |
| November | 168 | 85 | 125 | | | | 1,200,000 | 220,000 |
| December | 188 | 94 | 114 | | | | 460,000 | 72,000 |

TABLE VIII. EFFLUENT FROM HYDROLYTIC TANKS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| January | 80 | 26 | 95 | | | | 210,000 | 35,000 |
| February | 83 | 33 | 107 | | | | 190,000 | 29,000 |
| March | 67 | 36 | 111 | | | | 210,000 | 33,000 |
| April | 69 | 31 | 106 | | | | 350,000 | 48,000 |
| May | 59 | 44 | 120 | | | | 750,000 | 100,000 |
| June | 109 | 60 | 120 | | | | 1,100,000 | 73,000 |
| July | 107 | 58 | 124 | | | | 1,300,000 | 110,000 |
| August | 104 | 49 | 100 | | | | 1,000,000 | 150,000 |
| September | 63 | 37 | 109 | | | | 1,700,000 | 110,000 |
| October | 70 | 36 | 120 | | | | 2,000,000 | 100,000 |
| November | 69 | 34 | 116 | | | | 600,000 | 87,000 |
| December | 65 | 35 | 97 | | | | 390,000 | 45,000 |

TABLE IX. EFFLUENT FROM IMHOFF TANKS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| January | .. | 31 | 105 | | | | 320,000 | 61,000 |
| February | .. | 36 | 115 | | | | 330,000 | 56,000 |
| March | .. | 26 | 134 | | | | 150,000 | 51,000 |
| April | .. | 23 | 144 | | | | 750,000 | 100,000 |
| May | .. | 25 | 146 | | | | 1,100,000 | 210,000 |
| June | .. | 25 | 150 | | | | 800,000 | 120,000 |
| July | .. | 23 | | | | | | |
| August | .. | 24 | | | | | | |
| September | .. | 57 | | | | | | |
| October | .. | 20 | | | | | | |
| November | .. | 23 | | | | | | |
| December | .. | 41 | | | | | | |

TABLE X. EFFLUENT FROM FILTER BEDS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| January | 60 | 56 | 37 | 5 2 | 81 | | 53,000 | 5,800 |
| February | 73 | 46 | 40 | 5 4 | 82 | | 140,000 | 9,900 |
| March | 63 | 45 | 35 | 6 8 | 88 | | 49,000 | 5,600 |
| April | 93 | 67 | 34 | 8 0 | 94 | | 140,000 | 9,300 |
| May | 67 | 40 | 29 | 11 3 | 95 | | 260,000 | 18,500 |
| June | 96 | 52 | 32 | 8 7 | 92 | | 700,000 | 23,000 |
| July | 65 | 52 | 36 | 8 1 | 91 | | 440,000 | 31,000 |
| August | 58 | 44 | 26 | 8 0 | 96 | | 470,000 | 35,000 |
| September | 37 | 29 | 30 | 6 5 | 93 | | 650,000 | 75,000 |
| October | 48 | 32 | 30 | 6 7 | 98 | | 270,000 | 28,000 |
| November | 59 | 44 | 36 | 7 6 | 96 | | 140,000 | 17,000 |
| December | 96 | 54 | 40 | 6 1 | 83 | | 88,000 | 14,000 |

TABLE XI. FINAL EFFLUENT

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| January | 51 | 23 | 28 | 5 4 | 85 | | 59,000 | 6,700 |
| February | 32 | 22 | 29 | 5 4 | 88 | | 79,000 | 5,700 |
| March | 33 | 20 | 28 | 6 8 | 93 | | 59,000 | 5,000 |
| April | 44 | 29 | 23 | 7 2 | 90 | | 110,000 | 8,200 |
| May | 53 | 33 | 22 | 8 9 | 93 | | 600,000 | 14,000 |
| June | 49 | 32 | 24 | 7 4 | 97 | | 900,000 | 15,000 |
| July | 39 | 32 | 21 | 7 4 | 94 | | 1,300,000 | 32,000 |
| August | 38 | 21 | 16 | 7 1 | 98 | | 900,000 | 29,000 |
| September | 26 | 16 | 18 | 6 1 | 98 | | 850,000 | 68,000 |
| October | 28 | 17 | 20 | 6 4 | 99 | | 600,000 | 20,000 |
| November | 39 | 24 | 24 | 7 2 | 98 | | 350,000 | 15,000 |
| December | 40 | 29 | 29 | 5 9 | 86 | | 200,000 | 15,000 |

required 2 per cent equivalent ammonia content on account of the adhesion of sand and gravel in removing the sludge from the sand beds. Of the total output of this drying plant approximately two-thirds has contained the required amount of nitrogen and has therefore been paid for.

*Plant Performance*.—Practically no mention has been made thus far of the analytical results of the sewage at its different stages of transit through the plant. While the routine analyses do not include total solids, chlorine, alkalinity and fats, an average for these is 773, 161, 153 and 81.7 p.p.m. respectively. The figure for total solids was obtained in 1916, at which time the suspended solids were 138 p.p.m. A 24-hr. run in February, 1920, gave an average of 17.8 p.p.m. free ammonia.

To acquire some knowledge of the performance of the plant during the various seasons the average of all results for the different months from 1912 through 1920 inclusive have been compiled and are presented herewith in Tables VII to XI. The yearly averages are given in Tables XII to XV. Table XVI presents the plant efficiency by showing the per cent reduction in solids, bacteria, and deoxygenating powers between the raw sewage and final effluent and by presenting the nitrates and relative stability of the final effluent, the raw sewage being practically devoid of oxygen in any form.

The final effluent of the plant during 1919 contained 2.50 p.p.m. dissolved oygen and had an oxygen consuming value of 25.3 p.p.m. by the permanganate method with a 30-minute digestion period. During 1916 the total solids were 616 p.p.m. and the suspended solids 47 p.p.m.

Samples of the river water are taken at fairly regular periods from April to December of each year. There are eleven stations, one approximately one-half mile up stream from the discharge pipe, another at the mouth of the discharge pipe, and the others down stream with a maximum distance of 9¾ miles below the outlet. The nearest oyster beds are 14 miles below the discharge. At all times since the plant operation began there has been a plentiful supply of oxygen at each station.

This summary would not be complete without some mention being made of the two most important experiments conducted at the disposal plant since its operation began, on activated sludge and grease recovery.

*Activated Sludge*—Under an agreement between the Sewerage Commission of Baltimore and the U. S. Public Health Service to work jointly on the activated-sludge process a series of laboratory experiments was started early in March, 1915, and continued until August of the same year. There were six experiments conducted simultaneously, five of which were with the air drawn through the bottle by means of an aspirator, while in the sixth the aërating was done by means of a propeller inclosed in a tube. The continuous operation of the latter experiment was broken up so often that reliable results were not obtained. The other five, run under different conditions, indicated that the activated-sludge process conducted under the fill-and-draw method was applicable to Baltimore sewage; that it was possible to generate sludge more quickly with mixtures containing final settling basin sludge than with raw sewage alone or raw sewage plus raw sewage sludge, and that the absence of light had no noticeable effect upon the activated-sludge organisms.

The large-scale experiment in one of the Imhoff tanks, altered for the purpose, was begun in the early part of 1915. The intention was to gain information as to the applicability and costs of the continuous-flow process. Although it was possible to get very well "activated" sludge with a sludge ratio as high as 30 per cent, a short time after a continuous flow of raw sewage was allowed to pass through the tank the sludge lost its oxidizing power. A number of changes were made because of mechanical difficulties and clogging of the air distributors. Finally, the best results were obtained by the use of the filtros disk grid. Unfortunately a fire destroyed the air compressor house on Feb. 15, 1916, burning practically everything, including the manometer for measuring the volume of air used. After this building was rebuilt experiments were started with another

TABLES XII TO XV. AVERAGE YEARLY ANALYSES OF BALTIMORE SEWAGE BEFORE, DURING AND AFTER TREATMENT, 1912 TO 1920, INCLUSIVE

TABLE XII. RAW SEWAGE

| | Chemical Determinations, P.P.M. | | | | | Bacteria per C.C.* | |
|---|---|---|---|---|---|---|---|
| Year | Suspended Solids | Settling Solids | Biochemical Oxygen Demand | Nitrates | Relative Stability Per Cent | Total on Plain Agar | Acid Forming |
| 1912 | 54 | ... | ... | .. | | *1,900,000 | 56,000 |
| 1913 | 122 | ... | 115 | .. | | 1,700,000 | 360,000 |
| 1914 | 120 | ... | 131 | .. | . | 2,300,000 | 150,000 |
| 1915 | 256 | 183 | 113 | ... | .. | 1,100,000 | 160,000 |
| 1916 | 138 | 102 | 91 | ... | .. | 1,100,000 | 89,000 |
| 1917 | 260 | 69 | 90 | ... | .. | 950,000 | 59,000 |
| 1918 | 287 | 49 | 127 | ... | .. | 800,000 | 40,500 |
| 1919 | 111 | 66 | 171 | ... | .. | 1,400,000 | 160,000 |
| 1920 | 172 | 120 | ... | ... | .. | 2,200,000 | 320,000 |

* Gelatin count at 20° C.

TABLE XIII. EFFLUENT FROM HYDROLYTIC AND IMHOFF TANKS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1912 | 31 | | | | | | |
| 1913 | 76 | | 129 | | | 1,300,000 | 310,000 |
| 1914 | 85 | | 190 | | | 3,300,000 | 230,000 |
| 1915 | 109 | 58 | 153 | | | 1,100,000 | 210,000 |
| 1915 | | *55 | | | | | |
| 1916 | | 35 | 118 | | | 800,000 | 94,000 |
| 1916 | | *26 | *132 | | | *550,000 | *100,000 |
| 1917 | | 34 | 135 | | | 850,000 | 70,000 |
| 1917 | | *21 | | | | | |
| 1918 | | 36 | 114 | | | 850,000 | 63,000 |
| 1919 | | 37 | 93 | | | 700,000 | 66,000 |
| 1920 | | 39 | 92 | | | 650,000 | 93,000 |
| 1920 | | *28 | | | | | |

* Imhoff results

TABLE XIV. EFFLUENT FROM FILTER BEDS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1912 | 22 | | | 8 3 | 98 | | |
| 1913 | 56 | ... | 30 | 8.2 | 91 | 180,000 | 36,500 |
| 1914 | 60 | ... | 41 | 7.2 | 78 | 470,000 | 35,000 |
| 1915 | 89 | 68 | 37 | 6.2 | 87 | 250,000 | 31,000 |
| 1916 | | 48 | 33 | 4 4 | 93 | 290,000 | 12,000 |
| 1917 | | 49 | 38 | 7 4 | 92 | 200,000 | 12,000 |
| 1918 | | 40 | 32 | 8 1 | 96 | 160,000 | 7,700 |
| 1919 | | 46 | 31 | 7 7 | 89 | 190,000 | 9,300 |
| 1920 | | 27 | 27 | 7.0 | 92 | 150,000 | 13,000 |

TABLE XV. FINAL EFFLUENT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1912 | 13 | ... | .. | 7 5 | 98 | .. | 2,400 |
| 1913 | 22 | ... | 13 | 7.9 | 99 | 260,000 | 16,000 |
| 1914 | 37 | .. | 26 | 6.9 | 92 | 700,000 | 24,000 |
| 1915 | 43 | 28 | 21 | 5.5 | 94 | 750,000 | 25,000 |
| 1916 | 47 | 31 | 22 | 4 1 | 92 | 750,000 | 11,500 |
| 1917 | 42 | 27 | 28 | 7.4 | 92 | 330,000 | 11,500 |
| 1918 | 46 | 25 | 26 | 7.6 | 95 | 500,000 | 8,500 |
| 1919 | 43 | 24 | 24 | 6.7 | 92 | 250,000 | 13,500 |
| 1920 | 41 | 18 | 25 | 6.5 | 90 | 230,000 | 19,000 |

TABLE XVI. AVERAGE YEARLY EFFICIENCY RESULTS BALTIMORE SEWAGE-WORKS, 1912 TO 1920 EXPRESSED AS PERCENTAGES FROM ROW SEWAGE TO FINAL EFFLUENT

| | Percentage Reduction | | | | Increase in | |
|---|---|---|---|---|---|---|
| Year | Suspended Solids | Settling Solids | Biochemical Oxygen Demand | Acid Forming Bacteria | Nitrates p.p.m. | Relative Stability Per Cent |
| 1912 | 75 5 | | 95 8 | 7.5 | 98 | |
| 1913 | 82 3 | | 88 9 | 95 6 | 7 9 | 99 |
| 1914 | 69 0 | | 80 0 | 84 2 | 6 9 | 92 |
| 1915 | 83 2 | 84 7 | 81 4 | 84 4 | 5 5 | 94 |
| 1916 | 65 9 | 69.6 | 75.3 | 87 1 | 4.1 | 92 |
| 1917 | 83 9 | 61 4 | 68 9 | 80 6 | 7 4 | 92 |
| 1918 | 84 7 | 50 4 | 61 2 | 79 0 | 7.6 | 95 |
| 1919 | 61 3 | 64 3 | 81 2 | 91 6 | 6 7 | 92 |
| 1920 | 76 2 | 85 1 | 85 5 | 94 1 | 6 5 | 90 |
| Average | 75 8 | 69 3 | 77 8 | 88 0 | 6 7 | 94 |

Note: Raw sewage practically devoid of oxygen in any form.

ype of blower. This blower did not perform satisactorily and in consequence the laboratory analyses ere discontinued on May 19, 1916. Efforts to adjust he blower difficulties continued until the fall of 1916, hen the experiment was stopped. There is no account f the exact reason for discontinuing the activated-ludge experiments, but the most reliable information s to the effect that the lack of funds was the cause. lore extensive data on the Baltimore experiments can e found in *Engineering Record*, April 24, 1915, p. 521, nd July 3, 1915, p. 23; *Engineering News*, July 22, 1915, . 164, April 27, 1916, p. 798, and July 20, 1916, p. 106, nd in the *Municipal Journal and Engineer*, Oct. 19, 916.

*Grease Recovery*—Beginning in June 1915, and continuing approximately five months, an investigation was conducted at the Baltimore sewage-works by G. J. Requardt, formerly acting division engineer, and Arthur B. Merrill, formerly chemist-bacteriologist, to determine the feasibility of extracting fats and grease from the city sewage.

The large-scale experiment consisted of pumping the sewage continuously from the outfall sewer into a cylindrical tank of 428 gal. capacity at the rate approximating a 5-hr. detention period. Enough sulphuric acid was constantly added to the inflowing sewage so that the effluent was always acid. A number of small-scale experiments, somewhat similar to the tank experiment, were conducted in the laboratory. In the latter enough sulphuric acid was added to the sewage so that it remained acid after 3 hr. settling.

The results of these experiments show that the value of 30.9 grams per capita is reliable for the *total* amount of grease in Baltimore sewage, that the sludge accumulated in the large tank experiment contained on the dry basis 27.5 per cent of grease, of which 86.34 per cent was saponifiable and 13.66 per cent unsaponifiable. The sludge obtained had a very objectionable odor, contained 93.9 per cent water, and dried on the sand bed much less readily than good non-acidified sludge. Even after 48 days drying it retained 66.8 per cent moisture.

### Grease Recovery

At the conclusion of this work correspondence with six different manufacturers revealed the fact that only one would consider the use of the grease produced, and his requirements as to purity and per cent of water made the cost prohibitive.

The mechanical recovery of the floating grease by skimming and then applying heat and straining produced a substance with a distinct sewage odor and with such an amount of water that it was practically impossible to find a market for it. For this reason nothing further has been done along these lines.

When the work of The Sewerage Commission ended in the early part of 1916 the sewage-works was put under the supervision of the Highways Engineer's Department, of which A. E. Christhilf is the present head, with Milton J. Ruark in direct charge of the sewer division, and J. J. Holden superintendent of the plant.

## Drainage Work in the Florida Everglades

Construction of lateral ditches as well as of main canals by the Everglades Drainage District is probable, according to a paper read before the Florida Engineering Society by the chief engineer of the district, F. C. Elliot, Tallahassee, Fla. An extract from that paper is given below:

The main drainage canals extending through the Everglades, with their main controlling works, together with the control of Lake Okeechobee, constitute the work in general being provided by the Everglades Drainage District. Lateral ditches comprising the secondary system are left to each particular locality to construct at the time and in the manner convenient to such locality. But conditions appear to be developing which may make advisable the carrying out of the secondary system also by the District, for the purpose of insuring a properly co-ordinated system of both main and lateral canals for effective and satisfactory drainage. The reason for this is a very general lack of knowledge on the part of landowners as to the necessity of any sort of lateral or farm ditch system for securing local drainage and for supplementing the main canal system.

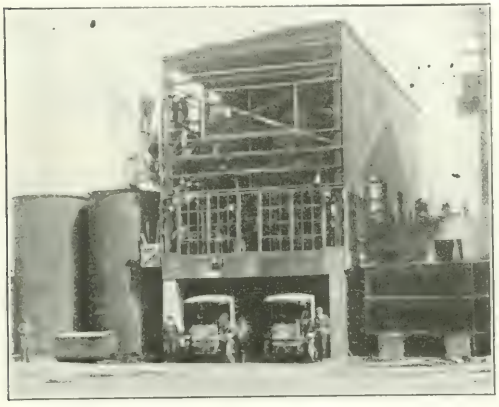
# New Philadelphia Asphalt Plant Has 4,000-Sq.Yd. Daily Capacity

## City-Owned Installation One of Largest in Country —Modern Mechanical Devices a Feature

By H. T. Macfarland

With [illegible]

ASSUMPTION of responsibility by the city of Philadelphia, Pa., for the maintenance of 621 miles of sheet asphalt pavement and the 115.3 miles of bituminous country road, coming shortly after the highway bureau of the department of public works had taken over the cleaning of streets and collection of refuse in several selected trial districts, has resulted in the construction of a municipally-owned asphalt plant, completed last March. Asphalt pavements in Philadelphia represent more than 50 per cent of the total improved thoroughfares. The new plant, which will be used, at least for the present, exclusively on repair work, has a rated daily capacity of 3,700 sq.yd. of finished sheet asphalt



DUPLICATE INSTALLATION ALLOWS SIMULTANEOUS LOADING OF TWO TRUCKS

topping, but will produce in excess of 4,000 sq.yd. of this material per day. The output of binder and of bituminous concrete will run 50 per cent in excess of the rated capacity for sheet asphalt. The Philadelphia plant is one of the largest city-owned installations in the United States and in point of mechanical equipment is the most modern.

Decision to install a municipal asphalt mixing plant was made by city officials only after a comprehensive view of the street repair situation in Philadelphia, and of the experiences of other cities which have their own plants. Heretofore repair work, like the laying of new pavements and the resurfacing of highways, had been done under the contract system. The operation of the municipal plant is expected to result in substantial economies, as well as greater mobility of the repair forces.

In the city plant are embodied the latest devices for the handling of crude materials and the efficient and economical production of asphalt pavement mixtures. The plant is located on the Delaware River at Fairmount Ave. Slips on each side of the narrow strip occupied by the plant provide adequate space for four or more barges, which will be utilized to bring sand from the New Jersey banks and stone and other materials wher water transportation is most economical. Spurs fro the Belt Line Railroad, over which cars of all lines ar routed, lead into the plant, so that asphalt and fuel o can be pumped directly from tank cars into the storag tanks provided. Limestone dust and other materials als will be transported by rail and unloaded directly int storage bins or rooms. From the plant trucks can b dispatched to all parts of the city by direct routes.

The mixing plant proper, supplied by the Barbe Asphalt Paving Co., consists of two 1,850-yd. Iroquoi straight-line stationary plants, set up side by sid Each unit can be operated separately, one, for instanc turning out binder and the other sheet aspha topping or asphaltic concrete mixture. Each ha its own operating platform, its own elevators an discharging points, so that two trucks can be loade simultaneously. Storage tanks, heating kettles, storag bins and all other units are grouped near the mixin plant, with derricks and other apparatus convenientl located.

Along the left hand slip is a large reservoir bi capable of holding two barge-loads of sand. Th material is unloaded by an electrically-driven derric equipped with a 1½-yd. bucket. The derrick carries 70-ft. boom, with a working area of 270 deg. It is pr posed to bring all sand to the plant by barges, since th New Jersey banks are readily accessible to water tran portation. Stone and dust will be delivered by rail. A second derrick, located in the center of the yard, wi be used to unload cars and transfer sand from th reservoir bin to the storage bins in the rear of the mix ing plant. When operating between reservoir and sto age bin, at a fixed angle of 45 deg., it will transfer bucket of sand every minute.

The battery of three storage bins, or operating bin is located directly in back of the mixing plant. Th center bin holds 75 cu.yd. of stone and each of the tw end bins, 100 cu.yd. of sand. All three bins are 22 f in height, and 16 ft. x 16 ft. in plan. The storage bi walls are made of tongue and groove 2-in. yellow pin 10 in. wide. The inside walls of the reservoir an storage bins were treated with a special creosote pai by the penetration method, the storge bins being give four coats.

Limestone dust is handled in bags. The plant equipped with dust collectors to reduce the du nuisance. Engineers make their determination befo the material goes into the dryer, and after the sand heated the dust is put back.

Oil burners are used for heating the dryer, but th system is a duplex one, so that coal can be burned desired. A 100-hp. boiler is used for heating stea coils and for operating the oil and other pumps. It equipped to burn oil.

When delivered in tank cars, the asphalt is tran ferred by pumping to four storage tanks with a capacit of 10,000 gal. each, located alongside of the track Asphalt from the storage tanks is pumped to the heatin kettles. The storage tanks are in series, and one o more can be cut out when necessary. They are line with coils, the lower or agitation coils being 1½ i Above the agitation coils are two horizontal grids an vertically, 3 spiral helixes. In the storage tanks th asphalt is raised to a temperature of 250 deg. F.

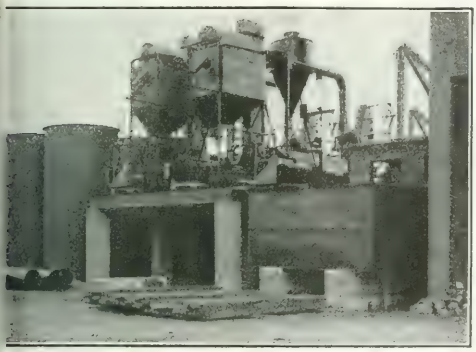
Four steam heating kettles of 4,000-gal. capacity eac are employed to raise the asphalt to the proper tempera

ure before it is lifted to the mixer. They are equipped ith horizontal steam coils. All asphalt lines are steam-acketed.

The two mixing plants are identical in construction. ll units of each plant are operated by one shaft, utches being provided for engaging the different units. 125-hp. motor, current for which is furnished by ie local service corporation, operates the drive. One otable feature of the plant is the compact arrangement ith all parts on a single frame holding shafts, gears id other units in line. The plant can be operated with minimum force, due to the convenient arrangement of vers engaging the units and controlling loading, mix-g and discharging.

The cold material elevator is on the rear of each unit, perating directly between plant and storage bins. ach line of elevator buckets can handle 12 cu.ft. of aterials per minute.

The heating drums in the two units are 20 ft. long r 48 in. in diameter. They are of the revolving type id made of heavy steel plate, with short channel flight



PHILADELPHIA ASPHALT PLANT, SHOWING LAYOUT PRIOR TO HOUSING IN

side for elevating and spilling the materials. A roller ain drive is used. An air exhaust fan produces the ecessary drum stack draft, while the piping carries the ist from the fan to the collector overhead. Two fuel-l burners are used under each drum.

The units are equipped with two-section revolving reens for fine and coarse material, covered with steel ods. The storage bin, of steel plates with two com-irtments, is equipped with a tailing pipe connected ith the screen and with an overflow pipe leading to ch compartment. There are separate discharge gates id operating levers for each compartment.

The weighing box, located within easy reach of the erator, is equipped with a steel gate at the bottom and erated with a lever. It is supported by an automatic ree-beam enclosed platform scale. Beside it is the volving-type asphalt bucket, suspended on a two-beam ale.

The mixer is of the two-shaft pug-mill type with a pacity of 12 cu.ft., steam-jacketed and steam dumping. is equipped with universal blades suitable for any ixture. A roller chain furnishes driving power.

Each plant is equipped with a steam-jacketed neumatic asphalt lift, air compressor, air receiver tank nd piping for lifting the asphalt from the kettles to ie weighing bucket.

Beneath the plant is a small room, where limestone dust will be fed into the elevator, and a larger dust storage room. The plant siding runs past the door of this room, so bags can be unloaded direct from cars.

The plant housing, erected around the assembled plant, is of corrugated sheet asbestos with steel core. The framing is of steel.

For the storage of fuel oil, a tank with a capacity of 15,000 gal. has been installed at the river end of the yard. The oil will be pumped direct from cars into the tank, which is surrounded by a concrete wall.

### Repair Service

Thirty men have been employed in the crew at the new plant. "Jitney gangs," or small groups of workers, who will be dispatched to various sections of the city to make minor repairs as soon as such pavement defects are reported, will form one feature of the service. Other gangs numbering more than 100 men will be scattered over the city and assigned particular territories to keep in repair. The city officials hope eventually to develop the service to a point where each gang will be held strictly responsible for prompt repairs and the maintenance of every asphalt street and road in first-class condition.

Motor trucks and other equipment for repair work have been provided by the city. A large garage is to be erected on a city-owned lot directly opposite the asphalt plant, so that there will be no delay in repairing or starting out the trucks. Delaware Avenue, with a width of 80 ft., offers ample facilities for the parking and turning of trucks.

The installation of the city asphalt plant marked one of the constructive works of his administration, Mayor J. Hampton Moore declared recently, when receiving the plant on behalf of the city. The completed plant represents an expenditure of approximately $110,000.

The plant was installed under the supervision of Frank H. Caven, director of public works, and Fred C. Dunlap, chief of the bureau of highways. The latter official played an important part in working out the arrangement of the units, and is largely responsible for the efficient location of plant, bins, spurs and other equipment. Fred Roth was construction engineer in charge of installation.

## Control of British Waterways

*London Correspondence*

Group control and organization of the inland waterways system in England is recommended in a second interim report issued by the Departmental Committee appointed by the Minister of Transport to inquire into the development of the canal and waterway system and occasioned by the advancement of the British Railways Bill. Group organization is recommended in lieu of the program dealing with the whole system of canals comprising what is known as "The Cross," or the entire system connecting north and south, and east and west, proposed by the Royal Commission. It is recommended that the groups be set up gradually, and as a start it is suggested that the River Trent be made the central route of the first group, with its organizaion to be undertaken without delay. It is intended that each waterway group shall be controlled by a trust, including representatives of the various parties at interest, such as traders and local authorities, and the state should state money be involved.

# Boston Engineers Report Against Licensing Law

AN ADVERSE REPORT to passage of the engineers' registration and licensing law, still pending before the Massachusetts Legislature, has been made by a joint committee of engineering societies and local sections, reporting to the combined membership. The bill had previously been opposed by the joint committee on licensing and the recent report reviews reasons for the conclusion reached. It is signed by twelve of the thirteen members of the committee.

A petition was filed in the Legislature, Jan. 4, 1921, by the Boston Chapter of the American Association of Engineers, accompanied by a bill to provide for the registration of professional engineers and land surveyors. On Jan. 7 the joint committee on licensing resolved that legislation on this subject by the present session of the legislature should not be recommended, at the same time requesting the Boston Chapter of the A. A. E. to withdraw its petition for legislation. The joint committee now reports that it is opposed to the passage of the proposed law, not only for the reason that it contains "many glaring defects and inequalities," but also because existing laws, as in the case of building codes, etc., appear to offer adequate protection in such cases. There would also be a tendency through licensing to place the inexperienced man, in the eyes of the law and the public, on a plane with the experienced engineer of higher professional attainments. Extracts from the recent majority report of the joint committee follow:

The life, the health and the property of the public, it was claimed [by the proponents of the bill] were in the hands of the engineers who were responsible for the structures and public works that the people use or enjoy and it was stated that existing laws did not sufficiently protect the public in these directions.

### Existing Safeguards Adequate

Prof. George F. Swain pointed out at the hearing the character and extent of the safeguards to the public that exist in the construction of buildings, public and private utilities, etc., through supervision by competent commissions and engineers, through building laws and other special laws requiring official supervision and approval of plans, inspection of work in process and of finished work. He expressed the opinion that if such measures were not sufficient the wise policy would be to add to them and to amend them in such a way as to cure their defects, but that no possible method of registering engineers could take their place or could provide a system of safeguards to society that was comparable with them in effectiveness.

An engineer is not usually chosen in a hurry or for work of an emergency nature, and in engaging an engineer to design engineering work of greater or lesser importance, a client now considers the professional reputation and work accomplished by the engineer whom he is to employ. Public or private interests are better safeguarded by such practice than by selecting an engineer by virtue of his holding a license.

It was demonstrated at the hearing under the proposed bill that a person who became registered, through society membership or otherwise, would be in the eyes of the law, fully competent to practice every branch of engineering, regardless of the field in which his training or experience had been. A system of licensing which provides for competency in one field may open up an opportunity for incompetence in others.

It is an open question as to what extent licensing laws should go in the registration of applicants; if the requirements of the examining board call for professional attainments of the highest order, the result would be public confidence in a registered engineer. If licenses are issued to men of mediocre or inferior ability, many would obta licenses and have the same standing before the public those of much greater professional attainments and rep tation, with the result that public and private intere would suffer from work of inferior character.

What is an engineer? One of the greatest difficulties licensing engineers is deciding this question. Some la define an engineer or engineering; others avoid it entire leaving it in case of litigation or similar difficulty for t courts to decide. If engineers themselves, in framing la for registration, cannot define what an engineer is, it c hardly be expected that the courts, which are depende in technical questions upon expert testimony, can prep a suitable definition of engineering. There have been ma attempts so to define the profession and with indiffere success. Many such definitions specify special branc and wind up with a blanket clause at the end to cover other branches of engineering, with the result that t branches of the profession previously designated might well be omitted. It is a question how laws can be fran effectively and properly to regulate anything that can be definitely and comprehensively defined.

### Universal Licensing of Specialists

In this connection, it is difficult to comprehend how a m registered as an engineer and whose principal knowlec is confined to, say mechanical engineering, is any mo qualified to pose as a chemical engineering expert th would be a lawyer, a physician or a plumber for instan or a person skilled in many other professions or trad provided their general educational qualifications correspo

Laws for the licensing of engineers should also inclu the licensing of architects and affiliated professions, for t reason of the two professions being so closely interwov that they are mutually interdependent in many ways.

Edwin H. Rogers, Boston Society of Civil Enginee city engineer of Newton, Mass., is chairman of the joi committee, consisting of six members of the Bost Society of Civil Engineers and one member each rep senting the following: Boston Section, American Ins tute of Electrical Engineers; Boston Section, Americ Society of Mechanical Engineers; Boston Society Architects; Boston Section, American Society of He ing & Ventilating Engineers; Boston Section, Americ Institute of Mining & Metallurgical Engineers; Bost Society of Landscape Architects, and Boston Chapt American Association of Engineers. The report is s signed by the representative of the A. A. E. chapter.

It is stated in the recent majority report of t licensing committee that the demand for licensing registering engineers in the locality of Boston, so f as they have been able to observe, appears to have co entirely from the American Association of Enginee It is further stated that "this evidence is further co firmed by the introduction of bills for licensing registering engineers in practically all the states of t Union and by the active campaign in support of the measures during the present year, in all states in whi such laws had not already been passed, by the Americ Association of Engineers.

"It appears to be the fact that these petitions f registration in all the different states contain the pr viso that membership in the American Association Engineers and in certain other professional societi shall be a sufficient requirement for registration as engineer."

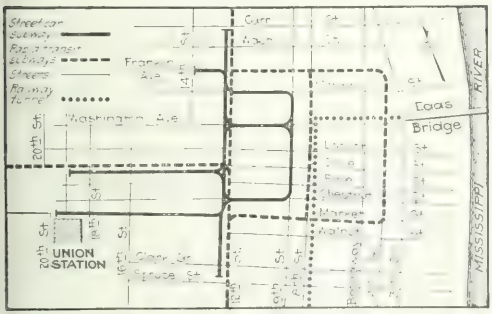
Opposition to the licensing bill at hearings la February appeared so strong that it resulted in th recommendation by the legislative committee that th bill be referred to the next annual session of the Legi lature. This recommendation was adopted by th Senate, Feb. 24, 1921, and subsequently by the House

# Street Railway and Rapid Transit Plans for St. Louis

## Systematic Linking of Car Lines to Serve for Ten Years, with Downtown Subway—Future Rapid Transit System

IMPROVED transportation service and a more equalized growth of the city are the objects sought by a reorganization of the street-railway system of St. Louis, Mo., as proposed by the City Plan Commission and explained in a report by Harland Bartholomew, engineer for the commission. Two main problems of the immediate future are the relief of congestion in the business district and the provision of more direct routings to all parts of the city. The following matter is a brief abstract of the report.

A single company now operates the entire street railway system, but franchise requirements and mortgages on various original lines have made it necessary to continue operation of certain routes. This results in inefficient and uneconomical service and is one cause of the present company having gone into the hands of the receiver in April, 1919. It is hoped that with the termination of the receivership there will come a company able and willing to meet the city's needs, and it is on this condition that the proposed plans are based. Interurban lines from the west are operated by the same company as a part of the city service;




PROPOSED STREET CAR AND RAPID TRANSIT SUBWAYS FOR ST. LOUIS

independent lines entering from the east do not penetrate far enough into the city to affect the street railway system, except as to terminal facilities.

A determining factor in the proposed plan of a more systematic arrangement of the street railway lines was the city's policy of opening, widening and extending numerous streets, which will facilitate more direct routing and quicken operation of individual lines. Unnecessary duplication of lines in many places and a lack of direct north and south routes are defects which mark the present system and which it is planned to eliminate by connecting and extending various lines and removing others which help to increase rather than to relieve congestion.

As the city is in the form of an ellipse, with its business district at the outer edge, the traffic haul is larger than if this district were at the geographical center. Hauls of five or six miles are the rule rather than the exception. This condition is made more objectionable by the fact that nearly 50 per cent of the distance is through deteriorated sections which are almost unremunerative from the traffic point of view. With the present street system more direct routings are available to the west than to the north or south, but the narrow and crooked streets which have made travel relatively slow in the latter direction are now being widened and straightened under plans developed by the City Plan Commission (see *Engineering News-Record*, May 13, 1920, p. 954).

The great majority of the people live within the 35-minute time zone from the center of the city (8th and Olive Sts.), but with the improved street railway layout about 11 sq.mi., 18 per cent of the city's area, will be added to zones from which this point can be reached in 35 minutes or less. At present 21 per cent of the city's area is more than ½-mile from a car line, excluding river-front areas, but with the new plan this would be reduced to 3 per cent.

### Subways and Rapid Transit

With the proposed extension and rerouting of the street railway service, the needs of the city may be served without serious inconvenience for at least ten years, so that independent rapid-transit facilities are not needed at this time. In fact, there is not now a sufficiently great movement of people in any one direction to warrant the establishing of such facilities. Furthermore, a rapid-transit system at this time would be detrimental to the proper growth of the city, as it would tend to encourage the shift of population to the outer suburban districts and thus lessen the usefulness and value of the intermediate areas, whereas the city needs greater intensity of development within these latter areas before a rapid-transit system will be justified. In fact, while suburban districts are now being developed there is no substantial development of the "blighted districts."

On the other hand, removal of certain transit lines from the surface of the narrow streets of the business district will soon become an urgent necessity. The rush hour movement in St. Louis is rather heavier than in other cities, but with the increased crowding of these narrow streets by automobiles it is almost impossible to meet the demands of the evening rush hour within this district.

A subway loop is suggested, therefore, for all east and west lines across the business district, as shown by the accompanying plan. This subway would be about 25 ft. wide and 14 ft. high, with its roof as close as possible to the street surface. Stations would have platforms with stairways to the sidewalk. The eastern or downtown side of the loop is placed on 9th St. in order to avoid interference with the steam railway tunnel on 8th St., connecting the Eads Bridge with the union station.

Subway loops for rapid transit lines independent of the street car lines will be necessary eventually, but these must be distinct from the street car subways and are planned as shown on the drawing. As these later subways would intersect the present railway tunnel, alternative plans for the latter are suggested: (1) That railway traffic be diverted to the Municipal Bridge and the lower (railway) deck of the Eads Bridge be given up to rapid transit purposes; (2) that a new railway tunnel be built on 3d St., outside of the subway district, in which case the present 8th St. tunnel could be utilized as a rapid transit subway.

Rapid transit service beyond the subway district is provided for in the plans by four elevated lines, two running west and the others northwest and southeast respectively. These would be concrete structures spanning the street car tracks, except that the one on the private right-of-way of the Hodiamont line would be a solid fill with concrete retaining walls and street bridges.

In 1920 the estimates of cost were $17,000,000 for the street car subway and $17,000,000 for the rapid transit subway or $80,000,000 for the complete rapid transit system, including elevated lines and subways. This would mean $97,000,000 for relieving the street congestion and providing rapid transit facilities, but, as stated already, the latter facilities will not be needed for several years if the surface lines are developed on the proposed plan.

## Rotterdam Floating Drydock

The port equipment of Rotterdam has been increased through the construction of a large floating drydock put into commission within the past few weeks, according to *Commerce Reports*. Its first service will be the overhauling of the Holland-American liner "Rotterdam." The dock has a length of 692 ft., an outside width of 167 ft. and an inside width between fenders of 137½ ft. It has a lifting capacity of 46,000 tons.

# Fire Resistance of Building Columns as Shown by Test

## Conclusions Drawn From Test Series of 106 Columns—Cast Iron and Timber Resist Longer Than Unprotected Steel—How Various Fireproofing Materials Fail—Concrete Makes Best Showing

By R. E. Wilson
Engineer, Associated Factory Mutual Fire Insurance Cos., Boston

A SERIES of elaborate tests to determine the fire resistance of bare and fireproofed building columns was carried out during 1917 and 1918 by the Associated Factory Mutual Fire Insurance Cos., the National Board of Fire Underwriters, and the U. S. Bureau of Standards. A special furnace and testing machine combined was built for the work at the Underwriters' Laboratories, Chicago, by which a column could be subjected to heat while under full load. Because of the large amount of data involved, the results have only just become available, through a detailed report published jointly by the three co-operating organizations. In order to make the results of this important investigation available for use by structural engineers and architects, an analysis is presented herewith in brief form. The conclusions expressed are supported not only by the data given in the full report, but also by the writer's observations as a member of the test party.

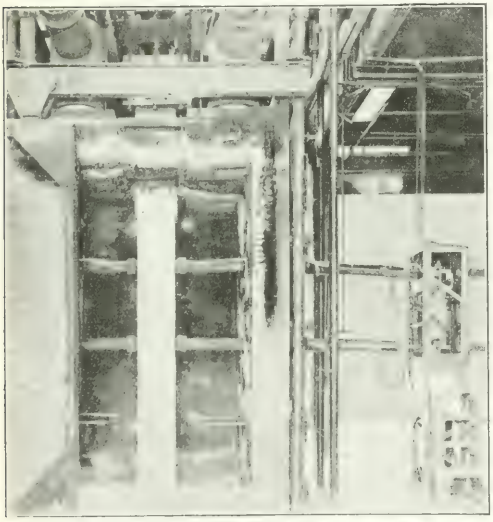


FIG. 1. FIREPROOFED COLUMN IN FURNACE WITH PYROMETER COUPLES AND DEFORMETER IN POSITION

The motive for undertaking the tests was the realization that authoritative information on the resistance of building columns to fire exposure was very limited, and that this produced much uncertainty concerning safe methods of construction, reflected in wide variations in building code requirements. Recognizing the need of dependable data on this subject as well as a more accurate basis for determining the value of different types of construction from an underwriting standpoint, the Associated Factory Mutual Fire Insurance Cos. in 1910 proposed that a series of test be made, and secured the co-operation of the National Board of Fire Underwriters, through the Underwriters' Laboratories, and, four years later, of the Bureau of Standards. Preparatory work, including the construction of the furnace and testing machine, began in 1912.

*Design of Columns*—The essential feature of the tests was to subject the columns to full fire exposure *while under working load.* The furnace and the hydraulic loading ram designed for this purpose are shown in Figs. 1 and 2.

In all, 106 tests were included in the series; 91 of these were first tests only, while in the remaining 15 tests hose streams were directed against the columns when they were at high temperature. All the columns had an effective length of 12 ft. 8 in. and were designed for a working load of approximately 100,000 lb. as calculated by the following formulas, which are generally accepted in good engineering practice for the various materials: Steel columns, $16{,}000\text{-}70l/r$; cast iron, $10{,}000\text{-}60l/r$; Lally columns (steel pipe filled with concrete), $A_s(13{,}500\text{-}140l/d + A_c(1{,}000\text{-}11l/d)$; vertically-reinforced concrete columns, $450\ (A_c + 15A_s)$; hooped concrete columns, $650\ (A_c + 15A_s)$; timber columns, $1{,}000\ 1\text{-}l/80d$). Both in length and capacity the columns were thus representative of interior columns used in buildings of moderate height.

*Type and Protection*—The specimens in the fire series consisted of: (1) Unprotected structural steel columns (rolled H, plate and angle, plate and channel, latticed channel, Z-bar and plate, I-beam and channel, latticed angle, starred angle); (2) unprotected round cast-iron columns, vertically and horizontally cast; (3) Lally columns (concrete-filled steel pipe); (4) unprotected timber columns; (5) steel columns partly protected with concrete; (6) protected columns of the various types, with both single and double coverings of metal lath and plaster, and with 2 in. and 4 in. thicknesses of concrete made with different kinds of aggregates, hollow tile of different kinds of clay, and solid gypsum block; (7) reinforced concrete columns with 2 in. integral concrete protection.

The columns and covering materials were obtained from various sources in different sections of the country, including the Chicago, New York, Boston, Cleveland and St. Louis districts, in order to secure samples which were fairly representative of the material used in building construction of the various classes. A large number of auxiliary tests were made on samples of all materials used. The materials of which the columns were constructed generally conformed to accepted specifications for the various kinds of structural material. The steel columns were detailed and fabricated in accordance with good engineering practice. The placing of the various coverings was generally done by experienced workmen in the several trades and the workmanship obtained throughout was fairly representative of that secured in good building practice. All concrete was mixed in a batch mixer. The columns were stored in the testing room and the age of the coverings at time of test ranged between 13 and 18 months.

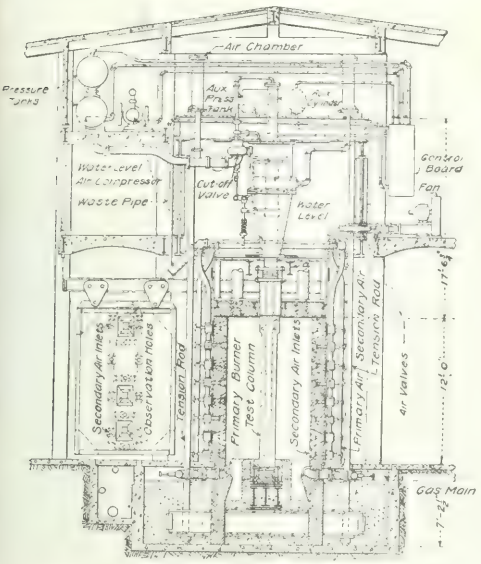



FIG. 1. GENERAL DRAWING OF FURNACE AND TESTING MACHINE.

*Manner of Testing*—With the exception of three cast-iron columns the steel, cast-iron and reinforced-concrete columns were tested with upper ends fully restrained and lower ends partly restrained. The remaining cast-iron columns, the Lally columns and the timber columns had unrestrained ends. Timber columns were tested with both cast-iron cap and pintle and steel plate cap bearings.

All steel columns were fabricated integrally with a steel head 3 ft. long, protected with concrete, which served to transmit the load from the ram. The other columns were attached to a head which served a similar purpose. The base of each column was embedded for 8 in. in fireproofing, leaving 12 ft. of length exposed to the fire.

A view of the testing furnace with auxiliary equipment and column in place is shown in Fig. 1, and details of the testing machine in Fig. 2.

*Procedure In Fire Tests*—The columns were subjected simultaneously to the working load and to a fire exposure increasing in accordance with a predetermined time-temperature relation until failure occurred or until they had withstood a test of 8 hr. In the latter event the load was immediately increased under full fire exposure until failure occurred. The working load was maintained constant on the column throughout the test by means of a calibrated hydraulic ram of 545,000 lb. capacity. The fire exposure was obtained by placing the columns in a gas-fired furnace with brick walls and concrete block roof, with a combustion chamber 7 ft. square by 12 fit. high. The furnace temperature was regulated closely in accordance with a time-temperature control curve which has been adopted by national technical organizations and testing laboratories. This curve calls for the following temperatures: 5 min., 1,000° F.; 10 min., 1,300° F.; 30 min., 1,550° F.; 1 hr., 1,700° F.; 2 hr., 1,850° F.; 4 hr., 2,000° F.; 8 hr., 2,300° F.

Measurements of the furnace and column temperatures, as well as the vertical and lateral deformation of the columns were taken throughout the tests. All temperatures were measured by electric thermo-couples. For the furnace, four couples were placed at different parts of the combustion chamber and for the columns, from seven to fourteen were placed at three or four levels, both on the column itself and in the covering. The vertical and lateral deformations were measured by means of two horizontal wires, 37 in. apart, attached to each side of the columns and protected with water jacketed sleeves within the furnace and extending to fixed points outside. The vertical movement of these wires was very accurately measured at an intermediate point by means of micrometers. The center deflection of the columns was measured by taking reading with reference to the reflection of point on the wires in polished metal scale. The effects of the fire on the test column were served through mica-glazed holes in the furnace walls.

*Procedure In Water Tests*—The fire-and-water tests began with a pre-determined fire exposure based on the ultimate fire resistance of similar columns in the fire series, but not exceeding 1 hr., after which a 1⅛-in. hose stream at from 30 to 50 lb. nozzle pressure was immediately applied to the highly heated column from a distance of 20 ft. for a period of 1 to 5 min., depending on the type of column covering. The water was applied in succession over the full height of three of its sides.

*Summary of Results*—The schedule of fire tests giving details of columns and coverings together with the time to failure and the fire resistance period assigned to each column tested is tabulated in Fig. 3. In Fig. 4 are shown typical cross-sections of columns with different protective coverings. The useful fire resistance periods for columns and coverings arranged by groups are given in Table 2. Views of typical columns in the fire series taken after test are shown in Fig. 5. It is pointed out that a considerable portion of the impairment of the covering, particularly in the region of failure, was in many cases caused by the large deflection of the column which usually occurred at failure.

The time of failure extends from the beginning of the test to the time when the column is unable to sustain the applied working load. The useful fire resistance period has been derived for columns within any group of similar tests by taking *two-thirds the average time to failure* within that group, provided no single test in the group is of shorter duration than the designated period. The one-third reduction is made to allow for all variations due to materials, workmanship and test conditions, and because of the fact that the number of tests in any group was not sufficient to develop the full possibility of difference in results. In assigning these periods consideration was given the results of the fire and water tests, and for the protected columns it was also required that after a 2-min. application of water the column section should not have become exposed in any place and that a sufficient amount of covering should have remained in place to prevent early failure of the column on subsequent fire exposure.

Those columns given the 8-hr. rating withstood the 8-hr. fire test satisfactorily and immediately sustained increased loading of two to three times the working load before failure occurred.

*Unprotected Steel Columns*—The tests showed conclusively that unprotected structural steel columns of

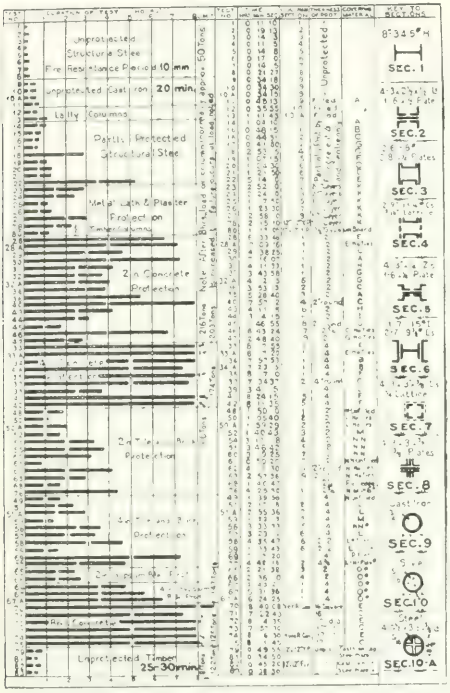



FIG. 3. RESULTS OF FIRE TESTS SUMMARIZED BY DIAGRAM

*Key to Covering Materials*

*a*—1 : 2 : 4 limestone gravel concrete.
*b*—1 : 2 : 4 N. E. granite concrete.
*c*—1 : 2 : 4 N. Y. trap concrete.
*d*—1 : 2 : 5 N. Y. trap concrete.
*e*—1 : 2 : 4 Chicago limestone concrete.
*f*—1 : 2 : 5 Chicago limestone concrete.
*g*—1 : 2 : 5 hard-coal cinder concrete.
*h*—1 : 2 : 4 Cleveland sandstone concrete.
*i*—1 : 3 : 5 Cleveland sandstone concrete.
*j*—1 : 2 : 4 siliceous gravel concrete.
*k*—Metal lath and cement plaster
*l*—Surface clay tile.
*m*—Shale tile.
*n*—Medium-hard semi-fire clay tile.
*nn*—Hard semi-fire clay tile.
*o*—Solid gypsum block.
*p*—Concrete slag brick.

NOTE—Total length of lines in chart shows time to failure in each test, break in line indicates useful fire resistance.

All partly protected columns tied with vertical and horizontal wire ties. Concrete protections tied with No. 5 B & S gage steel wire wound spirally on 8-in. pitch unless otherwise noted. In tile-protected columns concrete filling placed between tile and column unless otherwise noted. Tests marked with asterisk following letter denoting covering indicate that tile or gypsum block was tied with metal ties in horizontal joints; otherwise tied with wire around outside each course.

any kind have little value from a fire resistance standpoint and they should not be used in building construction where they could be subjected to a fire of any appreciable degree of intensity or duration, particularly in buildings more than one story high. In all such cases some form of protective covering should be provided. This may be done by filling the reëntrant portions or interior with concrete or by fully covering the steel with concrete, cement plaster on metal lath, hollow clay tile, brick, or solid gypsum block, the kind of material and the thickness of covering depending upon the amount of protection desired.

Unprotected steel columns proved unable to support their calculated working loads after temperatures in the metal of from 900° to 1,100° F. have been reached, the variation being due to the differences in the applied unit loads with different radius of gyration. The total expansion of the steel columns varied from $\frac{3}{4}$ in. to $\frac{1}{8}$ in., the lower values being due to local heating caused by failure of a portion of the covering. The shape of the steel section appeared unimportant except as it affected the size of the column protection. Slenderness ratio, within the limits of 40 to 80, seems to have had little influence on the fire resistance; the center deflections for columns with these ratios were less than $\frac{1}{2}$ in. up to the time when the column had reached its maximum expansion, though for higher ratios center deflections of nearly 1 in. were noted at this stage. As this deflection might necessitate replacement of a column after a severe fire when it would not otherwise be impaired, it is thought advisable to keep the slenderness ratio below 80, especially with the poorer types of protection.

*Protected Steel*—The value of a column covering depends both on the action of its heat insulating and absorbing properties in retarding the temperature rise in the columns, and on its ability to carry a portion of the column load. The initial load-carrying capacity of the covering varies with the rigidity of the covering and its sectional area as compared with the steel. As heating proceeds the higher rate of expansion of the metal causes the load originally carried by the covering to be

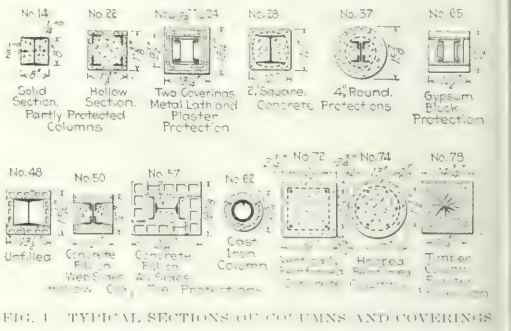



FIG. 4. TYPICAL SECTIONS OF COLUMNS AND COVERINGS

transferred to the steel until, at the point of maximum expansion, the metal has become heated to such an extent that compressive yielding takes place, causing a constantly increasing portion of the load to be transferred to the covering, the amount depending on the load-carrying capacity of the latter after the fire exposure. This load-carrying capacity of the covering considerably increases the time to failure of the column, in some cases the increase being over 100 per cent. The lighter unit loads to which the steel is subjected during this period make it possible for the metal to reach higher temperatures before failure; average effective temperatures of 1,400 to 1,500° F. were observed in some cases.

Concrete is considered the best covering material, not only because it gave the highest degree of fire resistance of any of the coverings tested but also for reasons based on other points of view. The necessary materials are usually readily obtained, the placing of the covering is subject to lesser variations due to workmanship than in the cases of materials not applied integrally, the cost is in most cases appreciably less than that of any other material giving the same degree of protection, and concrete covering can usually be readily repaired after moderate fire exposure whereas with most other materials partial or complete replacement is necessary.

USEFUL FIRE RESISTANCE PERIODS OF BUILDING COLUMNS AND COVERINGS

| Type of Protection | Type of Column Section and Details of Protection | Minimum Area of Solid Material Sq. In. | Useful Fire Resistance Period |
|---|---|---|---|
| **Structural Steel Columns** | | | |
| **Unprotected** | **Any type of section** Minimum metal thickness 0.20 in. | 8 | 10 min |
| **Partly protected** by filling reentrant spaces with concrete | **Solid steel section** | | |
| Limestone, trap rock, granite, sandstone or hard coal cinder aggregate | Mixture 1:6 or 1:8. Concrete tied with vertical and horizontal ties | 35 | ½ hr |
| Limestone or trap rock aggregate | Do | 60 | ¾ hr |
| **Partly protected** by filling reentrant spaces and interior with concrete | **Hollow latticed steel section** | | |
| Trap rock aggregate | Mixture 1:6. Concrete extends to outside of rivets, covering lattice and main members | 120 | 2 hr |
| Limestone aggregate | Do | 120 | 3½ hr. |
| **Metal lath and plaster** | **Any type of section** | | |
| One covering (1 in. thick) | Mixture 1:1:6:2½ Portland cement, hydrated lime and sand | 40 | ½ hr |
| Two coverings (each ¾ in. thick) | Do | 80 | 1½ hr |
| **2-in. concrete** | **Any type of section** | | |
| Siliceous gravel aggregate | Mixture 1:6. Concrete tied with not less than equivalent of No. 5 (B. & S. gage) wire on 8-in. pitch | 100 | 1 hr |
| Trap rock, granite sandstone or hard coal cinder aggregate | Do | 100 | 2½ hr |
| Limestone aggregate | Do | 100 | 4 hr |
| **3-in. concrete** | | | |
| Trap rock, granite, sandstone or hard coal cinder aggregate | Do | 140 | 3½ hr |
| Limestone aggregate | Do | 140 | 6 hr |
| **4-in. concrete** | | | |
| Siliceous gravel aggregate | Do | 200 | 2½ hr |
| Trap rock, granite, sandstone or hard coal cinder aggregate | Do | 200 | 5 hr |
| Limestone aggregate | Do | 200 | 8 hr. |
| **2-in., 3-in. and 4-in. hollow tile** | **Solid steel section** | | |
| *Medium hard semi-fire clay with no filling | Outside wire ties. Mortar joint between tile and column flanges | 80 | 1 hr |
| Surface clay or shale tile with concrete filling on web sides | Do. Filling serves as partial concrete protection | 100 | 1 hr |
| Extra heavy surface clay with filling on web sides | Do | 160 | 1½ hr |
| Semi-fire or surface clay with filling on all sides | **Any type of section** Outside wire ties. Filling serves as full concrete protection at least ¾-in. thick | 160 | 2 hr. |
| Do | Metal ties in horizontal joints, otherwise do | 160 | 2½ hr. |
| **2 layers 2-in. hollow tile** | **Solid steel section** | | |
| Surface clay with hollow tile filling | Metal ties in horizontal joints. Mortar joint between tile and column flanges and webs | 240 | 3 hr |
| Do | Outside wire ties, otherwise do | 240 | 1 hr. |
| **2½-in. common brick** | **Any type of section** Brick set on edge and end. Brick filling | 140 | 1 hr. |
| **3½-in. common brick** | **Any type of section** Brick laid flat. Brick filling | 240 | 5 hr. |
| **2-in. solid gypsum block** | **Any type of section** Gypsum block or poured gypsum filling; metal ties in horizontal joints; mortar joint between blocks and column flanges | 130 | 1½ hr. |
| **3-in. solid gypsum block** | Do | 180 | 2½ hr. |
| **4-in. solid gypsum block** | Do | 240 | 3½ hr. |
| **Round Cast-Iron Columns** | | | |
| **Unprotected** | | | |
| Unfilled | Minimum wall thickness 0.60 in | 12 | 25 min |
| **Unprotected** | | | |
| Interior filled with concrete | Do | 35 | ½ hr. |
| **Metal lath (high ribbed) and plaster** | Mixture 1:1:10:2½ Portland cement, hydrated lime and sand; ½-in. air space | 60 | 2 hr. |
| One covering; (1½ in. thick) | | | |
| **2-in. concrete** | | | |
| Trap rock, granite or hard coal cinder aggregate | Mixture 1:6 or 1:7. Concrete tied with not less than equivalent of No. 5 (B. & S. gage) wire on 8-in. pitch | 70 | 2 hr. |
| **2-in. hollow tile** | | | |
| Porous semi-fire clay | Outside wire ties. Mortar joint between tile and column | 70 | 2 hr. |
| **Unprotected** | **Steel pipe filled with concrete** Concrete mixture 1:1½:3 | 45 | 25 min. |
| **Unprotected** | **Steel pipe filled with concrete and reinforced in fill with structural shapes.** Concrete mixture 1:1½:3 | 55 | ¾ hr. |
| **Reinforced Concrete Columns** | | | |
| 2-in. integral concrete protection | Round or square vertically reinforced or hooped reinforced. Concrete mixture 1:6. Trap rock aggregate | 220 | 5 hr |
| 2-in. integral concrete protection | Round or square vertically reinforced or hooped reinforced. Concrete mixture 1:6. Limestone aggregate | 220 | 8 hr. |
| **Timber Columns** | | | |
| **Unprotected** | Unprotected steel plate cap bearing | 120 | 25 min |
| **Unprotected** | Unprotected cast iron cap and pintle bearing | 120 | ¼ hr |
| **½-in. gypsum wall board** | Cast iron or steel plate cap bearing, protected | 140 | ½ hr |
| **Metal lath and plaster** | Cast iron or steel plate cap bearing, protected. Mixture 1:1:10:2½, | | |
| One covering (1-in thick) | Portland cement, hydrated lime and sand, ½-in air space | 160 | 1½ hr |

* Any other kinds of clay tile not recommended, as tests indicate periods of ½ hr or less.

From a fire standpoint alone, however, other materials make equally satisfactory coverings provided their fire-resistance periods are sufficiently great to meet the necessary demands.

Concrete may be applied to steel columns either as a partial or full protection. The partial protection should completely fill the interior and reentrant portions of the main members. For columns of solid rolled or riveted sections this leaves the faces of the flanges exposed; for those of hollow latticed section the concrete is flush with the outside of rivet heads, completely covering the structural section and lattice bars. The full protection should cover all portions of the main structural members, including lattice bars and splice plates, by not less than the nominal thickness specified, although with round coverings the distance to the edge of the main column members may be reduced somewhat providing the resulting cross-sectional area is not less than that of a covering of the same nominal thickness. A 1-in. covering is sufficient protection for brackets and other details of small area.

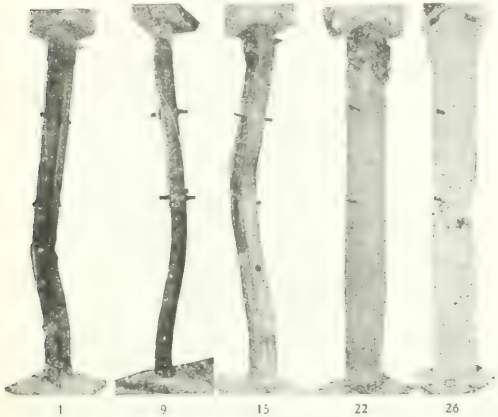
For concrete protections the two variables which most greatly affect the fire resistance are the total cross-sectional area of the column and covering and the kind of concrete aggregate employed. It was found that all other details being similar the resistance of the column is fairly proportional to its cross-sectional area. For this reason minimum areas are specified in the table of

useful fire-resistance periods, and areas at least equal to these minimums should be used to obtain the rated periods.

*Character of Covering Concrete*—The difference in protection afforded by the various kinds of concrete is very great. The different kinds of aggregate ordinarily used can be divided in this respect into three groups as follows:

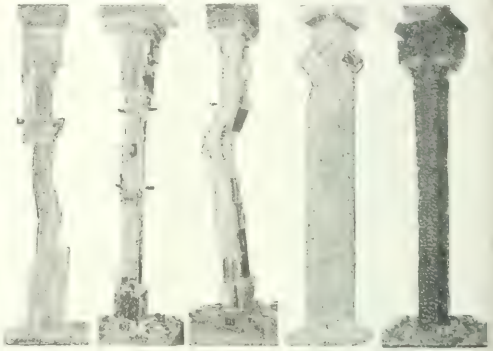
1. Siliceous gravel or other siliceous materials especially those containing a high percentage of chert, which is a non-crystalline form of silica containing water in chemical combination. Concrete made with this aggregate was found to be subject to excessive cracking and spalling on fire exposure, which greatly reduced its fire resistance as compared with other kinds of concrete. It is not recommended for use as a covering material when other kinds of aggregate can be obtained, and should not in any case be used for partial protections. (Tests subsequently conducted at the Pittsburgh Laboratories of the Bureau of Standards indicate that the fire-resistive properties of coverings made of siliceous gravel concrete can be appreciably increased by placing a reinforcement of expanded metal lath in the concrete. This procedure may sometimes be necessary where it is impracticable to use other kinds of aggregates).

2. Trap rock, granite, sandstone or hard coal cinders. Concretes with these aggregates all offer approximately the same amount of fire resistance, their periods being intermediate between those of high siliceous and of limestone aggregate concretes. Trap rock is slightly preferable provided it is a true trap. Trap rock and cinder concrete developed no spalling in the test although there was a slight amount of cracking during the latter part of the tests. The granite and sandstone




Rolled H, column, granite, concrete covering. (No. 15.) Latticed column, limestone, concrete covering (No. 22.) Steel column, metal, lath and plaster covering. (No. 26.) Note little damage to covering.

4-in. limestone concrete. (No. 33.) No cracking or spalling before failure. 2-in. trap, concrete. (No. 40.) Note fusion. Sandstone concrete. (No. 44.) Note corner cracking. Siliceous gravel concrete. (No. 45.) Note excessive cracking and spalling.




STEEL COLUMNS WITH GYPSUM AND HOLLOW TILE PROTECTIONS

4-in. medium-hard semi-fire clay tile, no filling. (No. 49.) Note thermocouple wires. 2-in. shale tile, concrete filling on web sides. (No. 52.) 2-in. hard semi-fire-clay tile, concrete filling on all sides. (No. 55.)

REINFORCED-CONCRETE COLUMN

Limestone concrete, 7-in. core steel. (No. 70.) Failure due to overloading after 8-hr. fire exposure, no spalling before.

TIMBER COLUMN UNPROTECTED

Cast iron cap and pintle bearing. (No. 71.) Note cap failure.

FIG. 5. CONDITION OF REPRESENTATIVE COLUMNS AFTER TEST. IMPAIRMENT OF COVERING DUE TO FIRE ESPECIALLY IN REGION OF FAILURE IS EXAGGERATED IN MOST CASES BY DEFLECTION OF COLUMN AT TIME OF FAILURE

cracked and spalled to some extent principally at the corners, the standstone showing these effects to the greater degree. A slight amount of fusion of the trap and granite concretes took place after tests of more than 7 hr. duration, but this had no apparent influence on the results.

[ *To be continued in next week's issue* ]

## Error in Article on European Bridges

In the table accompanying Fig. 3 of the article "Railway Bridge Construction, etc.," *Engineering News-Record*, July 14, 1921, p. 58, the lateral vibrations for Engine No. 153 was given incorrectly as 11.5 mm. As the whole tenor of the article showed this figure is much too great. It should have been 1.5 mm.

# Three Concrete Road Construction Methods Compared

## Truck Breakdowns Excessive—High Labor Turnover—Central Plants Superior to Wheelbarrow Work

*[Side by side comparison of methods of concrete road construction is rarely possible. In the construction near Charles City, Iowa, described below, this opportunity existed. Co-ordinated by brief investigation by a member of this journal's editorial staff, statements of facts and conclusions furnished by E. B. Gordon, resident engineer and Thure W. Ingemanson, inspector, Iowa State Highway Commission, are herewith presented.]*

OPPORTUNITY to compare the wheelbarrow method, the central proportioning plant method and the central mixing plant method of concrete road construction was afforded last season in building 12 miles of road north and west from Charles City, Iowa. The sketch plan indicates some of the controlling conditions, which were substantially alike for all sections of the road. Two contracts, A and B, were awarded. Sections 4 and 6 of contract B were constructed by the wheelbarrow method, and sections 1, 2, 3 and 5 by truck haulage of dry batches from a central proportioning plant. All the sections of contract A were constructed by wet batch haulage from a central mixing plant.

### Statement of Operations

An 18-ft. pavement, 7 and 8 in. thick, was constructed, using a 1:2:3½ mix on contract B and a 1:2½:1 mix on contract A. On contract B, sections 1, 2 and 3 were concreted in order, using trucks to haul the dry batches to the mixer. With sections 1-3 completed, a wheelbarrow outfit was started on section 4 and the truck outfit on section 5, both outfits working east. When section 4 was completed, the wheelbarrow outfit was moved to section 6 and worked north and west to meet the paving on section 5. On contract A, the sections were concreted in the order numbered, section 10 being carried over to 1921.

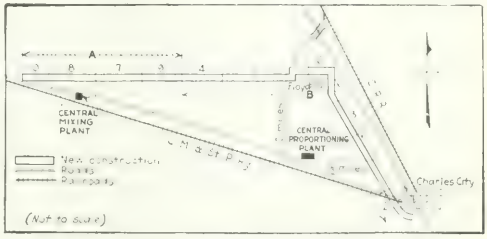
*Central Proportioning*—The central proportioning plant has the usual equipment of unloading derrick, overhead bins and cement warehouse. The derrick unloaded into the bins or into stockpiles. Rail deliveries were ample, no delay, practically, resulting from lack of stock at the proportioning plant.

Proportioned batches were hauled by one-ton trucks, with special dump bodies. Work was started with 15 trucks; later 20 trucks were used, and when the haul increased for section 5 west of Floyd, some two-batch, 2-ton trucks were added. These supplementary trucks were not added until the long 3¾-mile average haul was begun, and then the trucks were employed 70 per cent of the time hauling aggregate from the Floyd station to the wheelbarrow sections. All of the short haul work was done with the one-ton trucks.

For dry batch haulage and concreting, the organization consisted of: 5 men, with two teams, unloading aggregates; 2 men loading trucks; 5 men handling cement; 25 trucks; 3 men on the mixer; 6 men placing concrete for hand finishing; 1 man finishing; 1 water boy; 2 to 3 fine graders; 2 formsetters; 5 mechanics; 1 pumpman; 1 sprinkler man, and 2 men covering the slab. With this gang, including two foremen, of 64 men, the average output was 400 ft. in 12 hours.

*Wheelbarrow Work*—The organization for wheelbarrow construction consisted of: 5 men with two teams, unloading aggregates; 3 men handling cement; 3 trucks; 4 men, with two teams and two trucks, hauling cement; 2 men on the mixer; 16 wheelbarrow men: 6 men placing concrete for hand finishing; 1 man finishing; 1 water boy; 2 fine graders; 2 form-setters; 1 pumpman; 1 sprinkler man; 2 men covering and 1 foreman. The average output was 275 ft. per 11-hour day for this crew of 50 men.

Stockpiling for the wheelbarrow work began fully a month before concreting and continued until the last moment of the operations. In times of stress, the trucks hauling this aggregate, which were normally loaded by hand at the Floyd station, were manned by a night crew using the loading equipment at the central proportioning plant. The cement was sometimes unloaded directly from the cars into the trucks and sometimes it was handled through the central proportioning plant warehouse before being hauled to storage




SKETCH MAP OF CONCRETE ROAD

places along the road from which places it was hauled by team to the mixer.

*Central Mixing*—The central mixing plant consisted of the usual unloading derrick, overhead bins and mixer and cement warehouse. The operating organization was: 5 men unloading sand and gravel; 7 men handling cement; 11 trucks; 2 men, with one team and one tractor, hauling cement; 3 men on the mixer; 3 men placing concrete for machine finishing; 1 finisher; 1 water boy; 4 fine graders also covering the slab; 2 form-setters; 4 mechanics; 1 pumpman; 1 sprinkler-man; 5 men feeding conveyor and 2 foremen. The output, with 52 men, averaged 250 ft. per 10-hour day.

Shortage of aggregates was a constant trouble in the central mixing plant operation. Since it was realized at the beginning that the gravel supply would be inadequate the proportions of the concrete were changed to 1:2½:1, which approximated more nearly the available material. This change, however, did not make the supply adequate for continuous operation. It also contributed a delay in increased time required to discharge the mixer, because of the high proportion of sand—the time required was about 30 seconds longer than for a 1:2:3½ mixture.

Study of the three construction methods indicates the important considerations to have been: (1) Truck operation and mortality, (2) labor turnover, and (3) relative advantages of methods.

*Truck Mortality*—The ordinarily bad haulage conditions of unimproved country roads prevailed. Under these conditions the truck mortality was great. In dry

batch haulage with one-ton trucks, not more than 80 per cent of the fleet was ever in operation and at the end of the season, 80 per cent of the trucks were reduced practically to junk.

Observation indicated that the whole blame cannot be placed on the truck. For example, one truck on dry batch haulage was practically as good as new at the end of the season's work and it was in service practically 100 per cent of the working time. The explanation is that this truck was excellently operated and maintained. The driver was a young man from the contractor's home town, who was paid more than the other drivers and who not only gave his truck excellent care but took pride in its appearance. Had the remaining trucks been equally well manned it is the opinion that they would have endured the work equally well.

Despite, then, a truck mortality of 75 per cent in dry batch hauling, it is believed that one-ton trucks, with the reasonable care to which any car is entitled and especially on 1½- to 2½-mile hauls, are efficient equipment. On longer hauls of 2 to 4 miles the two-ton truck is no doubt cheaper; although it is slightly slower than the one-ton truck, this objection is overbalanced by the larger load and the greater durability of the heavier construction. Truck mortality, in any case, is largely a question of efficiency of drivers as indicated in the succeeding remarks on labor turnover.

### Use of Turntables

One factor which is not often considered in truck mortality is the practice of using or not using a turntable. Protection of the subgrade by using a turntable was only one of several benefits obtained. Saving in wear and tear on motors was an important gain. It was not uncommon, when the turntable was not used, to see drivers run their engines virtually red hot in struggling to make a turn on a soft or sandy subgrade. The engine depreciation due to many occurrences of this sort soon exceeded the cost of a turntable.

Besides the direct savings by using a turntable there was an evident gain in regularity of truck operations. Resident engineer E. B. Gordon states:

> Without a turntable I have seen as many as seven trucks trying to back and turn at the same time, often getting in each other's way, killing their engines, heating up their motors to the limit and generally demoralizing the drivers. With a turntable, the trucks drive up in an orderly procession, are turned around, back in and dump their loads and start back to the central plant without confusion.

It was a tiresome task for a driver to turn a heavy load on an 18-ft. subgrade, particularly if the footing was poor due to soft soil or sand. The difficulty and confusion reduced the morale of the drivers and the whole concreting crew. Two-ton trucks with pneumatic tires, because of their wider tread, did no more damage to subgrade than did the one-ton trucks. With solid tires the two-ton trucks were destructive.

*Labor Turnover*—Labor turnover furnished an interesting study. It was greatest on the wheelbarrow operations. In two months three entirely new crews were employed. A crew of Mexicans lasted about three weeks and was followed by a crew of negroes which lasted about two weeks. Finally a crew of white men was obtained, but had it not been for the fortunate closing of a local factory, it is doubtful if men could have been secured or the wheelbarrow sections completed in the allotted time. On the central proportioning plant the greatest turnover was of truck drivers. The central mixing plant drew its labor from the locality and had the smallest turnover as well as more efficient help.

### Quality of Labor

Observation of labor indicates the need of more careful attention to quality where machine operations are largely involved. The heavy turnover of truck drivers has been mentioned. As there was always a waiting list of local town boys wanting to drive trucks this rapid turnover did not on the face of things appear to be a serious factor. The waiting list, however, was made up of "kids looking for a soft job," and as stated by Mr. Gordon:

> Floaters do not make good caretakers of cars and on a truck outfit this is one of the most important factors to be considered, both from the standpoint of depreciation of machinery and as it affects the delivery of material. The trucks are the life of the job and they require constant conscientious care by their driver which cannot be expected from boys looking for an easy temporary job. Besides, drivers of this class waste time on the road. Labor is the most important factor in construction performed mostly by machinery. Machinery does the work in road construction with truck haulage from central plants, and requires competent help to keep it working efficiently. Many contractors overlook this fact and believe they are saving money by hiring boy operators at low wages, instead of making their machinery more efficient by hiring older skilled men at wages which will keep them in the work and interested in their machines.

On the dry batch haulage operations truck drivers were getting 40c. and 50c. an hour, or less than the Mexican wheelbarrow men, who were paid 60c. an hour. It is, therefore, small wonder that truck mortality was high. This high mortality resulted in delay at the mixer on the long haul which made at least 15 per cent of the placing outfit's time a total loss to the contractor.

On the wheelbarrow work, the high turnover was due not to low wages, but to unrest and independence. Labor was scarce and correspondingly careless about holding a job.

*Comparison of Methods*—Under the condition observed the yardages per man per hour were: Wheelbarrow, 1.11 sq.yd.; central proportioning, 1.10 sq.yd.; central mixing, 1.31 sq.yd. In comparing the organizations given, the difference between central proportioning and central mixing in number of men required is misleading, because the job using dry batch haulage had an adequate amount of material at all times and was able to work a large fleet of trucks, while the job using wet batch haulage was handicapped by a shortage of material throughout the entire season and could, therefore, not employ the maximum fleet of trucks inasmuch as the daily output was reduced about 50 per cent by lack of materials. Comparing the average daily output of the two outfits, Mr. Gordon states:

> I found that labor proved to be in the same proportion, making labor costs equal and leaving only a matter of personal opinion, between the two methods, as to which is the best to use under varying conditions. Personally, I can see no advantage, one over the other, in the matter of cost on a short-haul job, and on a long haul I think either method gets too expensive and the work should be classed as an industrial railroad job. With an average haul of 3¾ miles on Division B west of Floyd, the labor cost doubled over the labor cost where the average haul ran from 1½ to 2¼ miles as it did from Floyd to Charles City.

Assuming central proportioning and central mixing to be equal in cost of operation, both exhibited the following advantages over wheelbarrow work:

1. Reduced demurrage bills on account of being in a position to unload cars on to stockpile immediately

ter they have been spotted on side track. On wheel-rrow outfits, it is usually desirable to shovel directly m the car, with a result that, inclement weather, ddy roads, etc., tie up operations. Then, if unloaded to the ground, the material has to be handled twice expensive methods before it is even dumped on the grade since an outfit of this kind is seldom equipped th a crane

2. Reduction in waste of fine and coarse aggregate m approximately 10 per cent on wheelbarrow work about 1½ per cent on truck work. The latter per-tage was determined by actual observations on five erent concrete jobs last year, all within a radius of miles of Mason City.

3. A reduction in the number of ordinary laborers uired continuously on a wheelbarrow job, a problem thy of consideration of any country road work uiring any great number of men.

4. A reduction in the cost of handling all mate-s. For example, on a wheelbarrow job, all material handled; first, from the car into trucks or wagons hauled to the paving site to be dumped on the grade; second, it has to be handled again by shovel-into wheelbarrow, and in case of bad weather, uires either a third handling at the siding, or urrage bills, either of which are more or less ex-sive. These operations are ordinarily performed by d and are expensive. On the other hand, using the k outfit, material is handled twice also, but with hinery which greatly reduces the cost.

It is very difficult, in fact nearly impossible, to re a satisfactory subgrade where the aggregate lumped on the subgrade. Even though the sub-le has been prepared in first-class shape the trucks ling material to the job will cut up the grade more ess, and generally more, and after the material has distributed out ahead of the mixer, it is practically ossible to work a roller in ahead of the mixer to put grade in the shape it should be. Although trucks up the subgrade by the Central Plant method a r can still be worked to good advantage and a ly good sub-grade obtained even though it is not erfect of course as can be obtained by the indus-railroad method in conjunction with a subgrade hine.

---

### Slate Dust for Asphalt Mixtures

ne manufacture of filler for road asphalt mixtures promising field for slate waste utilization, accord-to the U. S. Bureau of Mines. At present from 80 5 per cent of the gross production of all slate quar-in the United States is discarded as waste. In the aration of asphaltic mixtures for surface roads, in tion to the sand and stone aggregates, finely pulver-limestone or portland cement is ordinarily used as ler. The City of New York alone requires about 00 tons of this filler material annually. An attempt been made by the Bureau to determine the adapt-ty of slate flour for such use. The results of its rimental work, while not yet conclusive, indicate the use of slate flour as a filler in asphalt road ace mixtures would result in improved highways that a wide use of such filler would afford a profit-outlet for waste slate, with consequent advantage ne slate producing industry. The cost of slate flour tle more than half that of portland cement.

## Draining Concrete Railroad Tunnels

SINCE concrete lining has been placed extensively in railroad tunnels of the west the question of how adequately to drain them has been receiving special attention. The old practice of leaving 2-in. pipe weep holes in the concrete has proved unsatisfactory. These small holes choke easily, and unless careful inspection is made regularly and a special tool is used—two requirements which it is desirable to avoid as far as possible—they cannot be depended upon to function. Cases are on record in which wall footing and invert 2 ft. in thickness were broken and distorted by hydrostatic pressure behind inadequately drained concrete lining.

A modern standard for tunnel weep holes, which has so far proved very satisfactory, has been adopted on the Pacific division of the Southern Pacific Railroad. These holes 6 x 8 in. in size are being made standard in all concrete tunnel lining. They are formed by boxes made up of 1-in. lumber, placed in the forms before pouring, and are spaced 10 ft. apart. The wood is intended only for service while the concrete is setting, and may be removed any time thereafter or left in place to decay. The holes are located just above the sill or on a level not lower than the top of the tie so that a tamping bar can can be readily thrust into the hole to clear out obstructions. For all but very short tunnels weep holes are always provided in concrete lining even though no water has appeared up to the time the lining is placed. The cost is so little and the insurance against dangerous pressure is great.

#### Effect of Tunnel Grades on Drainage

In long tunnels there are several other considerations involved in a satisfactory drainage system for getting water to the portals. The first of these is sufficient grade. Maintenance engineers oppose the construction of tunnels on less than 0.3 per cent grades, as anything less is likely to mean difficulty in maintaining drainage. The use of drain tile buried in the ballast either on center line or at the sides leaves a roadbed that can be finished off level, but there is danger that the tile will clog with mud and involve expensive maintenance if not still more serious objections.

The use of covered plank troughs along each wall with frequent openings in the sides has been fairly satisfactory. The cover can be removed and the trough cleared out with a square-nosed shovel. They are unsatisfactory insofar as they are sure to collapse in time due to the decay of the wood, an event greatly hastened by the conditions ordinarily obtaining in a tunnel drain. A better design comprises a concrete curb at least 10 in. from the wall, provided with openings through which water can escape from the ballast. If such a curb is provided with a shoulder, and a projection or ledge is cast at the same level along the wall, a cover plank can be placed over the drain to protect it from débris and to serve as a walk. Such a plank is permissible as a part of permanent construction because it is not in contact with water or moist earth and can be easily removed by hand for inspecting or cleaning the trough.

Whatever detail of arrangement is adopted, there are two requirements that will always be met in good practice, (1) a design such that inspection and cleaning can be made easily with tools which track men ordinarily carry and (2) the elimination of wood or other material subject to rapid decay except in very favorable conditions or on temporary construction.

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## Copyright Dates in Book Catalogs Urged

Sir—Catalogs of most of the book publishing concerns do not give the date of the copyright of their books. It is a great inconvenience to send off for a book which should be of recent date to find that it is ten or fifteen years behind the times. It simply means the return of the book and dissatisfaction. I suggest, as an improvement over the present practice, that publishers give copyright dates in their catalogs.

University of Idaho, T. C. MEAD,
Moscow, Idaho. Associate Professor of Agricultural Engineering.

## Goldman's "Financial Engineering"

Sir—My attention has only recently been called to the review of my book, "Financial Engineering," in your issue of Jan. 20, p. 127. The review shows careful study and is very good.

On p. 20 of "Financial Engineering" I specifically caution the reader on the matter of wear in these words: "The reader is cautioned not to confuse depreciation with wear as is often done in practice." This is followed by detailed discussion on this point. In spite of this, so strong is custom, that your reviewer falls into that very error, maintaining that wear should be charged as depreciation; that is as a fixed charge, which would imply that wear continues whether the equipment "is in use or idle." This is absurd. His excuse for not charging major repair items as an operating cost is that "this would distort the annual expenses of certain years . . ." This is unnecessary since a sinking fund can be provided for wear just as well as for depreciation or any other long-interval expense, if the operating life and the amount of use are known at least approximately. True, I employ a life table in which wear is a factor. No other data are available. The distinction between the operating and natural life has never before been made. But that does not alter the fact that wear does not occur when the unit is idle, and any analysis based on the opposite assumption will inevitably lead to error.

So also your reviewer takes exception to my considering depreciation as a trust fund. I do not know and do not care what economists think about this. "Eminent jurists" do not hold otherwise. They hold that the duty of a public utility is to render fully and adequately, the service that they undertake or contract for. And this can only be done if worn-out and depreciated equipment is continually replaced. If this fund is pocketed, how is depreciated equipment to be replaced? It would be only another way, and a very poor way, of going out of business. The position that such equipment could be bought and charged to capital invested would be utterly untenable. And what holds true for public utilities, holds equally for private business. The truth can only be arrived at by a correct analysis.

I do not understand your reviewer when he says that "the early part of the book is disconcerting because of a few radical dicta," as for example when "he avers that 'even the most elementary study shows there is no suc law' " as the so-called law of supply and demand. Wh "disconcerting"? Why "radical dicta"? Does he impl that my statement is incorrect? If so I shall gladl meet his challenge. Or is it "disconcerting" merel because it is different from what we have incautiousl been swallowing? O. B. GOLDMAN.

Portland, Ore., May 11.

[The reviewer's reply to the foregoing letter follow —EDITOR.]

Sir—Among the specific points that Professor Gol man brings up, one real question is whether or not h dogma on depreciation are preferable to the prese accepted composite ideas which are the growth of ma years of engineering, economic and legal thought. The have been so many attempts to hitch radically differe definitions to the innocent word "depreciation" th confusion has been confounded. To add another de nition and to build a book or a school of thought abo it now, would be a misdemeanor properly punishable l sentence of forced listening to the whole ensuing di cussions.

Professor Goldman makes depreciation result on from obsolescence, inadequacy and idleness, and he ir agines a "natural life" terminated by these effects on —as contrasted with an "operating life" which may l ended by one or all of obsolescence, inadequacy, superce sion, lack of requirement, or irreparable wear and tea Such a distinction appeals to me as too artificial a academic, for little equipment is allowed to lie around desuetude. It gives inadequate results to base the annu depreciation allowance, which is practical, specific, co matter-of-fact money, on such an unnatural idle li when the money needed depends on a life determined final inability to make good by repairs the effects of a tivity. All this Professor Goldman really admits wh he says that he uses life tables based on wear and te for "no other data are available"—and never will from the very nature of the actions involved.

The author in his letter insists that the annual dep ciation allowances are to be gathered into a trust fu created to buy new equipment with. In the first pl with growths of business and development of the ar the trust will be insufficient and an investment will s be needed. The next inevitable step from the trust id is to make the annual depreciation allowance depend not what the items of property actually cost but on wh will be the cost of the future substitute.

I believe that it is clearer, more logical, more e nomical as to production cost, conducive to better m agement and in harmony with the principles of United States Supreme Court decisions and the seve state accounting codes, to regard the depreciation all ance as the concurrent payment of a loss of inve capital. Once the repayment is made the investors d do with it as they please. So long as they are in public utility business they must maintain service a they will be ready to replace old antiquated appara with the latest designs if they have had their inv

ıent returned to them. They do not need it tied up in low-interest bearing fund when it could be employed ı better paying extensions.

Such debatable assertions are the "disconcerting dicta" f Professor Goldman's book and of his letter. They re disconcerting because here and there theory is eveloped that must needs be discounted, because the ıexperienced reader knows not how far such matters ıay permeate the rest of the book, because they etcken a Quixotic attitude that will not even recognize efinite economic accomplishments.

It must be remembered, finally, that all these things ere discussed are of no very great importance in view the general excellence and utility of the book itself.

Montclair, N. J., July 2. HARRY BARKER.

## Monumental Work on Municipal Refuse

LLECTION AND DISPOSAL OF MUNICIPAL REFUSE—By Rudolph Hering, D.Sc., New York City; Past President of American Public Health Association and of Engineers Club of Philadelphia; Past Vice-President Am. Soc. C. E.; M.A.S.M.E., etc., and Samuel A. Greeley, Chicago, Ill., M. of American Public Health Association, M. Am. Soc. C. E., Western Society of Civil Engineers, M.A.A.E., etc. New York and London: McGraw-Hill Book Co., Inc. Paper; 6 x 9 in.; pp. 653; illustrated. $7.

Monumental is a fitting word to characterize this ıatise on municipal refuse. Aside from the merits the book as a contribution to engineering literature, e volume is notable because it fittingly marks and owns Mr. Hering's long years of investigation and ıctice in the important field of municipal refuse posal. Mr. Hering was not only an American pioneer this field but for many years he stood almost alone, rticularly in presenting first-hand information on rent British and European methods of garbage posal. By putting the ripe fruits of his years of dy into his book he deserves both commendation from gineers and emulation on the part of those rich in erience in other fields. Having said this much of senior author it is only fitting to add that Mr. eley is one of the few younger engineers who have cialized in garbage disposal; that he made a tour investigation with Mr. Hering in Europe some years ; that subsequently he was engaged on the construcı of the large incinerator at Milwaukee, and still r was in charge of the operation of the incinerator well as of the collection and disposal of municipal use in that city. This combination of effort has duced a book rich in observation and experience in of the most important fields of municipal sanitaı. Coming from such authors at a time when muniıl refuse collection and disposal is in a very unled transition stage and when the earlier books on subject are by no means up-to-date "The Collection l Disposal of Municipal Refuse" is most welcome.

ıfter a general survey of the field—which, like other ts of the work, includes Europe as well as the United tes and Canada—there appear, in logical order, pters on house treatment, collection, supplemental nsportation, cost estimating for the latter, and a nber of chapters on the various means of disposal. chapters on disposal include depositing refuse in er and on land, feeding to hogs, sorting rubbish, ineration, and reduction. At this point the authors sent chapters on estimating costs and on selecting method of disposal. There follow chapters on stable bish, street refuse, night soil and dead animals. The l chapter is a general review of "Procedure in Small wns and Villages." It will be seen that all municipal wastes except sewage are discussed, beginning with the point of origin (house treatment) and continuing with collection, supplemental transportation and final disposal. A good balance seems to be maintained, but perhaps some readers would expect more than is given on sweeping streets.

Notable features of the book are its abundance of statistical data, its chapter summaries and conclusions, its outlines for drawing specifications and last to be mentioned but not least in importance, the judicial attitude of the authors in presenting the claims of the various methods available for accomplishing the same end. As to the statistical data, the authors seem to have presented too much rather than too little, although apparently they have done much sifting. The impression that there is more tabular matter than will prove to be useful is perhaps heightened by the fact that a considerable part of it is rather old. This is due in part to the long time that the book has been under way. It might be urged that war and post-war conditions make many of the older figures equally if not more valuable than later figures would be. In so comprehensive a book as this one it is almost impossible to give thoroughly up-to-date figures. It is unlikely that anyone will be misled by the figures for the earlier years. The question rather is, are all the old figures of sufficient value to justify the extra bulk and cost that they cause? The tables should not be dismissed without commendation for their excellent form—praise that should also be extended to what may be termed the entire range of editorial work on the book, credit for which and for the index the authors heartily give to T. J. McMinn.

Finally, the book deserves a place with the best that are available on other brances of municipal engineering and sanitation. It will do much to place refuse collection and disposal on a sound engineering basis.

## Irrigation Terminology

GLOSSARY OF TERMS IN USE ON PUNJAB CANALS. Prepared by H. W. Nicholson, B. Sc., Executive Engineer, Punjab Irrigation Branch. Simla, India: Government Press. Paper; 8 x 13 in.; pp. 15; 2 folding plates.

In an introduction to this glossary T. R. J. Ward, inspector-general of irrigation in India (Delhi), writes forcibly regarding the importance of preciseness of definition in any work of a scientific character, and expresses the hope that irrigation engineers will unite for a common terminology on (1) individual canals, (2) within each province, and (3) throughout India.

Considered as an exhibit of "terms in use" in one district, and as making for uniformity within that district, Mr. Nicholson's "Glossary" is commendable. But even for use within a single district it would seem to be less arbitrary in some of the terms, while as a move towards a common terminology for India and Burma a more rational choice of terms seems necessary. Some elaboration of this criticism may not be unwelcome as a possible contribution toward a world-wide engineering terminology. Our remarks will be confined to the terms "average supply" and "mean supply," wherein two synonymous words, as both the context and common usage show, are employed arbitrarily to designate two different things. "Average supply," according to Mr. Nicholson, "is the sum of the daily discharges of the channel divided by the number of days the canal is open at its head," while

"mean supply" has exactly the same base "divided by the number of days in the crop." In other words, according to the "glossary" itself, "average supply" is "a measure of the rate of flow" and "mean supply" is "a measure of the water used." Why, then, not be specific and avoid confusion by using the terms "average supply" and "average use"?

## Metallic Engineering Material

REVIEWED BY E. E. THUM
Associate Editor, *Chemical and Metallurgical Engineering*, New York City

THE CASE-HARDENING OF STEEL: An Illustrated Exposition of the Changes in Structure and Properties Induced in Steels by Cementation and Allied Processes—By Harry Brearley. Second Edition. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. 207; illustrated. $6.

FESTIGKEITSEIGENSCHAFTEN UND GEFUGEBILDER DER KONSTRUKTIONSMATERIALIEN—Von Dr.-Ing. C. Bach und R. Baumann, Professoren an der Technischen Hochschule Stuttgart. Zweite, Stark Vermehrte Auflage. Berlin, Germany: Verlag von Julius Springer. Cloth; 8x10 in.; pp. 191; illustrated.

Mr. Brearley, who is Works Manager of Brown-Bailey's, Ltd., an important steel company of Sheffield, England, writes a very informing book about the principles and practices of case-hardening. That operation, as is doubtless well known, consists of taking steel pieces which are low in carbon, soft and tough, and carbonizing the surface to a depth of perhaps $\frac{1}{8}$ in., whereby this "case" may be made glass hard. Pieces such as axles or armor plate which must be hard to resist wear or penetration and tough to resist impact are treated in this manner. Other parts, like ball races, which must be machined all over, can be cut from soft stock and later converted to a hard object incapable of being machined.

Case-hardening, as an art, rests on hoary tradition. Steel made in ancient times, and even today the steel produced by half-civilized tribes, comes in a rather haphazard way direct from the iron ore. The old smith desired to convert his ore into tough iron, and only when an excess of carbon entered his hot, spongy metal did it become steel—sometimes what we now know as pig iron was made inadvertently.

The first "indirect" process of making steel was invented about 1600. It made steel deliberately, and not by chance. It consisted of heating iron in close contact with charcoal, whereby the iron bar became a steel bar. This process is still commonly used by Sheffield iron masters for their finest cutlery, and is the direct ancestor of case-hardening practices.

Thus it is that the art described by Mr. Brearley is very largely controlled by rule of thumb; it is the fertile field for quacks and patent medicine vendors, and the hardeners themselves are men who are doing what their fathers told them was the right way to do—it was right because his father in turn told him it had always been done so. To reach these men and discuss their problems in a way which would be intelligible requires a clear style and an orderly development of the subject. But to get far along on this course it is necessary to introduce advanced metallurgy, for it has been only recently that the most searching investigations have shed light on the points in question.

Consequently the book in itself comprises an excellent introduction to the principles of physical metallurgy as applied to iron and steel, and, quite apart from its value as a text on case-hardening, could well be read by any engineer desirous of knowing something of the tremendous advances in machine design made possible by the discriminating use of heat-treated and alloy steels.

The rather unique German book noted above is an illustrated encyclopædia covering the strength of the metallic materials of construction. It presents graphs showing the relations between deformation and loading for a certain steel, for instance. Illustrations are printed alongside showing the typical test bar, the surface of fracture, and the normal microstructure. Many pictures are given of faulty structures and the nature of the breaks, both as seen by the eye and under the microscope. Carbon steels, plain and annealed, special alloy steels, cast iron and steel, malleable iron, brass, bronze, and the principal nonferrous metals are covered in this manner in 950 illustrations. Apparently most of the material is original with the authors. Typographically the book is excellent, the micrographs being particularly well printed It would be a good reference book for any contro or testing laboratory working with metals.

## For Students of Highway Engineering

REVIEWED BY CHARLES J. BENNETT
State Highway Commission, Hartford, Conn.

HIGHWAY ENGINEERING: Rural Roads and Pavements—By George R. Chatburn, A.M., C.E., Professor of Applied Mechanic and Machine Design and Lecturer on Highway Engineering the University of Nebraska, Lincoln. New York: John Wile & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in. pp. 379; illustrated. $3. 18s. net.

The author defines his work as a textbook suitabl for the layman and for particular use by agricultura students. If the purpose of the work is to discourag the layman from becoming a highway expert, the re sult should be easily achieved since the book abound in discussions of formulas which would be unintel ligible to the ordinary layman.

From the standpoint of the reviewer, the book is good text for students in highway engineering, bu should be studied with the understanding that man of the details in any work of this character are ope to discussion as, for instance, on p. 194 the state ment is made that in the construction of broken ston roads, the large stone should be at the bottom. Ther are many cases of successful construction where th rule has been reversed. The student of any enginee ing work, and particularly a work on highways, shoul not confine his study entirely to one book.

The author shows a broad knowledge of engineerin literature. Information is collected from countle sources, to which due credit is given. In some i stances, costs of doing certain classes of work a quoted. These costs are unreliable, as are any cos quoted in a book unless all the conditions under whi the work was carried on are stated.

In the discussion of sand-clay roads on p. 154, mo attention should be given to the proper clay for bin ing purposes. Bituminous concrete base is dismiss in three lines, while paving brick manufacture is giv careful attention. In other words, as the author tru says, the literature on highway engineering is bei written so fast that it is impossible for any stude thoroughly to surround the entire subject, or for a author to write in one volume all of the details highway and pavement construction.

The author's long and careful discussion of concrete d specifications and the selection of materials is of eat value as a collection of information on this very portant division of highway engineering. The par-aph on costs (p. 285) is subject to the criticism costs already made, as well as to the objection that ts have risen to such an extent that the estimates ed on costs of 1915 would be of little value today. sections on proportioning concrete, including the of the maximum density curve, promise to be ful.

he book is well arranged and is a valuable addi- to highway engineering literature, particularly in v of the fact that it should convince the layman the planning and construction of highways is ely an engineering problem not to be solved by the nary man in the street. Professor Chatburn is to ongratulated on the clearness of his English and shortness and directness of his sentences.

## aber's Reinforced-Concrete Design—II

NFORCED CONCRETE DESIGN: Vol. II. Practice—By ar Faber, O.B.E., D.Sc., A.M. Inst. C.E., A.C.G.I., etc, Con-ting Engineer, Chief Engineer to Trollope and Colls, Lon-n, etc. New York: Longmans, Green & Co. London: Ed-rd Arnold. Cloth; 6 x 9 in.; pp. 246; illustrated. $6.50.

o American author is going into the theory of forced-concrete design in the elaborate fashion as r. Faber. His first volume has already been referred n these pages. This second one is a continuance ual merit, particularly for those who are anxious to the full mathematical treatment of the more com-ted actions in reinforced-concrete frames. The statement of the conditions of bending moments in nuous beams and the moments in columns take up irst half of the book. The second half is devoted me specimen calculations, live-load allowances for g loads, and shear resistance in reinforced-con-beams. Extensive appendices have a number of ams for the design of concrete beams, formulas iagrams for bending moments in continuous beams, the verbatim reproduction of the London County cil regulations for reinforced concrete. In Mr. r's first volume there are many things which every ten appear or attempt to appear as new facts in nt literature. The same is true of this second ne. Many of the amateurs in reinforced-concrete n would do well to go over both books before they e too much time in their own mathematical calcula-

## For the Concrete User

RETE: Its Manufacture and Use—Milwaukee, Wis.: hring Co. Board Cover; 4 x 7 in.; pp. 207; illustrated.

e Koehring Co. realizes that the better concrete of its machinery produce, the more of its machin-t will be apt to sell. It has, therefore, gotten out ook noted above to instruct the prospective users chinery not so much in the use of that machinery the details of the equipment, as in the proper od of making concrete. The result is an admirable handbook for the concrete user. The amount of material in it is disappointingly small, though there me good new tables on quantities for given lengths ad pavements, etc., and a very good check list for ng trouble in machinery breakdowns. The main of the book, on methods of making concrete, how-is the standard information available to the expert ncrete construction. Inasmuch as the book prob-ably will not have as great circulation among the experts as it will among the inexperts in concrete work, the clear statement of these well known facts and the consecutive placing of information are unquestionably worth while.

## Travel Sketches of a Mining Engineer

THIS WORLD OF OURS—By J. H. Curle, Author of "The Shadow Show," Etc., New York: George H. Doran Co. Cloth; 6 x 9 in.; pp. 313. $2.50 net.

World travel seems to be the ruling passion of this mining engineer who, "on the right side of forty, and with an assured income, decided to continue seeing the world, as he had been doing since he was a lad, but unhampered by professional duties thenceforth. His book brings together by countries, or larger regions and general routes, many and various travel sketches, telling where he went, what he saw and what he thought or fancied (then or in remembrance) in all parts of the world. Dates are rarely given and the observations of many trips to the same parts are sometimes combined. Only a few short and sketchy chapters are given to the author's youth, university life and mining experiences, and most of even this part of the book consists of travel notes. The volume is entertaining, to some extent instructive and often thought provoking. Most people would find it better to read by occasional snatches than consecutively. That a book containing sketches of so many places and peoples, thumb nail sketches though most of them are, should have no index is a sin of omission for which both author and publisher deserve punishment.

## Catalogue of Rare Scientific Books

BIBLIOTHECA CHEMICO-MATHEMATICA: Vol. I and II; Catalog of Works in Many Tongues on Exact and Applied Science, with a Subject-Index—Compiled and Annotated by H. Z. [Heinrich Zeitlinger] and H. C. S. [Henry Cecil Sothern] London: Henry Sotheran & Co. Red Buckram; 6 x 9 in.; pp. 964; illustrated. £3 3s. net.

A wide range of books on chemistry, physics, mathematics and various branches of engineering is included in this handsomely made priced catalog. Many of the volumes are old and rare. The illustrations reproduced are of great interest. A comprehensive index adds greatly to the value of the work—begun in 1906 but continued in the form of a supplement. The volume will be of great interest and value to those whose interest in book collecting or bibliography extends into the field of science.

## A New Engineering Journal

"Management Engineering, the Journal of Production," (Roland Press, New York City; $5 a year) is a new monthly edited by L. P. Alford, lately editor of the *American Machinist* and then of *Industrial Management*. E. W. Tree is associate editor and there is an editorial council of 24 prominent engineers and manufacturers. Among the many contributed articles in the first issue are: "The Pioneer Spirit in Engineering," by E. S. Carman; "Basic Principles of Cost Production," by Sanford E. Thompson; "Education for Proprietorship," by Arthur E. Morgan; and "Classifying and Indexing the Clipping File," by Harrison W. Craver. The latter describes the system used under his direction by the Engineering Societies Library. This system has been adopted by the new journal for indexing its contents and the proper index number appears at the head of each article.

# PUBLICATIONS RECEIVED

AMERICAN ROAD BUILDERS' ASSOCIATION: Proceedings, 1920—New York: The Association. Paper; 6 x 9 in.; pp. [illegible]

CALIFORNIA DEPARTMENT OF ENGINEERING: Report, 1919-20. W. F. McClure, State Engineer. Sacramento, Cal.: The Department. Paper; 6 x 9 in.; pp. 106; illustrated.

CHICAGO MUNICIPAL REDUCTION PLANT: Operation, Maintenance and Construction; Report of the Subcommittee on Waste Disposal of the Committee on Efficiency, Economy and Rehabilitation of the City Council of the City of Chicago; Together with a Report of Irwin S. Osborn, Consulting Engineer. Chicago, Ill.: City Council. Paper; 9 x 12 in.; pp. 16; illustrated.

A note based on this report appeared in *Engineering News-Record*, May 19, 1921, p. 856.

CONCRETE DESIGNERS' MANUAL: Tables and Diagrams for the Design of Reinforced Concrete Structures—By George A. Hool, S. B., Consulting Engineer, Professor of Structural Engineering, The University of Wisconsin and Charles S. Whitney, M.C.E., Structural Engineer, Milwaukee, Wis. New York and London: McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in.; pp. 276; illustrated. $4.

DIE AUSNUTZUNG DER WASSERKRAFTE: Technische Und Wirtschaftliche Grundlagen Neuere Bestrebungen Der Kulturländer—Von E. Mattern, Regierungs—Und Baurat in Potsdam Privatdozent An Der Technischen Hochschule Zu Berlin. Dritte Auflage. Leipzig, Germany: Verlag Von Wilhelm Engelmann. Cloth; 8 x 11 in.; pp. 1029; illustrated. Paper; 192 m.; Cloth; 212 m.

Earlier editions of this work on Water Power Development were noted in *Engineering News*, Nov. 15, 1906, p. 524 and Feb. 18, 1909 (p. 18 of Engineering Literature Supplement.) Since the first edition the book has nearly quadrupled in size. The progress of the art in other countries than Germany is noticed. Apparently the world literature of the subject up to 1921 has been searched.

ECONOMICS OF BRIDGEWORK: A Sequel to Bridge Engineering—By J. A. L. Waddell, C.E. (Rens. Poly. Inst.); B.A. Sc., Ma.E., D.Sc. (McGill Univ.); D.E. (Univ. of Neb.); LL.D. (Univ. of Mo.); Kogakuhukushi (Doctor of Eng., Imp. Univ. of Japan.) New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 512; illustrated. $6. 30s. net.

EDUCATIONAL WORK OF THE COMMERCIAL MUSEUM OF PHILADELPHIA—By Charles R. Toothaker, Curator. Washington, D. C.: Dept. of the Interior. Paper; 6 x 9 in. pp. 28; illustrated. 15c. from Superintendent of Documents.

EIN JAHRHUNDERT DEUTSCHER MASCHINENBAU: Von Der Mechanischen Werkstätte Bis Zur Deutschen Maschinenfabrik, 1819-1919—Von Conrad Matschoss. Berlin, Germany: Julius Springer. Cloth; 9 x 12 in.; pp. 271; illustrated.

ELEMENTS OF MAP PROJECTION: With Applications to Map and Chart Construction—By Charles H. Deetz, Cartographer and Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Paper; 8 x 11 in.; pp. 163; illustrated. 50c. from Superintendent of Documents.

FINANCING AN ENTERPRISE: A Manual of Information and Suggestion—By Hugh R. Conyngton, Chairman of the Board, The Ronald Press Co. In Three Vols. Vol. I: The Enterprise, pp. 227; Vol. II: The Organization, pp. 203; Vol. III: The Financing, pp. 230. New York: Ronald Press Co. Cloth; 6 x 9 in. $7.

First published in 1907 under the nom de plume, Francis Cooper. A wide range of pertinent topics is discussed.

THE FUNCTIONS OF THE ENGINEERING EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS: By Charles Ross Richards. Urbana, Ill.: Engineering Experiment Station, University of Illinois. Paper; 6 x 9 in.; pp. 21.

FURTHER OBSERVATIONS ON THE EOSINMETHYLENE BLUE AGAR: By Alva Leslie Reginald. Reprinted from Journal of the American Water Works Association, March, 1921. Ames, Iowa: Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Paper; 6 x 9 in.; pp. 5.

HANDBOOK OF CONSTRUCTION EQUIPMENT: Its Cost and Use—By Richard T. Dana, Consulting Engineer, M. Am. Soc. C. E., Mem. A.I.M. & M.E., etc. New York and London: McGraw-Hill Book Co., Inc. Flexible; 4 x 7 in.; pp. 849; illustrated. $6.

A revised and enlarged edition of "Handbook of Construction Plant," noticed in *Engineering News*, Dec. 24, 1914. Prices as of 1920 are given.

HANDBOOK OF STANDARD DETAILS: For Engineers, Draftsmen and Students—By Charles H. Hughes, Author of "Handbook of Sliding Calculations, Construction and Operation." New York and London: D. Appleton & Co. Leatherette; 5 x 7 in.; pp. 312; illustrated. $6.

Has sections on drawings, fastenings, power transmission, pipe, tubes and fittings, rope and chain fittings, miscellaneous details, structural details, useful tables.

THE HARDINGE BRIDGE OVER THE LOWER GANGES AT SARA—By A. Robert Cooke, C.B.E., M. Inst. C. E., with Supplementary Notes on the Original Project by Sir Francis J. Spring, K.C.I.E., M.A.I., M. Inst. C. E. Simla, India: Office of the Chief Engineer with the Railway Board. Paper; 8 x 13 in.; pp. 178, illustrated. 2 folders.

Reprint, with additions, of a report from Inst. C. E., Nov., 1917, describing the construction of a bridge of 15 girder spans of about 345 ft. each and three land spans of 75 ft. each end, carrying a double track railway and a footway. The additional matter includes the original report and estimate made by Sir Francis J. [illegible] Spring, in 1903; 51 p. extract from an inspection report on the bridge made in Feb. 1915, prior to its being opened for traffic

I-EISEN UNITE RESONDERER BERUCKS ICHTIGUNG DE[illegible] EBREITFLANSCHIGEN I DER PARALLELFLANSCHIGE[illegible] I EISEN. Von Dr.-Ing. Richard Sonntag, [illegible] a. D., Beratender Ingenieur; V. B. I. in Berlin-Friedrichshagen Berlin, Germany: Verlag des Vereines Deutscher Ingenieure Paper; 7 x 10 in.; pp. 138; illustrated. 30 m.

AN INTRODUCTION TO MATHEMATICAL ANALYSIS—B[illegible] Frank Loxley Griffin, Ph.D., Professor of Mathematics, Ree[illegible] College, Portland, Ore. Boston New York and Chicago: Hough[illegible] ton Mifflin Co. Cloth; 5 x 8 in.; pp. 512; illustrated. $2.75.

THE JERSEY CITY DEVELOPMENT PLAN: Report of th[illegible] Board of Engineers. (Martin Schreiber, Chairman Enginee[illegible] Waterfront Committee, Chamber of Commerce; Philip Guis[illegible] M. Am. Soc. C. E., Secretary)—Jersey City, N. J.: The Boar[illegible] Paper; 9 x 12 in.; pp. 92; illustrated.

Prepared by a board of engineers appointed by the City Com[illegible] mission. Contains recommendations on harbor improvement[illegible] steam railroads, streets, housing and zoning, parks, garbage an[illegible] ashes collection and disposal and local transportation.

JUDGING THE QUALITY OF PORTLAND CEMENT—By Ro[illegible] J. Colony of the Department of Geology, Columbia Universit[illegible] New York: The Author. Paper; 6 x 9 in.; pp. 10; illustrate[illegible]

THE LUMBER INSPECTION RULES: Containing Rules Go[illegible] erning the Manufacture and Inspection of the Different Kin[illegible] of Lumber, Weights of Lumber, Comparative Strength of Bull[illegible] ing Timbers and other Information Useful to the Buyer a[illegible] Consumer of Lumber—Compiled by Lumber Inspection Rule[illegible] Fourth Edition. New York: Lumber Inspection Rules, 2[illegible] West 42d St. Flexible; 5 x 6 in.; pp. 341; illustrated. $3.

MODERN METHODS FOR MEASURING THE INTENSITY O[illegible] GRAVITY—By Clarence H. Swick, Geodetic Computer, U.[illegible] Coast and Geodetic Survey. Washington, D. C.: The Surve[illegible] Paper; 6 x 9 in.; pp. 96; illustrated. 15c. from Superintende[illegible] of Documents.

MOTOR TRUCK LOGGING METHODS—By Frederick Malco[illegible] Knapp, Student in the College of Forestry, University of Was[illegible] ington. Seattle, Wash.: Engineering Experiment Station, U[illegible] versity of Washington. Paper; 6 x 9 in.; pp. 49; illustrated.

NATIONAL ELECTRICAL SAFETY CODE: Discussion, O[illegible] 1921—Washington, D. C.: Bureau of Standards. Paper; 5 x [illegible] in.; pp. 330; illustrated. (Cloth Bound) 40c. from Superinter[illegible] ent of Documents.

ROADWAY AND TRACK—By W. F. Rench, Author of "Simp[illegible] fied Curve and Switch Work." Formerly Supervisor on Per[illegible] sylvania Railroad. New York: Simmons-Boardman Publi[illegible] ing Co. Cloth; 6 x 9 in.; pp. 242; illustrated. $3.

PERSPECTIVE: The Old and the New Method—By Archib[illegible] Stanley Percival, M.A., M. B., C. Cantab, Author of "Ge[illegible] metrical Optics," "Practical Integration," etc. New York a[illegible] London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 42; Illu[illegible] trated. $1.60.

THE PORT OF SHANGHAI: Shanghai Harbour Investigati[illegible] Second Edition—Shanghai, China: Whangpoo Conserva[illegible] Board. Paper; 8 x 11 in.; pp. 54; illustrated.

PREUSSENS GEWERBEFORDERUNG UND IHRE GROSS[illegible] MANNER. Dargestellt Im Rahmen Der Geschichte des V[illegible] lins Zur Beförderung Des Gewerbfleisses 1821-1921—Von C[illegible] rad Matschoss. Berlin, Germany: Verlag Des Vereines De[illegible] scher Ingenieure. Paper; 8 x 11 in.; pp. 165; illustra[illegible] 150 m.

SANITARY ENTOMOLOGY: The Entomology of Disease, I[illegible] giene and Sanitation—Edited by William Dwight Pierce, Ph[illegible] Consulting Entomologist, Formerly Entomologist Southern F[illegible] Cross Fence Investigations U. S. Department of Agricult[illegible] Bureau of Entology. Boston, Mass.: Richard G. Bad[illegible] Cloth; 7 x 10 in.; pp. 518; illustrated. $10.

SHANGHAI MUNICIPAL COUNCIL: Report, 1920, Pu[illegible] Works Department C. H. Godfrey, M. Inst C. E., Comm[illegible] sioner of Public Works. Shanghai, China: Public Works D[illegible] Paper; 8 x 13 in.; pp. 20; illustrated.

SOME CONDITIONS AFFECTING THE USEFULNESS OF IR[illegible] OXIDE FOR CITY GAS PURIFICATION: By Wm. A. D[illegible] ley, Illinois Coal Mining Investigations Co-operative Agreem[illegible] (This Report was Prepared Under a Co-operative Agreem[illegible] Between the Engineering Experiment Station of the Univer[illegible] of Illinois, The Illinois State Geological Survey, and the U[illegible] Bureau of Mines.) Urbana, Ill.: Engineering Experiment [illegible] tion, University of Illinois. Paper: 6 x 9 in.; pp. 52; Il[illegible] trated.

STATISTICAL ABSTRACT OF THE UNITED STATES, 19[illegible] Washington, D. C.: Bureau of Foreign and Domestic C[illegible] merce. Cloth; 6 x 9 in.; pp. 874. (Paper Covers) 50c. f[illegible] Superintendent of Documents.

THE STABILITY OF HILL SLOPES—By C. S. Fox, I[illegible] (Birm.), M.I.M.E., F.G.S., Officiating Superintendent, Geolo[illegible] Survey of India; with a Prefatory Note by Major E. P. A[illegible] son, D.S.O., R.E., Engineer-in-Chief, Hardwar-Karanpr[illegible] Survey. Simla, India: Office of the Chief Engineer with Railway Board. Paper; 8 x 13 in.; pp. 6; illustrated Annas.

TIMBER DEPLETION AND THE ANSWER: A Summar[illegible] the Report on Timber Depletion and Related Subjects [illegible] pared in Response to Senate Resolution 311. Contribution f[illegible] the Forest Service, William B. Greeley, Forester. Washing[illegible] D. C.: U. S. Department of Agriculture. Paper; 6 x 9 [illegible] pp. 16. 5c. from Superintendent of Documents.

WAR WORK OF THE BUREAU OF STANDARDS, APRIL[illegible] Washington, D. C.: Bureau of Standards. Paper; 6 x 9 [illegible] pp. 299; illustrated. 70c. from Superintendent of Documen[illegible]

ZEITSCHRIFT FUR ANGEWANDTE MATHEMATIK[illegible] MECHANIK Herausgegeben Von Professor R. Von [illegible] Band I, Heft 1. Berlin, Germany: Verlag Des Vereines [illegible] scher Ingenieure. Paper; 8 x 11 in.; pp. 160; illustrated

ZEITSCHRIFT FUR METALLKUNDE: Herausgegeben [illegible] Der Deutschen Gesellschaft Für Metallkunde Im Verein [illegible] scher Ingenieur Schriftleitung—Professor Dr. W. Guertler Dipl.-Ing. H. Groock. Berlin, Germany: Verlag Des Ver[illegible] Deutscher Ingenieur. Paper; 8 x 11 in.; pp. 10, illustrated

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## Shearing Stresses in Timber Trestle Stringers

ir—Subcommittee 2 of the Committee on Wooden dges and Trestles of the American Railway Engineering ociation has before it the subject of plans for trestles e submitted to the next convention for approval. One the subjects over which there appears to be a wide erence of opinion is the stress to be permitted in longi- nal shear. The stresses under this head adopted by last convention are 125 lb. per sq.in. for dense pine 100 lb. per sq.in. for Douglas fir. In practice the dif- nt railroads permit as high as 220 lb. per sq.in. in de- for dense pine, with no allowance for impact.

his wide disparity between theory and practice is ex- ned by some as due to the way longitudinal shear is puted. It is claimed that the usual method is to apply load at the same point as when computing vertical r, that there will be no longitudinal shear where there o deflection, that a load applied to determine verti- shear will never cause longitudinal shear, and that timber will fail from direct compression long before itudinal shear will occur. It is contended that to ob- longitudinal shear the load should be applied as in the at the laboratory or in the manner which will pro- maximum deflection. The imposed load of an engine ing across the deck of a trestle is not fixed.

e committee would like to have the views of as many are to write on this subject. Is the accepted method f uring longitudinal shear just to the timber, and will ve us a true indication of the strength of the timber sist that stress in service? Taking panel lengths of 2.. and 16 ft. and the engines now in use, where should h ngine be placed to impose the maximum load in longi- al.

A. M. VAN AUKEN,
icago, July 6. Chairman Sub-committee 2.

## Dam Failure Danger Exaggerated

'—Certain items of news and editorial comment which a appeared in the public press and in engineering periodi- l apropos of the recent flood at Pueblo prompt me to set some of my impressions in regard to them. I am ring particularly to an editorial of *Engineering and acting*, June 8, 1921, an editorial of *Engineering -Record*, June 16, 1921, and an article appearing in *ry Digest*, July 9, 1921.

e importance of dam design and construction prob- cannot be overrated. In general dams should be so as to be safe—safe with adequate margin. Where n life would be endangered by the failure of a dam, use for reasonable doubt should be permitted to re- unremedied. True, there are circumstances where a margin is justifiable. Thus, for a dam which is the s of storing only a relatively small quantity of water elow which there are many miles of uninhabited valley nyons, commercial considerations may possibly be al- to govern. The failure of Stony River dam, for in- e, caused no loss of life and little property damage, ly because thirty miles and more of watercourse lay en the dam and any considerable development or set- nt which could be damaged. Perhaps the Schaeffer on Beaver Creek above Pueblo, was of the kind where ser margin was justifiable.

r the greater part, however, even economic factors ly require absolute safety of investment. In any questions of doubt should be resolved in favor of .. Governmental supervision of dams, which cannot ccessfully challenged from the standpoint of public re, should see to it that the adequacy of a dam is e ured by the proper criterion. Where absolute safety is essential and consequent cost is incompatible with commercial success, the dam should not be built.

Dam design is by no means the simple problem that earlier textbooks might lead one to think. Especially is this true with reference to foundation problems which are inseparably a part of dam design. But the difficulties are not insuperable. Given tolerably good foundation conditions, dams can be made safe. Both editorials in point refer to alleged difficulties of determining the loading to which a dam will be subjected. It is implied that, unlike bridge design, the loads of dams must be "guessed at" or at least are subject to a "factor of ignorance." On the contrary, maximum loads of dams can be predetermined, and appropriate provision made in design, with greater assurance of adequacy than in the case of a bridge. The discussion of such a statement might warrant an extended article, but suffice it for the present to point out that increases in bridge loading not dreamed of by the designer have caused thousands of highway and railroad bridges to be superseded and many to collapse. The difficulties in dam design are rather to be found in the matter of foundations, and even in this respect one must not forget that bridges have their foundation problems and their failures.

However, it is not my object to argue that bridges or other structures should be subject to as much care in design and construction as dams. Instead, let us agree that there have been "too many dam failures" (as *Literary Digest* puts it), but that dams can be properly designed and constructed and that the requirements for safety can be adequately met. Is then the record of the past not sufficiently bad without needless exaggeration?

Ever since the days of the Johnstown flood, stories of dams which have failed or are about to fail, stories of horsemen speeding down valleys to warn the inhabitants, stories of tremendous damage and loss of life caused by dam failures, real and fancied, have been favored by the public press. More frequently than not, accounts of dam failures have been grossly exaggerated. These exaggerations are harmful, not merely to the engineering profession, but what is much more important, to the community at large. For the community must always remain dependent in large measure upon engineering structures. In days gone by pioneering development in the United States consisted largely of railroad construction, but since then more and more our largest public works have had to do with water. Inland waterway development, irrigation, flood control, water-power development all are important phases of engineering construction, directly or indirectly adding to the real wealth of our nation. And in most cases these are impossible of accomplishment without dams. The same is frequently true of water supplies.

Therefore, it seems to me that great harm is done unjustifiably to the engineer and to the community when the editor of *Engineering and Contracting* predicates an editorial on the subject of dam failures upon unconfirmed reports from Colorado that "a large part of the recent flood damage to life and property was due to dam failures"; likewise, when *Literary Digest*, quoting and taking its cue from the above-mentioned editorial, supplements copied material and its own comments with a photograph bearing the caption: "When the dams fail: Wreckage in the railroad yards at Pueblo." Even hydraulic engineers, such as I, have been somewhat surprised to find that evidently there is authoritative record of the failure of only one dam during the Arkansas River basin flood of early June and that that one dam (the Schaeffer reservoir dam), according to official report, did not fail until thirty hours after the peak of the Arkansas flood had reached Pueblo.

It is unfortunate that the representatives of the State Engineer of Colorado have apparently been unable so far to obtain any reliable record of the effect at Pueblo of the release of the contents of the Schaeffer reservoir. It is interesting to note, however, that the 3,100-acre-foot capacity of that reservoir would not have been sufficient to maintain the estimated flood peak discharge of the Arkansas at Pueblo for more than twenty-three minutes.

F. W. SCHEIDENHELM, Consulting Engineer.
New York, July 13.

# HINTS FOR THE CONTRACTOR

## Portable Water Tank for Concrete Paving

By Walter B. Cannon
Lankershim, Cal.

IN DOING odd jobs of concreting on the highway it is often difficult to secure water. The illustration shows a 1,200-gal. tank mounted on a 5-ton truck, with a 1½-hp. gasoline engine driving a 1-in. centrifugal pump

WATER TANK OUTFIT FOR PAVING CONSTRUCTION

mounted on the side. The pump is piped so that it can load the tank from ditch or pond or it can be made to pump from the tank.

The engine can be started and will run indefinitely without attention, and whenever water is wanted all that is necessary is to open a valve and the pressure is just about right for furnishing a mixer with water.

## Protecting Eyes in Electric Welding

By C. W. Geiger
San Francisco, Cal.

A DEVICE developed by an employee of the Market Street Railway of San Francisco and shown in the accompanying photograph, affords protection for the

[illegible] OF COLORED GLASS TO WARD WITH HELMET

eyes of an electric welder without the use of the usua metal head dress. It consists of a board slotted nea one end for the insertion of colored glasses which ar held in place by a clamp. The operator holds the boar in the proper position with his left hand, while hi right hand manipulates the welding tool.

This device does not prevent him from glancin up quickly to observe approaching traffic. In some loca tions where an assistant would otherwise be require with this device a single operator can safely carry o the welding operation because he always has an unol structed view in all directions. While the operator using both hands for removing box, tools, etc., th board is allowed to hang from the strap by which is slung around his neck. The device has proved popular that the company is now using it for all its welders who have field work to do.

## Boiler Becomes Reservoir When Steam Shovels Use Compressed Air

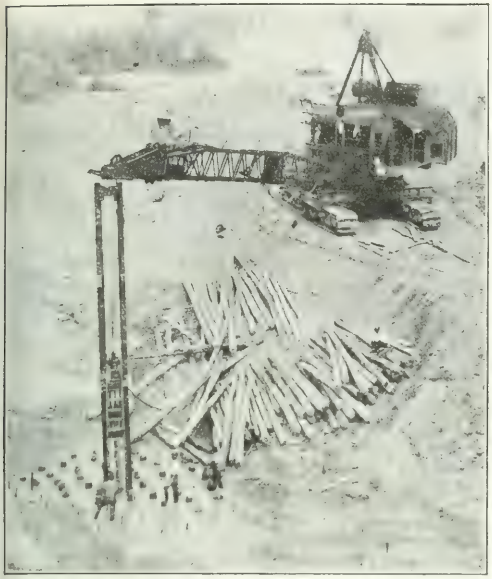
STEAM shovels operated by compressed air were us for handling muck in the tunnels of the Kerckh hydro-electric project in California. The air sup was delivered through a short flexible coupling from t air-line which served the drills at the heading. Bef the shots in the heading could be fired of course it w necessary to move the shovel back so as to avoid dama from flying rock. In order to do this without usi long hose connections, compressed air was turned i the boiler and this was drawn upon as a reservoir motive power. It was found that the boiler capac was sufficient to move the shovel back the required tance, usually several hundred feet, and return it to muck pile after the shot.

## Dragline Drives Fifty-four Piles In One Shift of 10 Hours

By C. H. Eiffert
Division Engineer, Miami Conservancy District

FROM thirty to forty piles on an average, w fifty-four as a maximum number, were driven 10-hour shift by a dragline excavator rigged as a p driver on the construction of the Black Street bri at Hamilton, Ohio, by the Miami Conservancy Distr Eight hundred and sixty foundation piles for piers abutments, as well as piles to support falsework, w driven in this manner. The foundation piles had average penetration of 17 ft. in gravel.

In rigging up the excavator for this work the le built of 6 x 8-in. timbers about 33 ft. long, were la to the end of the boom with wire rope, and were ra or lowered by raising or lowering the boom. A st hammer weighing 3,800 lb. was used, the weight the striking parts being 1,800 lb. The hammer operated by the hoist line running over the sheav the end of the boom. Piles were pulled into the l by the dragline cable running through a pulley the top of the leads. The dragline excavator ha 70-ft. boom and was the same machine used for bu ing cofferdams and excavating for foundations.



DRAGLINE PILEDRIVER OPERATING IN MIAMI CONSERVANCY WORK

When ready to drive piling, the boom was lowered to the ground, the leads were attached and the hammer was drawn into them. The leads were then spotted over the location of the pile to be driven and lowered, the weight of the boom being allowed to rest on them, forcing the lower projecting ends of the 6 x 8's from 2 to 3 ft. into the ground. This held them in place at the bottom, the boom holding them at the top.

## Weights of Forms for Filter Covering Determined From Models

By Perry Thompson
Sanitary Engineer, Yonkers, New York

IN CONNECTION with covering two open sand filters at Yonkers, N. Y., with groined and barrel arches the contractors wished to know in advance the weights of forms and centers they were proposing, and at the same time to determine other doubtful points and ensure practicability. Accordingly, models of whitewood, one-eighth size, were constructed. This proved a very convenient scale since whitewood may be had ⅛ in. and ¼ in. thick, representing 1-in. and 2-in. lumber.

The plan of subdivision is shown in the sketch, where the solid lines represent the form limits or joints, and the dotted lines represent the ridges, as shown in the photographs. It will be noticed that at the wall corner sections and along the north and south walls the diagonals do not meet. This is because they are at angles of 45 deg., an arrangement which made them easier to construct, while the distances are unequal; the result of original filter dimensions being such that no convenient common divisor could be found. Since the arches are practically level at the crowns no difficulty resulted.

Form *A* was heaviest and weighed 1.144 lb. Form *D* was lightest and weighed 0.645 lb. Multiplying by 512 (= $8^3$) we get the weights of full-sized forms of whitewood, but as the forms are being made of

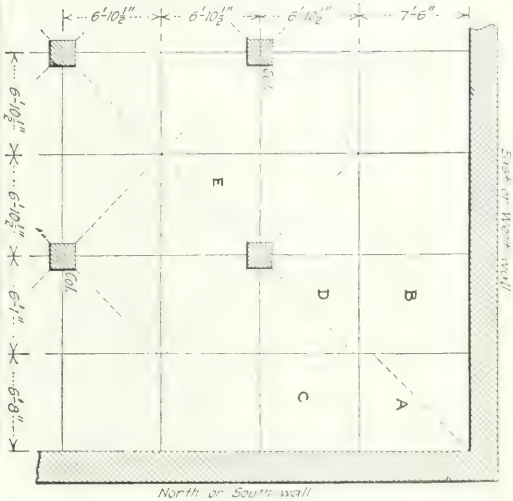



FIG. 1. PLAN OF SUBDIVISION FOR GROINED ARCH CENTERS

long-leaf yellow pine it is necessary to multiply again by the ratio of weight of the latter to the former, or 1.45, which gives the weights in dry long-leaf yellow pine. Adding 3 per cent for moisture we get for *A* 875 lb., for *B* 705 lb., for *C* 735 lb., for *D* 495 lb., for *E* 635 lb. and for *F* 825 lb.

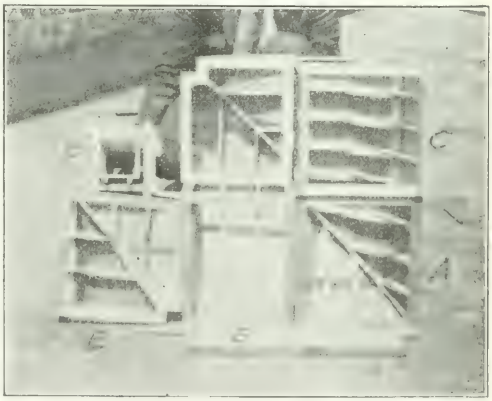


FIG. 2. UNDERSIDE OF FORM MODEL
Complete arch and groin section on right, quarter groin cap on left and column form above

The contractor expects that six or eight husky laborers will be able to handle the forms, which will be assembled regardless of weather in an open shed adjoining the filters.

# NEWS OF THE WEEK

New York, July 21, 1921

## Tunnel Engineers' Dismissal Unjustified, A. A. E. Finds

**Jersey Commission's Action Held to Be Prejudicial to Tunnel Enterprise and Public Welfare**

That the New Jersey Interstate Bridge and Tunnel Commission, in the manner of its attempted dismissal of the board of consulting engineers for the Hudson River vehicular tunnel, acted in a way prejudicial to the tunnel enterprise and to the public welfare and that other engineers, in attempting to fill positions thus made available, have been lacking in good taste and a fine appreciation of professional courtesy and ethics, are the main findings of the committee, consisting of F. Lavis, James F. Sanborn, and John P. Hogan, appointed June 17, by the New York Chapter of the American Association of Engineers to investigate and report on the situation created May 14 by the New Jersey commission in its passage, without the concurrence of the New York commission, of a resolution terminating the consulting services of Col. William J. Wilgus, John A. Bensel, Prof. Wm. H. Burr, Edward A. Byrne, J. Vipond Davies, and Col. George L. Watson. The committee's report, dated July 12, was approved last week by the board of directors of the local chapter of the association.

COMMITTEE GATHERS EVIDENCE

Prior to the submission of its findings, the committee sought the views of Col. Wilgus, chairman of the consulting board, T. Albeus Adams, chairman of the New Jersey tunnel commission, and George M. Wells and St. John Clarke, the two engineers last named having accepted appointments as technical advisers to the Jersey commission shortly after the dismissal of the consulting board; all complied with the committee's request for information except Mr. Adams.

After stating the facts in the case, which has been dealt with at length in the news columns of previous issues of *Engineering News-Record*, the A. A. E. committee expresses the following opinion: "It is very evident that if either commission felt aggrieved at the action or attitude of its technical advisers and the other commission refused to act, it must have some means of redress, but so far as your committee has been able to discover, there was little, if any, attempt on the part of the New Jersey board to settle such grievance as they may have had in agreement with the New York commission."

After calling attention to the fact that the New Jersey commission had refused officially to give to the committee any information, on the ostensible

*(Continued on p. 125)*

## New Federal-Aid Road Funds May Be Withheld

*(Washington Correspondence)*

Highway legislation is faced by a new danger. The reasons which caused the President to oppose soldier-bonus legislation are thought to have actuated him to take a similar attitude with respect to the $100,000,000 appropriation being asked for highway development. While there has been no announcement from the White House on the subject, it is believed that the President prefers that this appropriation be delayed until the condition of the Treasury has improved.

Leaders in both the Senate and House have not been friendly at any time during the session to the suggestion that additional funds be appropriated at this time for federal-aid work. During recent weeks, with the more general recognition that the Treasury situation is really serious, this attitude has come to be regarded in a more sympathetic way. For that reason it no longer is the difference of opinion between those favoring the Townsend bill or the Dowell bill that threatens to delay highway legislation—it is the apparent crystalization of sentiment in favor of restricting appropriations regardless of their urgency.

## St. Lawrence Waterway Report Made

Colonel W. P. Wooten, Corps of Engineers, U. S. A., and W. A. Bowden, chief engineer of the Canadian Department of Railways and Canals, have made their joint report to the International Joint Commission on the engineering features and possibilities of the Great Lakes-St. Lawrence waterway. An estimated cost of $252,728,200 is given for a 25-ft. depth, which includes a series of nine locks, 33 miles of canals, 10½ miles of lake channel and 108 miles of river channel, as well as the development of 1,464,000 hp. at Long Sault rapids. Provision is made for canal bottoms 200 ft. wide and open channels 450 ft. wide with locks 864 x 80 ft. The total fall from Lake Ontario to Montreal is 220 ft.

## British Experts to Survey Russian Harbors

As a result of a request made to the British Board of Trade by the Soviet Russian Government, two British engineers are to go to Russia to survey harbors and maintain their safety for navigation. V. Havelock Case, a dock and harbor expert, and D. B. Male, an authority on salvage operations, have been selected for the work. The Soviet Government requested the assistance of the British Board of Trade, which consulted the London Salvage Co.

## Rental Fees for Concrete Road Roller Reduced

**Macon Co. Announces Change in Schedule, Following Criticism by Contractors and Engineers**

Following the decision on March 2 of the U. S. District Court of Georgia, supporting the validity of the patents of the Macon Concrete Road Roller Co., covering its device and process for finishing concrete pavement with a light weight hand roller of small diameter and relatively great length (see *Engineering News-Record*, April 7, p. 610) contractors and highway engineers are expressing dissatisfaction at what are claimed to be unreasonable charges for the use of the method. In fact, the Associated Pennsylvania Highway Contractors, the local organization of the Associated General Contractors of America, has urged its members to refuse payment of the present license fees demanded and to consult with the association's local office at Harrisburg in cases where disputes as to payment arise. It is further understood that the Pennsylvania State Highway Department, in the light of the alleged high rental costs, has under consideration a change in its specifications whereby the use of the light roller method of finishing concrete paving surfaces will be eliminated.

OLD RENTAL BASIS

According to the Macon company's form of contract, the rental basis for the road roller is ¾c. per square yard which, for an 18-ft. highway, amounts to more than $50 per mile. A minimum charge of $100 is demanded for the lease of the roller on contracts amounting to 10,000 sq.yd. or more, while on smaller contracts than the foregoing a payment of $2 per day is specified, with a minimum charge of $50 and a cash deposit of $100. It has been estimated that the cost of manufacture of the roller itself is only about $10 or $15 and that in their demands for royalties at the rate of $50 per mile the lessors are asking more than a reasonable amount for the use of their device and process.

It appears that the method is generally acknowledged as a satisfactory one, the chief objection being on the grounds of excessively high rental charges.

[*Copy of the foregoing statement was sent by "Engineering News-Record" to the Macon Concrete Road Roller Co., June 29, with request for any comment the company might care to make. The following reply, dated July 11, has been received.*—EDITOR.]

"Following yours of June 29 and my communication to you on July 2 I beg to state that we have endeavored t

meet the views of both highway commissions, engineers, and contractors, and have changed our rental terms in accordance with the sketch as herewith inclosed. We realize that we have a most useful device for finishing concrete pavements and we were under the impression that the rental charge of 2c per yard would be low cost for the great value derived from its method. However, we were open to conviction and as soon as we discovered that this principle was unpopular we have endeavored to change the terms in accordance with their views.

"We will notify our agents and contractors of this change and will try to co-operate with them if you will be kind enough to make some mention of this change in *Engineering News-Record* in which we have been running an advertisement and securing a great many inquiries."

The new schedule of rental fees referred to in the foregoing letter is as follows:

"(1) Basis of rental will be $150 per year per roller or when used less than a year $30 per month for the first month and $20 per month for each additional month, with a cash deposit of $150 and a minimum charge of $50.

"(2) When two or more rollers are used and leased to the same contractor and additional charge of $75 per year will be made for each additional roller or when used less than a year $15 per month or portion of a month with a cash deposit of $75.

"(3) On small contracts where roller is used for a period of sixty days or less a cash deposit of $100 will be required and a minimum charge of $50.

"(4) Difference in amount if any to be refunded as of the day roller is delivered to our authorized agent or to the Express or Railway Company for shipment.

"(5) Where contractors deliberately infringe on our roller or process a much higher rental will be demanded."

## New York State Soldier Preference Law Held Invalid

A New York State law providing that any person who had taken and passed a civil service examination for promotion in the state, county or city service and who subsequently "entered the military or naval service of the United States . . . shall be preferred for any appointment or promotion thereafter made in such grade in the department in which he shall be employed" was held invalid by the Court of Appeals of New York State on July 14. The law had been upheld by the State Supreme Court and by the Appellate Division.

It was contended that the statute provided no standard of army or navy service, so that even one who had been dishonorably discharged would have equal benefit with one who had performed long and valuable service; also that the law nullified the original act setting up a uniform method of promotion.

## Hetch Hetchy Tunnel Headings Advance 2,780 Ft. in June

Eight headings of the tunnel in the mountain division of the Hetch Hetchy project were driven a total distance of 2780 ft. during the month of June, this progress being made without the loss of a single round of shots at any heading while working on regular schedules. The regular schedule was suspended two days at the Big Creek headings while engineers were plumbing the shaft and five days on the east Big Creek heading during timbering of the section.

The footage in the several headings was as follows: Early Intake, 361 ft.; South Fork, east, 322 ft.; South Fork, west, 319 ft.; Adit 5-6, east and west, 611 ft.; Big Creek, east, 270 ft.; Big Creek, west, 357 ft.; Priest, 540 ft.; total, 2780 ft. The three headings last named are of the smaller section, i.e., 10 ft. 3 in. in diameter. All the others are the larger unlined section, which has a diameter of 13 ft. 8 in. The two headings being driven from adit 5-6 are worked alternately, that is, the shifts go from one heading to the other and only three crews are used on the three shifts that work both headings. The Big Creek headings have to be reached through a shaft 677 ft. deep.

The 18 miles of tunnel in the mountain division of this project are under contract to the Construction Co. of North America.

## Old Chicago Bridge Removed

The Rush St. swing bridge over the Chicago River, built in 1874 at a cost of $50,000 has been sold for junk and pulled down, having been superseded by the new Michigan Ave. bascule bridge. The old structure was 240 ft. long and 60 ft. wide, with three trusses carrying the two roadways and outside sidewalks. It was operated by steam until 1900, when electric operation was introduced. For dismantling, the bridge was swung open and blocked up on the protection pier, being then cut up by oxy-acetylene torches and the pieces loaded into barges by a derrick. The bridge was purchased and dismantled by the Ketler-Elliott Co., which paid $500 for it as old metal.

## Street Cleaning by Contract to End Dec. 31 at Philadelphia

A pending proposal that all street cleaning work in Philadelphia be done by the City on and after Oct. 1, advocated by Director of Public Works Caven and Mayor Moore, was defeated 13 to 8, by the City Council of Philadelphia on June 27, and Jan. 1, 1922, was substituted as the date for complete change from contract to city work. A portion of the work has been done by the city since Jan. 1 of this year and the remainder under contracts giving the city the option of cancelling them Oct. 1. It was estimated that a change from contract to city work would save the city $150,000 during the last three months of the year.

## Louisiana Revises Motor Vehicle Taxes

### Constitutional Convention Fixes $15 for Autos and $25 for Trucks as Minimum Fees

*(By M. C. Huckaby, Baton Rouge, La.)*

There has just come to a close in Louisiana the session of the unlimited Constitutional Convention and among the outstanding features of its work is provision for the first real road-building program that the State has ever had. It is based on a "pay-as-you-go" policy rather than upon long-term bond issues.

Several states are now financing their road systems at the expense of the automobiles and trucks, and tax on gasoline has been proposed. The new policy in Louisiana is a combination of the two and may seem to some to be rather drastic. Quoting from the new Constitution:

"The Legislature shall impose a license tax upon all motor vehicles as follows:

"On automobiles for private use there shall be imposed an annual minimum license tax at fifteen ($15) dollars, said license tax to be graded up from this amount based upon horsepower;

"On trucks or automobiles used for the transportation of passengers or freight, or for the purpose of the delivery or carrying of goods or merchandise, there shall be imposed and annual minimum license tax of twenty-five ($25) dollars, said license to be graded up from this amount based upon both horsepower and carrying capacity.

"On all other vehicles using the public roads, the Legislature is authorized to impose an annual graded license tax based upon carrying capacity"

TAX ON GASOLINE

On gasoline, when sold and used in Louisiana, there is to be levied a tax not to exceed 2c. per gallon while on kerosene and other fuels used for the purpose of generating motive power the Legislature may also impose a tax.

It is estimated that a general highway fund of $4,000,000 to $5,000,000 a year will be received from the above sources and that the funds raised by local districts will bring the amount up to $10,000,000 to $12,000,000 a year for all road purposes throughout the State. The State will not pay any interest on long term bonds. In order that this might be made stronger, the further provision was inserted:

"No debt shall be created, or certificates of indebtedness or bonds issued, to be paid in the future out of the proceeds realized from any state tax or license to be collected under and by virtue of this ordinance, or imposed thereunder by the Legislature, but the said license and taxes shall be collected from year to year and expended for the purpose of construction and maintenance of the system of state highways and bridges."

The schedule of assessments or fees levied on the several types of vehicles will rest with the Legislature which

will meet in special session Sept. 6. It naturally follows, though, that, if the minimum fees are set on the smallest vehicles and graded up in proportion, the change will be considerably felt by the automobile and truck people. The old law assessed a flat rate of $7.50 on trucks and 25c. a horse power on automobiles, using the S.A.E. formula for computing horse power, which will, no doubt, be thrown out and some other method adopted that will in a measure approach the object sought in arriving at some equitable and just method of assessment.

It is believed by many that the Legislature may reorganize the state highway department.

## Heavy Rains Start Movement of Pittsburgh Slide

Some movement of the slide of last November at Kirkpatrick St. and Bigelow Boulevard, Pittsburgh, developed during the last few weeks as the result of heavy rains. On June 24, according to C. M. Reppert, chief engineer of the department of public works, there was a heavy rainfall, reaching "cloudburst" intensity in the Bigelow Boulevard district and flooding the boulevard roadway and the temporary bridge over the slide. The fill in the old ravine of Jones Hollow at the foot of Kirkpatrick St. became saturated. When the rain stopped, after several days, discoloration and thin, soupy material coming to the surface made it evident that underground water was coming through the rock face into the old fill. Subsidence of the upper part of the slide then began and gradually extended downhill.

In the earlier part of the trouble the Pennsylvania R.R. put shovels to work dipping out the thin, supersaturated material. Later a general movement occurred which carried the toe of the slide as far as the first main track, but no heaving of the ground occurred. Where the boulevard crosses the head of the slide it was kept open by blocking up the pile trestle built last October as a temporary crossing over the subsiding ground. Its settlement was at times quite marked, particularly during one night; the maximum settlement was 27 in. The structure rests on piles up to 60 ft. long, which generally pass through clay to rock; apparently they failed from their points slipping on the rock surface.

Operations to reclaim the slide have been in progress for some time under a force account contract with the John F. Casey Co. Up to the present this work has comprised the installation of a drainage system to take care of the surface water and to cut off as much as possible of the underground water passing through the fill from the rock surface. This work is now about completed, and when in service is believed to be able to take care of any emergency which may arise. Plans for the restoration of the boulevard over the head of the slide are being developed and will probably be issued shortly.

## New Bids Received for Hudson Vehicle Tunnel

Following the rejection of all bids opened in New York City July 12 for the construction of the Jersey ventilating shafts of the Hudson River vehicular tunnel, new bids were received on July 19 from six contractors, the low total of $371,000 being submitted by the Shaft Construction Co., New York. This is the third time that the Jersey shaft contract has been advertised. The first call for bids, to be opened on March 29, was annulled because of differences between the New York and the New Jersey commissions regarding the widening of certain streets in Jersey City.

The rejection of all bids received last week was the result of a peculiar set of circumstances arising out of the late delivery of the certified check from the low bidder, the Holbrook, Cabot & Rollins Corp., whose price for the work totaled about $380,000 as against $428,000, the next lowest bid, received from the Jocylen Construction Co. of Bayonne, N. J. Shortly before 3 o'clock, the time set for receiving bids, a messenger from the Holbrook, Cabot & Rollins Corp., arrived at the commission's offices with that firm's bid on the Jersey shaft work. The messenger, however, had neglected to bring a certified check, as required. It is understood that the check had been made out, but through an oversight had not been brought to the tunnel commission's offices by the contractor's messenger. Three o'clock arrived, and in spite of urgent telephone calls to the Holbrook, Cabot & Rollins office for the certified check, that document did not arrive until about 3:20 p.m.

### A Question of Time

The two commissions then proceeded to a reading of the bids received. When the Holbrook, Cabot & Rollins bid was reached an objection to its reading was voiced by the representative of the Jocylen Construction Co., on the ground that the certified check required to accompany all bids had not been received before the time of bidding closed.

A point then was raised as to whether the commission's announcement of three o'clock should be interpreted as daylight-saving or Eastern standard time. It is understood that counsel ruled that Eastern standard time should govern, and under this ruling the Holbrook, Cabot & Rollins bid and check arrived on time. In newspaper advertisements of the contract, however, it was specifically stated that bids would close at 3 p.m. daylight-saving time. In spite of objections, the Holbrook, Cabot & Rollins bid was read with those from nine other contractors.

Immediately after the canvassing of the bids, the tunnel commission members met. It was brought out in their discussion that acceptance of the low bid of Holbrook, Cabot & Rollins would probably involve the commission in a law suit brought by the second lowest bidder, while if an award of the contract were made to the Jocylen Co., the commissions might be charged with irregular procedure in awarding a contract at a price almost $50,000 in excess of the low bid. The two commissions finally decided that the best way of avoiding trouble would be to reject all bids and call for new bids one week later, on July 19.

## Creosoted Wood Floor Responsible for Pittsburgh Bridge Fire

Details concerning the construction of the Thirtieth St. bridge over the Allegheny River, Pittsburgh, which was destroyed by fire on July 8, have been supplied by J. G. Chalfant, county engineer, as follows: The bridge was a continuous truss over the three spans of the south or main channel portion and was built by Gustav Lindenthal in 1887-88 for a bridge corporation. It remained a tool bridge until March 16 1911, when Allegheny County purchased it; since then it has been a free bridge The channel span was 304 ft. 8 in. long center to center of piers, and the north and south spans each 228 ft. 6 in. center of pier to end bearings. The trusses were spaced 22 ft. apart on centers, giving a 19-ft. clear roadway, with a 6-ft sidewalk on the downstream or west side of the bridge.

At the time the county condemned the bridge, the roadway floor was carried on timbers resting on the bottom chords of the trusses, with longitudinal joists and oak cross-planking. This floor was replaced in 1914 with a creosoted pine floor, consisting of 5 x 16-in timbers about 2 ft. 4½ in. on centers, 4 in. plank laid longitudinally, and 3¼-in wood block. The blocks were treated with 30 lb. of creosote oil per cubic foot, and the timbers and plant with 1 lb. per cubic foot. The joints in the wood block pavement were poured with bituminous filler. This floor had been found too flexible under heavy traffic and a contract had been awarded for additional timbers to be placed between the original 5 x 16-in. timbers; since the fire this contract has been cancelled.

Fire was discovered by a workman employed by the county on bridge repair at 12:35 p.m., July 8, near the south end of the channel span. At this time the fire had gained considerable headway, as the flames were coming up over the side of the floor. Alarm was turned in promptly from both ends of the bridge, and fire equipment was on the scene in about 5 to 8 minutes, but evidently was unable to reach the fire under the floor, as the channel span and the south span were both in the river at 1:05 p.m. The north span is still standing and will probably be used for foot traffic in connection with a temporary suspension bridge on the old masonry.

The workman who discovered the fire advanced the theory that it had been occasioned by a leak in a gas line on the upstream side of the bridge. He has no facts to substantiate his theory, and the county engineer has not been able to determine the cause of the fire.

## Bureau of Standards Building 10-Ft. Wind Tunnel

The aerodynamic section of the Bureau of Standards is constructing a new wind tunnel, 10 ft. in diameter, the bureau has just announced. The design for the tunnel is completed and material for construction is being assembled. Completion of the tunnel will give the bureau exceptional facilities for all research involving a study of the behavior of objects in a wind stream.

## Oppose 10-Ton Truck Weight Limit

A movement has been started to repeal the recent law enacted by the Ohio Legislature limiting motor trucks and their loads to 10 tons. The law becomes effective in August. It reduces to a 10-ton limit the former permissible maximum gross load of 14 tons. Automobile associations, truck owners and contractors are opposing the new restrictions.

## Additional Candidates Named for Staten Island Tunnel

The Board of Estimate and Apportionment of New York City, up to date has failed to approve the recommendations which its chief engineer, Arthur S. Tuttle, made for the engineering personnel of the proposed Staten Island tunnel under New York Harbor. As noted in the July 7 issue of this journal, p. 37, the chief engineer recommended for the Staten Island work the appointment of Col. William J. Wilgus and Frederick C. Noble as consulting engineers, Jesse B. Snow as tunnel engineer, Charles B. Drew as principal assistant engineer, W. McK. Griffin as resident engineer, and Alfred D. Hill as designing engineer. In opposition to the first three candidates named above, it is understood that the Board of Estimate has under consideration the names of Henry B. Seaman and John F. Sullivan, as consulting engineers, and Robert W. Creuzbaur as tunnel engineer. Each of the consulting engineers to receive a yearly salary of $10,000 and the tunnel engineer $12,000.

Mr. Seaman is a former chief engineer of the New York Public Service Commission in which position he served three years, resigning to enter private practice. During the war he served as supervising engineer of the emergency plant extension for the torpedo boat destroyer program of the U. S. Navy Department, having charge of construction of thirty-five plants in various parts of the country.

Mr. Creuzbaur is a consulting engineer and a former technical adviser on public works to the Borough of Brooklyn, New York. He has also served in a number of New York City's engineering departments. During the war he was for two years with the Emergency Fleet Corporation as consulting engineer in connection with the plants at Hog Island, Bristol, Pa., and Newark, N. J.

## Fire Destroys Seattle Wharves Causing $400,000 Loss

Fire, supposed to have started from a spark dropped by a railway locomotive, caused a loss of approximately $400,000 to the Harbor Island plant of the East Waterway Warehouse & Dock Co. in Seattle July 9. The loss is entirely covered by insurance. About $2,000,000 worth of property was endangered by the fire, which started midway of the long wharf and spread underneath the planking and among the creosoted piles with great rapidity. The flames destroyed 900 ft. of open wharf, and 600 ft. of wharf attached to the No. 2 warehouse. Work of repairs will be gotten under way immediately.

## Henry Ford Offers to Buy Muscle Shoals Plant

Henry Ford, the Detroit automobile manufacturer, has made an offer to the government for the purchase of the nitrate plant at Muscle Shoals, Ala., on the Tennessee River, a plant which includes completed nitrate-producing units together with a partially completed dam across the river and a partially developed water power started by the government during the war and shut down the end of the last fiscal year. According to a memorandum from the Department of Commerce, the principal points in Mr. Ford's offer are:

(1) He will take a 100-year lease upon the Wilson dam and No. 3 dam and electric installation when completed. For this he proposes to pay interest at the rate of 6 per cent on the sum of $28,000,000, which is the estimate for the total cost, and to amortize not only this sum but the entire cost of both dams over a period of 100 years. (2) He offers to purchase all the nitrate plant and equipment, lands, steam plant, etc., for $5,000,000. (3) He offers to convert and operate the large nitrate plant for the production of fertilizer compounds and as a standby for government explosives in case of war. (4) He agrees to limit the profits of the fertilizer plant to 8 per cent, an independent board embodying representatives of the American Farm Bureau and the National Grange and the Farmers' Union to certify to this maximum.

In the announcement Secretary Hoover states: "The acceptance of the offer is entirely for decision by Congress, and that body no doubt will be greatly guided by Secretary Week's views in the matter. Mr. Ford has made a genuine proposal. It shows courage to agree to pay out $5,000,000; to spend further sums upon large works, and besides to take an annual obligation for about $1,500,000 for 100 years, and to agree to maintain a nitrate plant in reserve for the government for that period. Whatever may be the result, Mr. Ford's offer does prove what the public associations have contended —that the completion of this project has a commercial value."

## Tunnel Engineers' Dismissal

(*Continued from p.* 122)

plea that it is holding such evidence as it may have for use in possible legal proceedings, the report sets forth in the following language its opinion as to the main issue involved:

"There can be no question that if anybody, private individual, corporation, or public commission, is dissatisfied with the services of any engineer in his or their employ, be he the most eminent consulting engineer or a student just out of college, he has the right to dismiss such engineer and seek other assistance. It is, however, a well established, even though an unwritten rule of professional ethics, that should an employer discharge an engineer, and especially an engineer in responsible charge of work or one employed as a consultant, without reasonable cause, that it is unethical for another engineer to take over the work or the position.

"The board of consulting engineers which was appointed and which, in conjunction with the chief engineer and his staff, has brought the enterprise to the point where its successful completion can be practically visualized, is not only a body of eminent engineers but also a body of eminent, well known and public-spirited citizens, and such a board, in connection with an enterprise of this character, should not be, and as a matter of fact cannot be, discharged just as one might discharge an office boy, and especially is it true at such a critical period of the work. Whatever the technical legal status of the matter may be, public sentiment, where properly informed, will not permit it."

The report goes on to say that so far as the committee is aware, the New Jersey commission, except in the matter of the Jersey City street widening, has never made any public statement of its grievances against the board or given the latter any opportunity to refute or explain the charges against it. The point is made, also, that, according to information received by the committee, the consulting engineers took no action in the matter of street widening, regard it is one of policy rather than of a technical engineering nature.

The public generally and the engineering profession especially, according to the committee's report, has as much confidence in the ability and integrity of the board of consulting engineers as it has in either of the commissions, and only the gravest reasons, it is held warrant such action as the New Jersey commission has taken. It seems to the committee, therefore, that either the New Jersey commission has no such reasons, having failed to make them public, or if it has, is remiss in proceeding with the work designed and sponsored by the same board, which it actually is doing. The report points out also that since the dismissal of the consulting board, the two commissions have arrived at a compromise agreement in the matter of street widening in Jersey City, but the matter of the

dismissal of the consulting board, which this dispute is said to have caused, or at least precipitated, is still open.

The committee concludes its report with the following opinion: "Your committee is unanimously of the opinion that the action of the New Jersey Interstate Bridge and Tunnel Commission, in attempting to dismiss the board of consulting engineers in the manner set forth in their resolution of May 14, acted in a manner prejudicial to the tunnel enterprise and the public welfare, and that, in view of all the circumstances which have been publicly known, it is certainly not in good taste and not in accord with a fine appreciation of professional courtesy and ethics for other engineers to attempt to fill the positions thus made available."

## Personal Notes

DR. A. W. FREEMAN, Commissioner of Health of Ohio since 1917, having completed the term for which he was appointed, will become resident lecturer on public health administration, Johns Hopkins School of Hygiene and Public Health, Baltimore.

R. O. GALLAGHER, formerly superintendent of roads for Hamblen County, Tenn., is now resident engineer for the Tennessee highway department on construction of a federal-aid road between Mountain City and Bristol.

WILLIAM H. OKUM, formerly with the construction department of the New York Central R.R., and recently production engineer of the Avis Manufacturing Co., manufacturer of brass products, Brooklyn, N. Y., is now vice-president and works engineer of the Superior Wood Heel Co., Brooklyn, N. Y.

J. N. OLSON, assistant engineer Gulf Lines, Atchison, Topeka & Santa Fe Ry., at Galveston, Tex., has been transferred to the office of the chief engineer at Chicago, Ill.

ELLIS G. MIDDLETON has resigned as village engineer of Le Roy, N. Y., to become connected with the highway commission of West Virginia.

B. A. BRIGGS, formerly superintendent of streets of Colorado Springs, Col., is now with the Colorado state highway department.

J. H. HUNTER, for many years chief engineer of the Canada Starch Co. has been elected chairman of the Montreal branch of the Engineering Institute of Canada.

MAJOR JULES DUCHASTEL, city engineer of Outremont, Quebec, has been appointed president of the Automobile Association of Canada.

CHARLES M. MCKERGOW, of Montreal, Canada, has been appointed professor of the mechanical engineering department of McGill University.

R. C. LIMERICK, formerly project engineer of the Arkansas highway commission, has been appointed state highway engineer to succeed V. P. Knott, resigned.

J. POWELL WEHRUNG has been appointed county engineer, Runnels County, Tex., with headquarters at Ballinger, Tex.

W. C. MORSE, for a number of years identified with the regrade work in Seattle, Portland and other northwest cities, has opened offices in Seattle, Wash., to engage in general engineering-contracting work.

MAJOR CLIFTON E. HICKOK, city engineer of Alameda, Cal., since 1917 with the exception of a year spent in the Corps of Engineers, U. S. A., during the World War, has been appointed city manager of Alameda.

CHARLES E. HEWES, city manager of Alameda, Cal., has been appointed city manager of Long Beach, Cal.

DR. JOSEPH W. ROE, secretary of the Railway Car Manufacturers' Association and executive engineer of the Pierce-Arrow Motor Car Co., Buffalo, N. Y., has been appointed professor of industrial engineering of New York University. He was graduated from Sheffield Scientific School, Yale University, in 1895. For several years he was identified with the department of mechanical engineering at Yale and the courses in industrial engineering there were developed by him.

HORACE M. BRINGHURST, formerly with Arthur G. McKee & Co., Cleveland, Ohio, is now sales engineer in charge of the steel lumber department of the General Iron Works Co., Cincinnati, Ohio.

JAMES P. HAYS has been appointed general superintendent for the Austin Co., Cleveland, Ohio, on the construction of a $250,000 soldiers' memorial auditorium at Mount Union College, Alliance, Ohio.

BRIG.-GEN. HARRY TAYLOR, Corps of Engineers, U. S. A., in immediate charge of river and harbor matters, has completed an inspection trip of the projects located on the Great Lakes.

CHARLES H. MOOREFIELD has been appointed state highway engineer of South Carolina, with headquarters at Columbia.

LT.-COL. FRANK B. KING, who was in command of the 112th Engineers in France during the World War, has been placed in charge of water and sewer extensions at Duncan, Okla., for V. V. Long & Co., Oklahoma City, Okla.

C. DOUGLAS BUCK has been appointed by the Delaware state highway commission as assistant to the chief engineer, Charles M. Upham, who will serve the Delaware commission in a consulting capacity during his term of office as chief engineer of the North Carolina highway department, a position he will occupy during a leave of absence from the Delaware department.

WILLIAM F. BROCK, an engineer in the department of public works, Columbia, S. C., has been appointed highway engineer with the U. S. Bureau of Public Roads, at Jackson, Miss.

ARTHUR M. SHAW, consulting engineer, New Orleans, La., has sailed for San Pedro Sula, Honduras, C. A., to supervise the design and construction of a complete sanitary sewer system there.

## Obituary

A. L. HUNT, county engineer, Baker County, Fla., died at West Palm Beach, July 4, where he was attending the meeting of the state board of engineering examiners, of which he was a member. As a civil engineer he was connected with railroads of Florida for about 30 years. He was chief engineer of the old Orange Belt Ry., building the line from Sanford to St. Petersburg. He also laid out the town of St. Petersburg.

GEORGE W. POPE, contracting structural engineer for the Minneapolis Steel & Machinery Co., Minneapolis, Minn., and a member of the company's staff for 18 years, died July 9. He was graduated as civil engineer from the University of Wisconsin in 1898. During 1917 and 1918 he was in charge of the purchasing of fabricated steel at the Hog Island ship yards, and in 1919 he returned to the Minneapolis company to take charge of reinforced concrete work.

## Business Notes

THE MASTER TOOL CO., Cleveland, Ohio, has been organized with J. Nightingale, president; Charles F. Overly, vice-president and general manager; William Eckert, secretary-treasurer. The company will manufacture a new line of pneumatic tools and will specialize in reclaiming all types and makes of same.

THE BADGER CONCRETE MIXER CO., of Milwaukee and Watertown, Wis., has recently purchased a 27½-acre tract of land at Winthrop Harbor, Ill., where it will erect a factory for the manufacture of Badger concrete mixers and McVicker tie plates for the Railway Safety Tie Co. A workmen's housing project in connection with the new factory has been developed by the company.

DR. G. J. FINK, formerly with the Hooker Electrochemical Co., has been added to the technical staff of the chemical department of the National Lime Association, Washington, D. C.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Missouri Seeks to Dissolve Building Material "Trusts"

The Attorney General of the State of Missouri has filed ouster proceedings in the State Supreme Court against thirty-four corporations engaged in the production and sale of lumber, sand and gravel, according to recent press dispatches. The allegation is made that the defendant companies have entered into an unlawful combination to prevent competition and maintain excessive prices in violation of the state anti-trust law. The court is petitioned to forfeit the charters of the companies and either to confiscate their property or to impose a fine.

Twenty of the corporations involved are members of the St. Louis Lumber Trade Exchange and fourteen of these are members of the St. Louis Material Dealers Association.

The most recent action of the Attorney General supplements previous proceedings against sixteen corporations, members of the St. Louis Millmen's Association. In all, fifty defendant companies are named in ouster proceedings. The filing of the suits against the companies has followed an inquiry into the business practices of the three associations carried on by the attorney general.

## Production of West Coast Lumber Drops Heavily

For the week ended July 7 the production of 104 mills reporting to the West Coast Lumbermen's Association was only 46 per cent of normal, a fact attributable, says a recent report of the association, to light demand, restricted credit and heavy stocks at the mills. New business and deliveries were likewise depressed, orders for the weeks totaling almost 38,500,000 ft. b.m., and shipments in excess of 36,000,000 ft. b.m. The opinion is expressed in the association's bulletin that, with a resumption of railroad purchases which will follow the distribution of the $500,000,000 to the railroads by the Federal Government, a gradual improvement is anticipated for the fall with a possible return to a normal condition by spring.

## Changes in Retail Food Prices

The retail food index issued by the United States Department of Labor, through the Bureau of Labor Statistics, shows that there was a decline of only 1 per cent in the retail cost of food to the average family in June as compared with May. Wholesale prices, taking into consideration 327 commodities, decreased about 2 per cent in the aggregate. Compared with the high peak of prices in May, 1920, the June level of wholesale prices showed a decrease of 55 per cent.

## A New Departure—Engineering News-Record's Construction-Cost Index Number

### Steel, Lumber, Cement, Common Labor Are Basis of Index Figure Which Rose to Peak of 273.8—Is Now 194.82

Since 1900, and particularly after 1910, complaints concerning the rising cost of living have been increasing in volume both in Europe and America. Numerous systems for studying this increase have been developed. In the United States, according to the Bureau of Labor Statistics, six series of index numbers relating to wholesale prices are currently maintained, four of them by financial papers. In England there are three important series; one in France; in Germany there were three up to the time of the war; while the Governments of Canada, Australia, South Africa, India, Netherlands and New Zealand publish official index numbers, and private investigators have made series for Belgium, Norway, Sweden, Austria, Spain and Italy. Most of the series were founded comparatively recently, the oldest being that of the *London Economist*, which was started in 1869.

Probably the chief reason why reliable studies of price changes were not made until comparatively recently was the prejudice felt against price averages. Early investigators were hampered by the dearth of quotations. The first index number, by Carli in 1750, was constructed with the per cent increases of three commodities—grain, wine and oil. Improved business organization and the availability of a greater amount of data have minimized the lack of confidence in the accuracy of averages of price variations. Furthermore better transportation made wholesale prices in the larger cities basic for many local markets. Today the value of index numbers is generally acknowledged.

#### A Construction-Cost Index Number

Not only has the doubt as to the trustworthiness of index numbers been largely dissipated, but the pendulum of public opinion has actually swung too far in the positive direction. Index numbers must be understood in order to be applied usefully. Few of the widely used index numbers are made to serve one special purpose, most of them being designed to show only changes in the price level. Despite their limitations, however, they are employed to show rise and fall in the cost of living, depreciation of gold, alternations of business prosperity, evidence that wage schedules ought to be revised, the effect of tariff revision, and the reason for political avalanches.

*Engineering News-Record* proposes to publish in the first issue of each month an index number that will indicate the trend of construction cost in the United States. To achieve this the three major materials least influenced by local conditions have been selected. These materials are steel, lumber and cement, and they are combined with the cost of common labor.

Index numbers are called "simple" or "weighted," according to whether they are a mere average of figures having equal importance or the average of figures which have been given their relative importance. It would be obviously incorrect to add the prices of, say, a ton of steel, a barrel of cement, a thousand feet of lumber and a week's wages, dividing the result by four. One might with as much justice (or error) add a pound of steel, a bag of cement, and a board foot of lumber. Instead the relative importance of the four factors in construction operations has been determined, as closely as the problem permits.

TABLE I.—PRICES OF MATERIALS AND LABOR

| | Structural Steel Pittsburgh Base | Cement Net Bbl. f.o.b. Chicago | Pine, Base New York | Common Labor Average for Country |
|---|---|---|---|---|
| 1913 | $1 50 | $1 19 | $28 50 | $0 19 |
| 1914 | 1 15 | 1 14 | 29 00 | .20 |
| 1915 | 1.30 | 1.16 | 28 00 | .21 |
| 1916 | 2 55 | 1 44 | 31 50 | .23 |
| 1917 | 3.67 | 1.77 | 37.75 | .32 |
| 1918 | 3 00 | 1 97 | 43 25 | .45 |
| 1919 | 2 55 | 2 01 | 50 00 | .51 |
| 1920 | 2.95 | 2 09 | 67 50 | .56 |
| 1921 (6 mos) | 2 25 | 2 20 | 57 00 | .57 |
| July, 1920 | 3 10 | 2 15 | 65 00 | .70 |
| July, 1921 | 2 00 | 2.17 | 48 00 | .51½ |

To arrive at a correct balance the first investigation was of the total annual production in the United States of steel, lumber and cement, and of the number of common laborers exclusive of farm labor. The years 1913, 1916 and 1919 were selected for the materials. The average production of steel was about 33,000,000 tons; for cement, 90,000,000 bbl.; for lumber the average of 1913 and 1916 according to government figures was 42,000,000 *M* ft. b.m. The number of common industrial laborers (1910 census) is 4,000,000.

To convert these factors into money, so that they would be comparable, 1913 was selected as the base year, and index numbers were computed from that year to date, using, where possible, the prices published monthly in *Engineering News-Record*. All these prices have been carefully verified. The steel price used is the Pittsburgh base for structural shapes. For cement, the consum-

er's net price exclusive of bags, f. o. b. Chicago was used, as being representative. For lumber, the New York base (3 x 12 to 12 x 12) on Southern pine was used. For labor, from 1913 to 1920 inclusive, the rates paid common labor in the steel industry were used with slight revision, and since 1920 the average common labor rates for the nineteen or twenty cities covered monthly in *Engineering News-Record*. These average prices are given in Table 1.

The following figures, found in the preceding paragraphs, help in determining the proper weight to be given the various materials and labor:

| | |
|---|---|
| 33,000,000 tons steel @ $30 | $990,000,000 |
| 90,000,000 bbl. cement @ $1.19 | 107,100,000 |
| 42,000,000 M ft. b. m. lumber @ $28.50 | 1,197,000,000 |
| 1,200,000,000 man days @ $1.52 (8 hrs.) | 1,822,000,000 |
| | $4,116,100,000 |

It is natural that the question should arise why total production is taken instead of the amount of steel, lumber, cement and labor used on construction work. One reason for using total production is that total production influences cost of construction. In the case of steel, for example, even if it were possible to segregate from the total the amount of steel used on construction, an indeterminable error would be introduced by using the latter. Construction cost is influenced directly or indirectly by the cost of machinery and tools, by the demand for armor plate and rails, and by the export demand. It is therefore desirable to take into consideration the entire production. The same is true for cement, and only less so for labor. As regards labor, the shift from one industry to another is of such nature as to necessitate considering the total for common labor (exclusive of farm labor) in determining the part it plays in construction cost.

With the principles outlined in the preceding paragraphs as a basis, and with the aid of the judgment of experienced construction men, the elements of the computation adjusted to give 100 for the base year 1913 are as follows:

| | |
|---|---|
| 2,500 lb. structural steel, $1.50 per 100 lb. | $37 50 |
| 6 bbl. cement, $1.19 | 7 14 |
| 600 ft. b.m. pine, $28.50 | 17 10 |
| 200 man-hours, $0.19 | 38 00 |
| | $99 74 |

The *Engineering News-Record* Cost Index Number, computed as above, starts at approximately 100 in 1913, and is carried forward without intermission to July, 1921, where the number stands at 194.82. It will be published regularly in the first issue of each month. During the last nine years the number has risen to a maximum of 273.80 in June, 1920, and has shown yearly figures as tabulated below:

| | |
|---|---|
| 1913 | 99 74 |
| 1914 | 92 99 |
| 1915 | 88 26 |
| 1916 | 137 29 |
| 1917 | 189 02 |
| 1918 | 202 77 |
| 1919 | 207 81 |
| 1920 | 238 79 |
| 1921 (7 Mos.) | 214 39 |
| July 1921 | 194 82 |

## Employment in New York State

Though there was a reduction of 2 per cent in employment in factories of New York States in June as compared with May, a decided improvement in some industries, and particularly in textiles, is shown in statistics prepared by the state industrial commission. The number of workers in the textile industry in June as compared with January increased 52 per cent. The total decline in employment for all industries during the period of depression has been 28 per cent. Save for a small decrease in rope and twine manufacture and cotton goods finishing every branch of the textile industry showed a gain during June. A statement from the industrial commission asserts that "seasonal activity in the building trades was responsible for greater production in June in the manufacture of brick and lumber mill products. The cement and plaster industry reported a decrease in employment during the month. . . . The metal industries again showed the heaviest reduction."

## Railroads Carried 2,249,657,625 Tons in 1920

The total tonnage of commodities transported over the Class 1 railroads of the country during the year ended December 31, 1920, totaled 2,249,567,625 tons. Of that tonnage 53.60 per cent was made up of the products of mines. Manufactured articles and miscellaneous comprised 21.91 per cent of the tonnage carried, while products of agriculture furnished 9.78 per cent; products of forests 8.74 per cent; all less-than-carload freight, 3.98 per cent and products of animals, 1.99 per cent.

## Highway Bids on 68 Miles Are 86 Per Cent of Estimate

Bids opened by the New York State Commission of Highways on July 13 revealed the fact that the low bids on the eighteen construction and repair projects covering 68 miles of highways totaled $2,327,882, or approximately 86 per cent of the engineers' estimate on the work. There was not one project advertised upon which no bids were received and the total number of bidders was 111. Ninety-one contractors bid to build 60 miles of road of various types, one project of 8.8 miles attracting eighteen bidders. Another project of a length of 3.2 miles received twelve bids and another of five miles, ten bids. A repair project 3.66 miles long attracted eleven bids. Only three projects received two bids or under and two of these projects were repair jobs each, less than a mile long.

Not only were the low bids 14 per cent under the engineer's estimate, but the high bids totaled $2,603,717, of approximately 96 per cent of the engineer's estimate. On the project for which 18 contractors bid, the low bid was $50,000 under the engineer's estimate and there was a difference of less than $40,000 between the low and the high bidders.

## American Plan Probable Result of San Francisco Strike

The American plan is gaining popularity rapidly as a means of getting back to work on a satisfactory basis after the long period of controversy between builders and the unions in the San Francisco Bay district. (Previous reference to the controversy there appeared in *Engineering News-Record*, Feb. 3, p. 239; April 14, p. 660; and June 2, p. 970.) As a result of the rejection of the arbitration award by the building trades council on April 30 and the failure of efforts to induce that body to abide by the terms of the arbitration agreement, the builders exchange determined to have no further relations with the building council.

On June 13 the American plan was inaugurated with a fixed wage scale based upon the reduction of 7½ per cent prescribed in the arbitration award. In the month that followed the architectural iron workers, elevator constructors and teamsters unions accepted the American plan and returned to work on that basis as did also members of one carpenters union. The indications on July 13 were that despite a loyalty to their unions and because of dissatisfaction with union leaders, the tendency of union men was to accept the American plan rather than remain idle.

### Building Mechanics Imported

During the strike there has been little or no disorder. The builders exchange is conducting employment agencies with branches in Los Angeles, Seattle, Portland, Salt Lake and other cities, and building mechanics are being brought into San Francisco as fast as they are needed in the work under way. These men have been brought in under the assurance that if found to be qualified craftsmen, as claimed, they will have steady employment for ninety days and equal chances with union men for further employment if and when the unions return to work. A hotel was leased for the accommodation of these men. On July 13 there were more than 1,200 building construction jobs, large and small, under way in San Francisco and vicinity and about 4,000 men at work, of which 1,000 had been brought in from other points.

Commercial, industrial and financial interests of San Francisco are supporting the American plan movement, and an industrial association has been formed whose members have pledged a fund of $1,300,000 to maintain the present movement on a permanent basis. A statement of the program of this association is that:

It is not aimed at the destruction of unions, but has adopted the fundamental policy that dealings shall be with individual employes only and agreements will not be made with unions. There shall be no restriction in output or the use of materials or machinery. Work shall be on a basis of an 8-hour day, a minimum 5½ day week, time and a half for overtime, double time for Sundays and holidays

## Building Wage Disputes in Several Cities Settled

Adjustment of building-wage sched-s downward has been made in several ies during the past few weeks. Arbi-tion proceedings are in progress in iers and in still other localities strikes lockouts continue to defer building nstruction.

New York City building trade me-nics, whose associations are mem-rs of the building trade council, have used to confer with the building des employers association on the stion of wages, asserting that there s no need for such a discussion, inas-ch as there was a contract existing ween the council and the employers ociation which established a definite e of wages until Jan. 1, 1922. Prac-lly 100,000 men would be affected re a wage decrease put in effect in w York City. It is possible that the ployers association will be able to otiate with plasterers, stone cutters, k layers and painters, as those ons are not members of the building des council.

A strike of twomonths' duration in vidence, R. I., was brought to a close week through the agreement made ween the plasterers' union and the tracting plasterers whereby the es shall be $1.05 an hour until July 922. This represents a reduction of per hour. Most of the other trades made previous settlements.

### Untermyer's Decision

The decision of Samuel Untermyer, arbitrator in the Westchester nty, New York, building trades dis-e, has been made public and has n accepted by both sides to the con-versy in accordance with the condi-s under which he was chosen arbi-tor. Mr. Untermyer's decision fixes wage scale at $8 a day from Sep-ber 1, which means that the building des mechanics will receive $9 up to t date. Corresponding reductions to be made after September 1 in pay of those receiving less than $9 ly now. Mr. Untermyer did not fine his decision to a fixation of es but discussed other conditions the building industry. He finds that or is being exploited, that the cost living reduction is sufficient to war-t a dollar decrease in wages, and t the five-day-a-week arrangement one of the local unions is a "vicious cedent, detrimental alike to the wel-e and efficiency of the men and to prosperity of the country if it were become a universal rule."

Wages in many of the building trades Trenton, N. J., have been reduced m 50c. to $2 a day by the arbitrator. rpenters, tile fitters, metal lathers d electricians will continue to receive per day. The new schedule which came effective July 18 maintains the -hour week, time-and-a-half pay for ertime and double pay for Sunday.

The investigating committee created Rochester, N. Y., for the purpose of making an investigation of the building-trades situation has made public a voluminous report in which it offers eight recommendations as a basis for adjustment of the present controversy in the building trades. The recommendations are (1) that wages be arbitrated within ten days after submission to the arbitrator; (2) that upon an award being made the men return to work under the terms of the old agreement; (3) that the right to boycott non-union material be held in abeyance during the term of the agreement; (4) that no discrimination be made against the men now employed by the contractor; (5) that there shall be no restrictions placed upon the amount of work performed by an individual or group of individuals nor shall production be limited; (6) that there shall be no cessation of work at any time on account of jurisdictional disputes; (7) that there shall be suitable procedure for conference, conciliation and arbitration; and (8) that pending such proceedings there shall be no walkouts, strikes or lockouts.

## Ohio Highway Work Averaging $1,000,000 Weekly

More than $1,000,000 a week was spent on the highways in Ohio during the latter part of June and this amount will be continued if not increased during the coming few months. Vouchers for a total of $2,461,504 were paid out by the Ohio Highway Department for work done between June 15 and July 1. This is the largest amount every spent in that short period of time since the department was organized.

## Bids Opened on Wilmington Port Work

The Hughes Foulkrod Co., Commonwealth Building, Philadelphia, was the low bidder on the Wilmington, Del., port work, when bids were opened last week. The total bid of the Philadelphia concern was $1,311,000. Seven other bidders bid on the total work which includes berthing and retaining bulk heads, a marine cargo shed, a coast-wise cargo shed, cafeteria and barracks, grading and filling, track work and miscellaneous installations. The two other bidders next to the low bidder were Snare & Triest, New York City, and John R. Wiggins Co., Philadelphia

Although but eight contractors bid upon the entire work, combination bids were received from thirty-three contractors.

## Pennsylvania Receiving Bids on 60 Miles of Durable Pavement

Until Aug. 5, the Pennsylvania State Highway Department will receive bids for the construction of approximately sixty miles or hard surface paving. Most of the work is to be of one-course-reinforced concrete, though alternate bids including a bituminous surface on a concrete foundation will be received on several projects. There are twenty-seven projects in twenty-five counties in the list.

## The Government's Part in Solving the Housing Situation

In addressing the National Association of Real Estate Boards in Chicago, July 15, Herbert Hoover, Secretary of Commerce, asserted that, though the federal government had a responsibility in the solution of the housing situation, it had no notion whatever of going into the housing business either directly or indirectly. "It will not fix prices nor wages," asserted Secretary Hoover, but he said that what assistance it could offer would be directed toward driving every combination out of business that attempted to restrain trade, toward facilitating the flow of credits into home-building channels, and toward accumulating ad disseminating information, scientific study of certain problems in materials and methods, and in cooperation with the industries to receive voluntary reduction in wastes so that the cost of homes might be decreased.

Investment in tax-free securities Secretary Hoover asserted had materially diverted capital that should have been used for building, and had resulted in increasing the interest rate to home builders. An examination of saving institutions, the cheaper lines for home buildings, he said would reveal that the total sum of money available, either in mutual savings banks, building and loan associations, or in savings departments of national or state banks and trust companies, or in the assets of insurance companies, would aggregate $22,000,000,000. Eliminating building and loan associations, all of whose assets are used in building, and the actual savings banks who devote from 40 to 50 per cent of their deposits for this purpose, he said that it would probably be found that savings departments of the national banks or the state banks of the trust companies and of the insurance companies which comprise more than half of the total savings, do not loan for home buildings more than 10 to 15 per cent of their deposits or savings assets. Such a diversion of savings money into commercial channels meant, asserted Secretary Hoover, a natural drift toward a higher interest rate.

### Remedial Measures

Inasmuch as Secretary Hoover asserted he believed a more stable economic system would obtain were a more regular proportion of savings made available to home buildings, he deemed the proposed amendment to the Federal Reserve Act, through which a greater per cent of savings deposits of national banks might be used for building purposes, was an advisable change. He also said that he believed it would be a highly desirable condition if 40 to 50 per cent of the deposits in postal savings banks could be used for home-building purposes.

One of the things which the Government is undertaking and which Secretary Hoover asserted should be of general interest, is "an organized effort to solve certain problems in waste by

organized co-operation with the industry and by scientific investigation throughout the Department laboratories." A nation-wide scientific revision of the building code, which would doubtless lead to greater strength, durability and fire resistance of structures yet which would result, in a more scientific use of materials, in a decreased construction cost, Secretary Hoover asserted would be followed by "a scientific revision of the fire insurance regulations, so that suitable materials may be more promptly utilized and the art of building more rapidly advanced." He said that the Government was now undertaking a study of the activities of various communities in the United States and foreign countries in the development of home building, the results of which investigation would be generally circulated.

## Contract Price for Mile of Road Is $16,332

The State Highway Department of New Hampshire recently awarded a contract for the construction of a bituminous macadam road 18 ft. wide and 1.01 miles long at a cost of $16,332. Included in the items of work are 2,120 cu.yd. of earth excavation, 1,671 tons of bituminous macadam, 450 tons of crushed native stone, 675 cu.yd. of field stone, 21,847 gal. of bituminous material, and 10,710 yd. of modified surface course. Another contract was let at the same time for 2.2 miles of modified asphalt pavement at a total cost of $55,932. This is an average of $25,444 per mile. In the second contract were included 6,368 cu.yd. of earth excavation and borrow, 2,677 tons of bituminous macadam, 23,274 sq.yd. of paving.

## Builders Who Employ Ex-Service Men To Get Contracts

*(London Correspondence.)*

The British Minister of Labour ha announced that from September 1 next contracts for the government on whic bricklayers, plasterers, slaters and tiler were employed would be let, save i exceptional circumstances, only on con dition that the contractor was employ ing ex-servicemen, in accordance wit the conditions of the government's dilu tion scheme. (*Engineering News-Re ord*, June 23, p. 1099.) Every effort being made by government department to insure that a proper proportion c ex-service men is being taken on an employed on existing contracts.

The attitude of the trade unions co cerned in the majority of cases hostile.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for t important cities. The last complete list will be fou in the issue of July 7, the next, on August 4.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minne-apolis | Denver | San Francisco | Seattle | Montre |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $3.03 | $4.00 | —$4.30 | $2.93 | $3.31 | $4.65 | $4.25 | $4.60 | $5.00 |
| Structural rivets, 100 lb. | 4.40 | 5.25 | 5.75 | 4.88 | 5.20 | —5.50 | 6.00 | 5.50 | 8.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2.93 | 3.25 | 3.75 | 3.00 | 3.53½ | +4.02½ | 2.35 | 4.00 | 4.25 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 50.65–5% | 45% | 58½% | —53.9–5% | 36% | 49.50% | 47½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 49.10 | 59.22 | —57.50 | 49.10 | 57.80 | —62.00 | 80.00 | 65.00 | 75.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@—2.70 | (del.)—2.50 | 2.80 | 2.17 | 2.46 | 3.10 | 3.09 | 3.10 | 4.28 |
| Gravel, ¾ in., cu.yd. | 2.25 | 2.35 | 3.00 | 2.25 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1.25 | 1.40 | 2.50 | 2.25 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | —1.90 to 2.00 | 2.25 | 2.80 | 2.50 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 47.00 | —38.00 | 35.00 | 55.00 | 36.00 | 47.00 | 27.00 | —23.00 | +120.00 |
| Lime, finishing, hydrated, ton | —18.49 | —20.00 | 25.00 | 20.00 | 29.00 | 32.00 | 25.40 | 24.00 | —28.00 |
| Lime common, lump, 200 lb. bbl. | 3.79 | —1.45 | 2.75 | 1.65 | 1.50 | 3.10 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | —11.00 | +12.65 | 12.00 | 17.00 | 14.00 | 18.00 | —14.00 | 18.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .13 | .09475 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | .1232 | .15 | .13 | .07410 | .092 | .10 | .14½ | .12 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | .76 | +.79 | —.97 | .84 | .88 | +.96 | .96 | .79 | .84 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 1.00 | .50 | .50@.63½ | .81½ | .75 | ..... |
| Common labor, non-union, hour | ..... | .25 | .35@.45 | .45 | .50 | .37½@.50 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45%5% means a range of 45 to 50 per cent. Charge of 15c. per 100 lb for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted alongside dock. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. Wire quotes on brown lime; white is 15c. additional. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone a quoted f.o.b. cars, other materials delivere **San Francisco** quotes on Heath tile, 5½ x 8 11½. Prices are all f.o.b. warehouses exce C. I. pipe, which is mill price plus freig to railway depot at any terminal. Lumb prices are delivered "at ship tackle in S Francisco ex mill." **Seattle** quotes Douglas fir instead of pine; and on lime paper bags. **Montreal** quotes sand ston gravel and lump lime per ton. Cemen lime and tile are delivered; sand, grav and stone, on siding; brick f.o.b. plan steel and pipe at warehouse.

## Changes Since Last Week

Concreting materials, particularly gravel and crushed stone, show a noticeable drop in price in New York. Gravel is quoted at $2.25 per cubic yard, as against $2.50. Crushed stone shows a drop to $1.90@$2. Cement ranges between $2.60 and $2.70 delivered.

Hydrated lime is down in Montreal, Atlanta and New York.

Quotations on structural shapes in Dallas show a decline of 20c. per 100 lb. while Denver reports a drop of 50c. in structural rivets.

Minneapolis reports increased discounts on steel pipe, the present discount on 3½ to 6-in. lap-welded being 53.9-5 per cent, as against 51.9-5 per cent.

Both Denver and Dallas show a marked drop in cast-iron pipe—a redu tion of $8 per ton in Denver and $7.5 in Dallas.

Pine is quoted in Atlanta at $38 against $40. Seattle quotes Dougl fir at $23 as against $28.50.

Linseed oil is steady, the only fluctu tions being an increase of 1c. per gall in Atlanta and Denver and a drop of 1 in Dallas.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 87 — NEW YORK, JULY 28, 1921 — Number 4

## Waste in Building

NO PANACEA can cure the disease of waste in the building industry revealed in Col. Thompson's report to the Committee on Elimination of Waste, which is abstracted in the news pages this week. The ills are too varied and too many for hope of immediate relief. In the principal troubles listed, however, there is a sharp difference between those which are due to individual ignorance or neglect and those which are fundamental, a result of evil conditions which will require a revolution to correct. All of the wastes due to inefficient management are readily remedied; they are in fact faults of the lower grade contractor and ones which a proper practice would not permit. The cure of this evil lies in emphatic and continued education. The wastes due to irregular employment, on the other hand, are not within the power of the individual to correct nor are the restrictive union working rules amenable to revision except as the result of a long campaign in which the labor leaders must have the most prominent part. With the Thompson report before it as an outline of conditions, American Engineering Council would do well to approach the Associated General Contractors with a view to joint action looking toward a systematic solution of the problem of building waste. It will be a long job which cannot be started too soon.

## Claude

THE best map existing in the Oklahoma City water distribution system until recently was no better than the information in the brain of an old negro, Claude. Claude was a water boy in Oklahoma City when the city was young, less than thirty years ago. The other day Claude walked the streets east and west pausing at each intersection to tell the accompanying engineer what mains and valves existed under the ground. What he said was more dependable than the maps. The story of gates broken closed, principal mains with ungated hydrants on them and paved-over valves is told on another page. How many water departments depend on Claudes?

## Public Works Estimates

THE wide gap between the original estimate for a public work and the actual cost can be no better illustrated than by the recital of the history of the proposed central heating, lighting, and power plant project for some of the public buildings in Washington. It will be remembered that five years ago a vigorous fight was prosecuted by the defenders of the "city beautiful" against the erection along the Potomac of a Government power plant which was to have chimneys disfiguring the skyline. In spite of this opposition, Congress authorized the construction of such a plant at a cost not to exceed $1,494,104, a sum which was increased a couple of years later—that is, in June, 1917—to $1,737,104. The first bid received on the work was for $1,698,500, which was in excess of the earlier appropriation and the plans were revised so that the bid accepted was $1,640,148. Work was started but foundation troubles led to its suspension in June, 1916. Based on the investigation of these troubles, revised plans were made in October, 1917, and the lowest bid for the additional work was $635,793. In June, 1918, the whole project was shut down to release labor and material for war purposes and the contractor paid $855,944 for the work which he had done. Recommendations now made to Congress state that, exclusive of the material delivered, worth somewhat over $200,000, the contract is 18 per cent completed. Considering from a financial standpoint, that is with the material added, it is 36 per cent completed. To proceed with the project and complete it the Secretary of the Treasury now reports would cost $4,000,000. This brief résumé is not given in criticism of any one connected with the project, but merely to show how a typical history of a public engineering project may read.

## Railroad Tunnel Lining

REPLACING the timber lining with concrete in western railroad tunnels is as logical a procedure now as was the use of timber lining when the roads were built. Much the same reasoning applies as in the early use of a timber trestle which is replaced by a fill or a more permanent structure as soon as earnings warrant or as soon as maintenance of the original structure becomes excessive. However, a tunnel involves uncertainties that complicate the situation more than would be likely with any surface structure and it will be many years before all the old timber linings will be replaced with concrete. Some of the considerations involved and construction methods that have been applied on western railroads are reviewed in the article on another page. On lines where the locomotives burn oil, as is now the case on most Pacific Coast roads, and with concrete lined portals to protect the timbering from fires of external origin, the two most serious dangers in timber-lined tunnels are derailment and the loss of the arch. The latter represents not only expense to the railroad company but may mean prolonged blockade of the line. Derailed cars are almost sure to strike and catch on the plumb posts, wedge the cars across the tunnel and, if the overlying material happens to be heavy, may let down the arch. Wrecks of this sort catching on fire and burning the timber lining in both directions from the damaged section have blockaded main line railroads for weeks at a time because, in addition to clearing out the jammed equipment, it is necessary to open up the tunnel and restore the roof support. The hard, smooth surface of a concrete lining, on the other hand, prevents derailed equipment from damaging the tunnel or endangering the arch. While there are some notable exceptions, the tendency is strongly toward concrete lining on all permanent construction.

### Cement and Aggregates

ELSEWHERE in this issue figures are given showing that for the first six months of 1921 the shipments of cement were 98 per cent of the shipments for the same period of 1920, and those of stone, sand and gravel 87 per cent. This seems a remarkable fact in view of the belief generally voiced that 1921 is a particularly lean construction year. It is true that so far this year roadbuilding has had one of the greatest periods of activity in its history. Yet highway work calls normally for about 25 per cent of the cement production. This year the per cent will undoubtedly be higher. Between 40 and 50 per cent of the cement goes to agricultural uses, and the balance to miscellaneous construction. Since the cement industry is in good shape it is natural that the aggregate producers are doing a good business. How is it then, if the construction industry is suffering so badly through inactivity, that the production and shipments of construction materials are so near to normal! Can it not be said again that we must be doing much more construction work than is popularly believed?

### Conditions Reflected in Prices

IN CONNECTION with the foregoing it can be seen from present and past price quotations of cement and aggregates that business with these industries has been good. While a price war is being waged among steel manufacturers, operating on a 25 per cent production in the endeavor to stimulate buying, the price of structural shapes in the New York market has dropped to within 40 per cent of the average 1913 price. No such reduction has come in either cement, sand, stone or gravel. All these materials are double what they were in 1913. It is quite apparent that cement and aggregate producers do not have to enter into any price-cutting competition in order to stimulate business.

### Railroad Engineers in Professional Class

ENGINEERS, whether or not they work for the railroads, should be interested in the Interstate Commerce Commission "Rules Governing the Classification of Steam Railway Employees and Reports of Their Service and Compensation," prepared by the U. S. Railroad Labor Board under the direction of J. L. Jacobs, industrial engineer, Chicago. Engineers have now a classification of their own. They are officially given professional status since they are listed under the "professional service" class along with three other groups, chemists, lawyers and architects. The order went into effect July 1, and the railroads are now revamping their classifications in accordance with the new rules. Engineers should see to it that they are properly placed. It will be much easier to get proper allocation now than a year from now.

### Road Research

HIGHWAY research received a new impetus this week with the announcement by Engineering Foundation of the National Research Council's plans for the work of its advisory board and the selection of Prof. W. K. Hatt as director of future activities in this highly important field. This board, it should be explained, is not to function as an agency of investigation and experimentation, but rather as a means of assisting existing organizations in determining upon a national program of highway research, co-ordinating these activities, appointing committees for specific problems and, in fact, serving as a clearing-house for research information regarding roads. The time is ripe for a movement of this sort and the board takes a bread-gage view of the scope of its work in stating that the field will include economics, design construction and administration. In announcing its program the Engineering Foundation has made it known that "there is abundant money available for the research work itself." This news is reassuring. It frequently happens that the soundest kind of argument can be made in support of a program of experimentation such as that outlined for the highway research work. The trouble in the past has generally been, not in formulating a program, but in financing it.

## Engineering Society Movements in Great Britain

IN WRITING from England last year the editor of *Engineering News-Record* indicated that engineering society movements in the United States were being closely paralleled by those of Great Britain. The young men are organizing on their own account; in the old societies a long period of conservatism is giving way to policies of expansion. Recently our English correspondent has summed up the situation for us as regards the Institution of Civil Engineers. His picture is a counterpart of that which we find in our own society of civil engineers. Says our correspondent:

"There is considerable controversy among members of the Institution of Civil Engineers regarding its organization and functions and the part it will play in the future in the engineering world of Britain. Several members have complained of the impending policy of decentralization evidenced by the formation of local bodies of members of the society, due to the demand of provincial members for a larger share in the facilities offered by the institution. Among the younger members there is claim for a larger share in the administration of the body, and also for more facilities for their own advancement in the science of civil engineering. While many of the older members are quite satisfied with the conduct of the institution, many others maintain that it needs bringing up to date so as to conform with modern ideas and tendencies. For instance, many students and associate members maintain that the institution should assist its members in finding employment, that is to say, to establish an employment bureau on the lines adopted by other scientific bodies. Some go as far as to say that no engineer should be appointed who is not approved by the institution. Thus the society would take upon itself the functions of a trade union. This view is interesting especially as there is a strong movement afoot to promote a bill in Parliament to restrict the profession to qualified engineers. Such a bill if passed would probably lead to other developments; for instance, the establishment of a code of ethics and scales for remuneration. The adoption of such principles would go far toward establishing definite standards of education, both technical and practical, besides protecting the public from unqualified engineers. It is also felt that the institution might promote social and educational activities not only in London but in the great provincial centers."

All of which is but further evidence of the existence in England of the same fundamental conditions in the engineering profession that obtain here.

## A Nation-Wide Highway Census

IN SPITE of the fact that roadbuilding has developed into the nation's greatest engineering activity, the fundamental data available regarding its extent and cost are far from complete. Many of the states, of course, have adequate records of their highway work, but from the national standpoint an all-inclusive summary of the situation does not exist. Any adequate picture of the status of road construction and finance must include, not only federal-aid, state and county work, but also the extensive paving operations within the limits of incorporated cities and towns. Lack of centralization in the administration, by states and lesser governmental units, of the various classes of highway and street improvement, has rendered difficult the task of a nation-wide survey. This deficiency the U. S. Bureau of Public Roads proposes to remedy by a country-wide census of highway mileage and funds, as outlined by Mr. Allen in this issue. Without such data as it is now planned to collect annually, highway work cannot be administered on the sound business basis which its future success demands. In practically all of our basic industries—steel manufacture, for example—the need for accurate statistical information regarding raw materials, production, unfilled orders, etc., as an index of fundamental current conditions, was long ago recognized and machinery developed for its periodic collection and compilation. The same procedure will be a great boon to the highway field. The gathering of these statistics is not a one-man job. The success of the effort depends upon widespread co-operation in which states, counties, townships, road organizations, and individuals must share. The load is too great to be borne by a few. The tremendous value of the results to be secured, however, justifies a prompt and accurate reply from all sections of the country to the federal government's questionnaire. In addition to its main object, one of the great auxiliary benefits to accrue from such a census is, obviously, the development of a uniform system of reporting road construction receipts and expenditures.

## The Void Theory Revived

FERET, the French engineer, builded probably better than he knew when thirty years ago he published his famous void theory of mortar strength. Few contractors or engineers today are familiar with his paper, but every one of them when he specifies a 1:2:4 or 1:3:6 concrete is following Feret's deduction that void filling requires about twice as much stone as sand. Four or five years ago, several different investigators working mainly in this country commenced to throw some doubt on the void theory and though there were many engineers who continued to plead that proper proportioning requires that the cement paste just fill the voids in the sand and the mortar just fill the voids in the stone, tests showed that it was impossible completely to fill such voids in field concrete, even were it possible accurately to determine the voids in the aggregate in the condition it is when it is mixed in concrete. Consequently, proportioning theories began to look toward other properties of the aggregate—its linear and surface dimensions, for instance—and toward the effect of the amount of water which so obviously controls strength. To those workers in concrete who have been somewhat confused with the multitude of testimony and the contradictions in tests in these new theories of concrete proportioning, the return to the void principles advocated by Professor Talbot in his A. S. T. M. paper abstracted in this issue of *Engineering News-Record* will be most refreshing.

Although Prof. Talbot acknowledges his indebtedness to the earlier void theory and particularly to Feret, it will be clearly understood by reading the paper that he is working on some quite new lines. The early theories held that every void in the sand should be filled with cement paste and every void in the stone with the mortar. The bulking effect of wet sand was known and measured, but not quantitatively appraised in proportioning the concrete. Feret's tests, furthermore, applied practically only to mortar. Talbot goes further. His tests establish that concrete strength is inversely proportional to concrete voids, which he says is the same, quantitatively though not proportionately, as mortar voids, for in most practical concrete the mortar fills all the stone voids. He then proceeds to establish exact values for the variation in mortar voids for any given aggregate under varying conditions of water content and cement-aggregate ratio. He contends that the concrete strength-voids ratio is consistent regardless of grading, and that therefore all that is necessary in correct proportioning is to establish the mortar voids conditions of the aggregate under investigation and to fix the amount to be used in the concrete mixture of desired strength from a comparison with the standard curves for voids-strength relations. In other words, the analysis is based on mortar voids and not on aggregate voids as in earlier void theories.

Obviously this theory, as all other theories of proportioning, rests on tests. Professor Talbot has made a great number of such tests, but has a great many more under way and is, therefore, not insistent on the truth of his theory until he has had more confirmation. It should be stated, incidentally, that other investigators claim that tests do not always show density to be a measure of strength, so that the contradiction between tests is not yet fully composed.

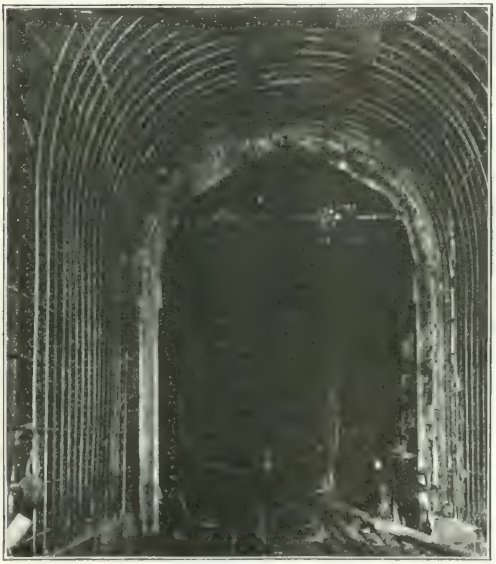
It has been noted that although the Talbot theory admits the fact that the cement paste will not completely fill the voids in the fine aggregate, it is based on the principle that the mortar does completely fill the coarse aggregate voids. In his paper Professor Talbot says that the tests made and examined so far seem to confirm this contention within 1 or 2 per cent variation, which can be readily taken care of in his formulas for designing proportions. It would seem, however, that this particular feature of the studies would need considerable confirmatory tests for field placed concrete. Any one who has seen apparently well-settled concrete drop an inch or two in the form under the application of air hammers outside, wonders if possibly there are not in most field concrete voids not entirely accounted for by the failure of the cement paste to fill the sand.

A final remark regarding this and other apparently complex theories of proportioning may be worth while. The theories seem to be unduly elaborate and complicated to the man who has been in the habit of mixing 1:2:4 concrete, but the fact should not be overlooked that all of the elaboration and all of the complications are taken care of at one time by a few men working in a laboratory or an office, and that the field man who puts in the concrete need have no more difficulty in putting in a 1:1.96:3.52 concrete—provided that proportion has been established by some other engineer—than he would have in putting in his familiar 1:2:4 mix.

# Relining Pacific Coast Railroad Tunnels With Concrete

**Timber Put In When the Roads Were Built Has Given Long Service, but Hazard and High Maintenance Lead to Substitution of Concrete—Methods Used on Various Roads**

IN THE early days of railroad construction in the West, practically all tunnels were lined with timber. Concrete lining was most rare. Cement would have required a long haul, while excellent redwood or cedar timber was nearly always available near the site and in those days could be cut and placed for about $25 per thousand. These woods have long life and high fire-resistant qualities; a considerable amount of redwood timber recently taken from tunnels on the Northwestern Pacific R.R. where the section was being enlarged was found to be in excellent condition after being in place 35 years. This long life cannot ordinarily be expected where heavy material is traversed, and in fact, timber lining is now regarded as a constant hazard because, in addition to the fire danger, there is the possibility of distortion through movement of the earth strata or through destruction by derailed equipment.



FIGS. 1 AND 2. CONCRETE LINING WORK IN PROGRESS, TEHACHAPI TUNNEL 6
At right, finished concrete section, with adjustable steel beyond. At left, section ready for concreting, showing timbers still in place behind the reinforcing. Concrete pipe on the right is serving an adjoining section.

As traffic and competition increase, blockades become more serious and freight and passenger departments become anxious to see concrete lining substituted for timber. Fortunately, concrete has become comparatively less expensive. Hence, in the extensive relining which has been done in recent years, for the most part concrete is being substituted for the timber.

On the Southern Pacific system, timber tunnel lining is being gradually replaced with concrete on lines where there is no question either as to permanence of location or continuation of a single-track line. Over the Tehachapi Mountains, for example, when the double-tracking project is carried out the new track will be built on a new location and the present single track (on 2.2 per cent grade) will be maintained for west or down-bound traffic. Yet all tunnels on the Tehachapi grade are being lined with concrete, and, in fact, the work is being given preference over that on other parts of the system. This is because of the greatly increased danger of blockades here, due to the fact that the maximum grades and sharpest curves on the 500 miles between Los Angeles and San Francisco occur in a 20-mile stretch on which there were, until recently, 17 timber-lined tunnels. Derailments due to worn and broken equipment are more likely to occur here than elsewhere on the line. Within recent years fires in the timber lining, and tunnel jams caused by derailed equipment, have several times blockaded traffic for days. Although this is only a single track, for 68 miles it constitutes the main line of both the Southern Pacific and the Santa Fe between San Francisco and Los Angeles, so that a tie-up very soon becomes a serious matter.

*Lining at Ends Most Important.*—The danger of fire in timber lining is believed to come chiefly from sources outside the tunnel. For this reason, it is held, the danger is much reduced by concrete lining *at the portals*. In fact, lining the portals for a distance of about 100 ft. into the tunnel is now the accepted policy on the important tunnels of all western lines. The protection against fire afforded by portal lining was regarded as important enough in the case of the San Fernando tunnel to warrant the expense of a separate

camp at the west end in order that a 125-ft. length at that portal could be lined a year earlier than it would have been done by the concreting crew which was working through from the other end. Practically all the concrete lining placed by the Southern Pacific is reinforced. The Western Pacific, on the other hand, uses unreinforced lining, 18 to 24 in. thick, except where unusually bad conditions have to be met and a special section is designed. This company has designed various special types of lining. One of these has the crown of the arch well over to one side and ranges in thickness from 2 ft. at that point to a thickness of 4 ft. 6 in. at the bottom of the walls. In ordinary cases, however, the Western Pacific has found a uniform unreinforced section adequate, and no failures have been reported. The standard concrete lining of the Santa Fe system is unreinforced concrete 18 in. thick. This company early established the policy of putting permanent lining in its tunnels and all but two on the lines of this system west of Albuquerque were relined with concrete in the late nineties.

FIG. 3. TYPICAL CONCRETE LINED SECTION, WESTERN PACIFIC R.R.

### Practice of Various Roads

Timber lining was used exclusively in the original construction of the Northwestern Pacific R.R., a line extending from San Francisco some 300 miles north. The first tunnels on this line were built about 37 years ago and very little timber renewal has been made to date. In fact, even allowing for replacement at much less than the average life of redwood, the renewal cost has been figured as less than the interest on concrete lining. Of course that does not take account of the decrease in hazard when concrete is used. In the district traversed by this line, however, the forest-fire menace is not considered great and the traffic is not sufficiently heavy to make very serious the hazard of blockades resulting from derailments in tunnels.

The common practice in the West is to estimate the life of redwood in sills, bulkheads, on bridges where the wood is in contact with the earth, etc., as three times the life of Douglas fir. Douglas fir is considerably stronger in cross-bending, and because wet-and-dry conditions in tunnel work are often not unfavorable, fir or pine is frequently used for tunnel posts, while redwood is used for footblocks and lagging, the latter usually in 3-in. thickness. How far the life of timber lining is affected by climatic conditions may be judged from the recent statement of the chief engineer of a railroad in the Northwest who said: "East of the Cascades we find that timber linings last from 12 to 15 years, while in the coast country it is often necessary to make renewals six years after date of construction."

In addition to the work on the Tehachapi, the Southern Pacific is concreting the San Fernando and Chatsworth tunnels (6,978 ft. and 7,238 ft. long respectively) in southern California as well as several tunnels on the Santa Cruz line. Moreover, on all divisions where tunnel maintenance gangs are worked, concrete lining is occasionally put in for short sections where heavy ground necessitates strengthening or replacing the timber lining.

*Maintenance and Inspection*—The cost of maintaining timber-lined tunnels through heavy material is always large, and increases as the timbers age. Some railroads keep tunnel maintenance crews in all divisions where there are timber-lined tunnels. On the San Fernando and Chatsworth tunnels maintenance crews averaging 18 men at each tunnel have lived at the portals and worked continually in one tunnel since shortly after the line was opened. Concrete lining will hold the tunnel arch in sections where the timbers are continually being crushed. For this reason, where a short timbered section becomes very difficult to hold, concrete lining is often put in for this short distance, leaving the remainder of the tunnel to be lined with concrete later, when financial conditions permit.

### Decayed Footings

Where the timber is alternately wet and dry the decay is more rapid than otherwise. Ordinarily footings show decay first. Joints in the segments of the arch are also vital points. Inspectors looking for these conditions watch also for posts split by earth pressure. One experienced tunnel engineer states that it is his practice to note the deflection in the plumb posts as a basis on which to estimate the pressure of the overlying material.

With proper inspection methods it is believed that indications of practically every danger arising from weakened timbers can ordinarily be detected in time to have the timber replaced before the danger point is actually reached. Decayed plumb-post footings on the Los Angeles & Salt Lake R.R. have been repaired by putting in 8 x 12 and 12 x 12-in. sills and bracing these by 12 x 12-in. spacers put across from wall to wall just beneath the ties.

On this same railroad, as a means of reducing the danger of fires being started in the arch segments by cinders, the plan of nailing strips of corrugated iron to the top segment was tried. It was found, however, that the nails rusted out and allowed these metal strips to hang, thus becoming dangerous to trainmen riding on top of the cars. Tongue-and-grooved redwood was then used as a ceiling, covering all three of the segments. This is reported to be very satisfactory.

Tunnels through solid rock have been found to require comparatively little maintenance. In tunnel sections that did not require lining when the line was built, there has been little difficulty with water or with

TABULATION OF TUNNEL LINING ON WESTERN RAILROADS

| Railroad | Total Tunnel Length in Ft. | Lineal Ft. Timber Lined | Lineal Ft. Concrete Lined | Percentage Concrete Lined | Lineal Ft. Not Lined |
|---|---|---|---|---|---|
| Western Pacific | 45,588 | 26,964 | 8,370 | 18 | 10,253 |
| Southern Pacific | 153,484 | 112,221 | 32,536 | 21 | 8,727 |
| Northwestern Pacific | 34,900 | 30,074 | 1,542 | 4 | 3,283 |
| Santa Fe—West of Albuquerque | 10,049 | 1,760 | 8,289* | 82 | 0 |
| Great Northern—R.R. (Western District) | 40,329 | 7,364 | 26,289 | 65 | 6,676 |
| Los Angeles & Salt Lake R.R. | 9,198 | 8,869 | 0.0 | 0 | 329 |
| O—W.R.R.& N. Co. | 23,560 | 10,319 | 6,103 | 26 | 7,138 |
| C. M. & St. P. R.R. | 61,877 | 3,042 | 48,071 | 78 | 9,010 |
| Sacramento & San Francisco | 3,458 | 0 | 3,458** | 100 | 0 |

*Includes 396 ft. tunnel lined with steel.
** Now being lined.

spalling rock. For example, a western railroad purchased a cement gun and equipment, expecting to use it for treating solid rock tunnels. That is, it was thought that this device would be useful for filling up crevices, stopping leakage and protecting the rock from weathering so that small pieces would not fall on the track. Frequent inspections, however, have failed to show the necessity for any such treatment and in the three years since the equipment was purchased it has never been used for this purpose

### Reconstruction Methods

Various methods of relining railroad tunnels have been devised to suit traffic requirements or conditions of the old lining and the earth strata in the tunnel itself; witness the steel-lined tunnel, the precast concrete sections and the "coyote hole" method mentioned in the following. In the main, however, there are only two essential points on which lining methods differ: (1) Concrete is either cast around the timbers or they are first removed; (2) concrete is placed by gravity and by hand, or by the pneumatic process.

When timber lining is to be replaced with concrete, standard practice on the Southern Pacific system requires, in effect, the redriving of the tunnel because the timbers have to be set back far enough to allow the concrete to be poured inside the increased clearance thus secured. This setting the timbers back is the largest item in the cost of concrete lining. It requires all new timbers and the excavation of a large amount of material because the timber lining was put in for an 18 or 20-ft. clearance height while the specifications for concrete lined sections now call for 22 ft. clearance above rail. This means 4 to 6 ft. excavation in setting back the arch segments, beside the 2 ft. or more setback on the sides. In single-track tunnel the concrete lining is finished 16 ft. wide on tangents, with an increase in width on curves of 1 in. for each degree of curvature. The concreting can be done so much faster than the enlarging that the latter has to be laid out for several years in advance.

### Methods of Placing Concrete

Setting the timbers back and then leaving them in place when concreting costs much more than the method of removing the timbers and replacing them with concrete, section by section. But the former method, in addition to giving an opportunity for increasing the clearance, affords assurance against cave-ins, of which there is more danger when employing the latter method. The cost of enlarging the section to Southern Pacific standards, using new timber and with labor and material prices as of April, 1921, is estimated to average about $85 per foot of tunnel; the cost of placing concrete lining is estimated as about $100 per foot. Because of the great volume of traffic handled on this system and the belief that competitive lines would get the through business in times of tieups, great importance is placed on avoiding any interruption of service.

With the comparatively light traffic over one of the competing roads, on the other hand, a 15-hr. main-line tunnel blockade could be absorbed in yards and sidings, and, by the use of extra equipment, satisfactorily cleared when the tunnel was open. Under these conditions it would be unnecessary for the latter company to refuse business in the time of such a blockade; in its tunnel-lining work, therefore, the concrete is being put in section by section, as fast as the timbers are taken out.

The pneumatic method of placing concrete lining has been made standard on the Southern Pacific system. This plan has the great advantage that it avoids the loss of time in taking out jumbo cars to allow trains to pass. This same railroad does its tunnel lining work with its own forces because the crews seem to require railroad experience in addition to experience in tunnel work in order that the lining may be done efficiently without obstructing traffic. Under the construction program followed on this system, the footings are poured first, and when they have had time to set, the walls and arch are placed. If an invert is required, footings and invert are poured as one operation.

On the Western Pacific concrete lining is still placed by hand in sections that cannot be reached by gravity chute from a high car; this is largely because their method of doing the work does not readily lend itself to the pneumatic system. The work is carried on in three stages, each stage being worked from one or more high-cars especially equipped for the operation to be performed.

### Removing Timbers

The first stage consists of cutting out the timbers and, by means of crown-bars set back the necessary distance, protecting the exposed section of the tunnel for its full perimeter. As the concrete forms are used in 6-ft. sections, the timbering is removed for this length at each point where the tunnel is opened up. The crew removing timbers begins at the crown of the arch and goes entirely around the section, using timbers or blocking of whatever sort may be necessary to carry the thrust of the overlying earth to the timbers on each side of the section opened up. A second jumbo and crew puts the forms in place, while the concrete is poured by gravity from a third jumbo carrying mixer and chute. Gondola cars of rock and sand are usually spotted in the tunnel with the concrete jumbo car and these materials are shoveled from the gondola cars into hand buggies. The buggies are taken on runways up to the mixer, which is located at a level where it will just clear the arch crown. Concrete in the arch itself is shoveled into place by hand.

With this method, work can be advanced simultaneously at a number of different points, the crew and equipment being moved from place to place in accordance with a schedule planned so as to carry on the work most expeditiously for a given number of men.

Two tunnels recently enlarged on the Northwestern Pacific near Tiburon and San Rafael, respectively, were increased in height from 17 to about 22 ft. without any interruption to traffic. The work on the arch was carried on from jumbo cars which began at the portals and drove the arch of the tunnel anew, using the crown-bar method and putting in the new arch segments as they went. Crews working at track level followed the jumbos, setting back the plumb posts underneath the new crown bar. Excavated material was dumped from the jumbo car into six-yard dump cars on the track below which were handled by means of gasoline motor trucks fitted with flanged steel tires.

*Work in Difficult Ground*—In driving seven tunnels on the Willits-Eureka extension of the Northwestern Pacific in 1914, so much difficulty was experienced in holding the more difficult portions with timber lining

that a special concrete lining 30 in. thick was substituted. In the worst spots the points of attack were separated as widely as possible and only about 2 ft. was opened up at a time. Whatever the length opened up, the full section was excavated, forms set, and concrete poured in as close sequence as possible. The pouring ordinarily constituted about a day's work, so with four sections open, excavation would be going on at two, form building at one, and concreting at one. Two to four men could work together to best advantage in excavating the sections, dropping earth and timbers to the floor, where muckers kept the track clear.

On this work concrete was poured from a high platform supported by 10 x 14-in. posts, under which there was sufficient clearance for traffic. Posts were set along the wall so as to support the wall forms and were spaced on 8-ft. centers for the full length of the work. The wall forms consisted of 4 x 6-in. horizontal wales, 2 x 6-in. studding and 2 x 10-in. surface sheathing. The same sheathing was used on the arch, the segments for which were built up of two or three-ply 2 x 12 and 3 x 12 planks. Concrete was delivered on this high line in hand buggies over distances ranging up to 800 ft., and was dumped into the forms, shoveling being necessary only above the spring line.

### Special Methods

A few examples of unusual lining methods are cited in the following:

At the west end of the San Fernando tunnel it was desired to place a short section of concrete lining as a small separate job. First, a 4 x 6-ft. hole was driven just above the crown of the arch, then, after the timbers had been moved back in the usual way and concrete forms placed inside them, concrete was taken into the hole on small push cars and dumped into the forms, thus placing the entire lined section without shoveling any of the concrete by hand. This method had the advantage that concrete was placed without interfering either with train schedules or continuous mixing.

The lining in a tunnel on the San Francisco & Sacramento R.R. is being built up for most of its length with precast reinforced slabs made in a casting yard near the portal, taken into the tunnel on flat cars and placed with a specially constructed derrick car.

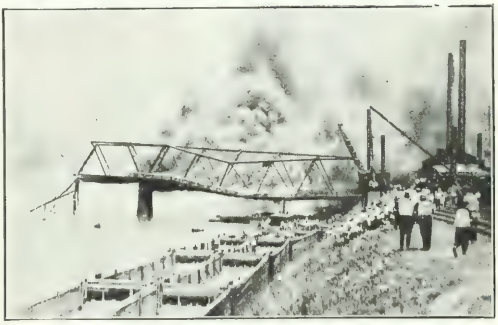
As a means of fire protection in a short Santa Fe tunnel in Johnston's Canyon, Ariz., rubble masonry was placed in between the timbers from the sills up to a height of 9 ft. Above that is a sheathing of ¼-in. steel plates. These plates are 30 in. wide and long enough so that a single plate reaches from the top of the rubble masonry around the curve to the center of the arch. The sides of each plate are attached to light angle irons, spaced 30 in. apart and bent to the same curve. These angles in turn are attached both at the crown and the springing line to a pair of 3 x 3 x ¼-in. angles fastened to the timbering.

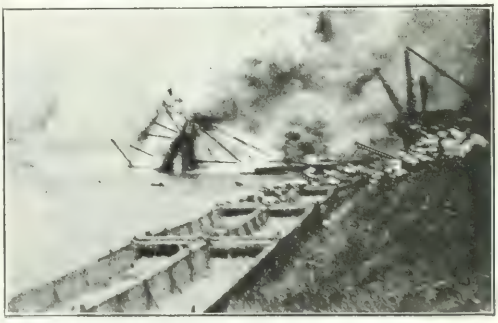
## Japanese Earthquake Investigation

The third number of Volume 9 of the Bulletin of the Imperial Earthquake Investigation Committee (Tokyo, Japan, March, 1921) contains papers by F. Omori on measurements of vibration of the 660-ft. wireless telegraph station tower at Haranomachi; of a 12-story brick tower and of 5-story pagodas; also a letter from Prof. C. Derleth, Jr., of the University of California on the vibration of the Sather tower at Berkeley.

## The Burning of a Pittsburgh Bridge

***The photographs reproduced here were taken during the progress of a fire which destroyed a steel truss bridge with a wooden floor across the Allegheny River at Pittsburgh, on July 8. The photographs were taken at intervals of from ten to fifteen minutes. A report of the fire is found in Engineering News-Record, July 14, p. 81.***





# Government to Make Road Survey

## U. S. Bureau of Public Roads Plans Nationwide Census of Mileages, Revenues and Expenditures

By T. Warren Allen
Chief, Division of Control, U. S. Bureau of Public Roads, Washington, D. C.

THE U. S. Bureau of Public Roads has just launched a project to ascertain the total miles of rural as well as urban highways in the United States, the character and extent of their improvement, the cost incident to their construction and maintenance, the origin and disbursement of the funds for highway purposes and the details of administration under which the work of improving the nation's highways is carried out. Somewhat similar partial surveys were made by the Bureau in 1904, 1909 and 1914.

The present survey differs from those of the previous years in that it will not only embrace the rural roads, outside of incorporated villages and cities, but also the urban highways, including city streets, boulevards and alleys inside of all such incorporated areas having a population of 2,500 or more.

The need for such a survey is most urgent. Congress is studying the entire highway situation, the various states are building or planning extensive state road systems, while the counties and other local communities are voting large amounts of bonds or taxing themselves to the limit in order to raise funds for the betterments of their roads. Through this complex arrangement many kinds of taxes, bonds, assessments and fees are collected and appropriated for road purposes. But the origin of these funds, as well as the relation they bear to the value of the property taxed or the return from such investments, are as yet but vaguely known. Nor have we any definite data as to the improvements which should still be made nor the resources available for such work.

### Object of Survey

The present survey aims to determine not only how much money we are spending on our roads and from what sources our road revenues are derived but also what results are secured from these expenditures. The investigations will therefore seek to determine the total road mileage in each county and incorporated community, the mileage improved with each of the several distinctive types of surfacing, the mileage under systematic maintenance as well as the extent to which the road mileage has been classified and the mileage embraced on such classified systems.

In order that we may know something as to whether the cost of our roads is distributed in accordance with the benefits derived, the investigation will include a survey of the various sources from which the funds are derived for construction of roads, of bridges and also for maintenance, together with the amount from each source. Data will also be collected as to the total investment in road machinery and equipment and the expenditures for its repair and maintenance. At present not even approximate information is available as to the amount invested by the states, counties, cities, towns and other communities in road building and maintenance plant, machinery and equipment, nor how much is annually expended for its maintenance and repair.

The Bureau of Public Roads believes that, with the total annual road and street expenditures rapidly approaching the billion dollar mark, it is time that the nation make a careful survey of the entire field of public highway activities in order that it may have at least as much accurate information in regard to the essential features of our highway work as a private organization would hold absolutely indispensable in the interest of common sense, efficiency and economy. The present plans provide not only for securing these data for this year but look forward to keeping this information up to date. An extra form will be left in the hands of each road official for recording and reporting the work and expenditures, etc., of next year.

### District Offices to Aid Work

The bureau has now established, by virtue of its control over federal-aid projects throughout the nation, some thirteen federal district offices. It is proposed to make these offices the center for gathering the data from the states comprising each district.

To make this survey a success, the bureau feels that the co-operation of every unit of government doing road work is necessary and essential, and therefore requests the earnest assistance and co-operation of not only all road officials, but also of all associations, organizations or individuals that may have any information or data as to these particular lines of local highway activities.

### Co-operation Sought

It is apparent that no single unit of government doing road work should be omitted in gathering these data. The federal agents recognize that in some of the smaller units of government there is no centralized control and no complete records. Here the local automobilist or others can give material assistance in checking up by speedometer readings the exact mileages of the various types of roads in the unit and the total road mileage.

The federal agents also point out that if future records are kept in accordance with the forms adopted for this survey all units of government will have adopted a uniform system for recording highway expenditures. Each succeeding year it will then be possible to gather the data of expenditures with ease and with some uniformity for comparative purposes. One extra form will be left with each highway official for making a return for 1922.

The results of the survey will be published for distribution when the compilation is completed. From it the large number of methods of road financing, control and operation of the varied highway programs of the nation will be clearly set forth and in detail.

## Use of Lime in Water Purification

The amount of caustic lime used by water purification plants in the United States is estimated at 65,000 tons per year in a paper presented recently to the National Lime Association by C. Arthur Brown, chief engineer, Engineering Bureau-Water Purification, American Steel & Wire Co. This amount of lime is used by about 120 plants out of something like a thousand filter plants in the United States. Mr. Brown estimates that between 30 and 40 per cent of the water purification plants in the country might use lime advantageously. He notes also that the first complete municipal water softening plant in this country was designed by himself for Oberlin, Ohio, in 1902.

# Steel Fabric in Concrete Road Costs 1c a Yard to Place

## Pennsylvania Highway Constructed Under 1921 Specifications Requiring 56 Lb. of Metal per 100 Sq.Ft.

By H. Eltinge Breed
Consulting Engineer, New York City
(Copyright by H. Eltinge Breed)

*This article is published in response to many inquiries received since the appearance of "Use of Steel Reinforcement for Concrete Pavements" in "Engineering News-Record" Dec. 23, 1920, p. 1231. Mr. Breed's study of the construction methods and costs discussed below, was made for the National Steel Fabric Co.*

THE progress of road building is being so accelerated by the increasing demands of traffic, that the contractor has scarcely time to understand one scheme of operation before a new set of conditions is thrust upon him. Most recent of these is the 1921 requirement of the State of Pennsylvania for the use of steel fabric reinforcement, having an effective weight of 56 lb. per 100 sq.ft., an increase in weight over the 1920 specifications of 31 lb. Among various wild hazards about it, three questions persistently recur:

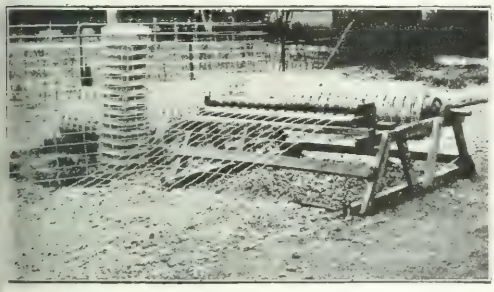


FIG. 1. DEVICE FOR STRAIGHTENING METAL FABRIC ROLLS

What is the best method of handling steel reinforcement? Does its use slow up the contractor's operations? How much does its placing cost?

To try to help answer these questions, the writer visited that road in Pennsylvania officially known as route 133, Upper Darby and Haverford townships. It is 12,077 ft. (2.28 miles) long, reinforced cement concrete type 6-, 8-, 6-in. section, 18 ft. wide, and carries 57 lb. of metal to the 100 sq.ft. The specifications require that the main members of the fabric reinforcement be placed transversely with the road to within 2 in. of the side forms; that the sheets be lapped 4 in., and placed in the slab 2 in. below the crown. These provisions for heavier reinforcement and its placing should afford additional safety to the slab, and, at a slight increase in initial cost, provide insurance against maintenance. Pennsylvania, as a state, is taking the lead in this direction.

The contract for this road was let Feb. 18, 1921, to the low bidder, Vincenzo Di Francesco, of Llanerch, Pa., for $118,429. The division engineer in charge is Mr. Longstreet and the inspector is Harry Dwyer.

The main plant units are concrete paver, two stone crushers with elevators, screens and bins, one charging bin of 300 tons capacity (200 tons stone and 100 tons sand), 5-ton trucks for sand, cement and metal and 2-ton trucks with hand hoists on aggregates divided to carry two batches. Brief observation indicates to some extent the efficiency with which a job is running, but the real test is the day-in, day-out performance. On this job 6,400 lin.ft. of pavement were laid between April 21 and May 18. The daily record for the last ten days of that period was: 300 ft.; 261 ft (7 hr.); 408 ft.; rain; 322 ft.; 336 ft.; 374 ft.; 397 ft.; 425 ft.; and 410 ft.—or an average of 358 ft. a day for the nine actual working days, or 132 cu.yd. of concrete for a working day of 11 hr. The contractor believes that he can improve upon this performance.

FIG. 2. TOP SURFACE CONCRETE BEING PLACED ON METAL FABRIC REINFORCEMENT

Cement and steel come on to the road from a railroad siding one mile from the job. The steel fabric is unloaded from the cars into motor trucks. A carload contains 130 rolls of National Steel Fabric Co.'s welded galvanized steel reinforcement. Each roll contains 125 ft. of fabric 58 in. wide and weighs 360 lb. There are approximately 8,420 sq.yd. to the carload. This material was unloaded and hauled 1½ miles by a truck with two men to load and unload in 10 hr. They took 13 rolls for a load. With the truck at $30 a day and labor at 35c. per hour, the cost for hauling and distributing is $0.0044 per square yard.

Straightening, measuring, cutting, and placing alongside takes from 45 to 54 min. per roll, *i.e.*, 3 men work from 15 to 18 min. per roll. Taking 54 min. as an average, with labor at 35c. per hour, this cost would be $0.0049 per square yard. One-half day's time for one of the four men behind the mixer to lay the metal fabric on the concrete would cost $2.50 for a $5-a-day man, thus bringing the cost of placing to an average of $0.0036 per square yard. Thus the total cost for unloading, hauling, straightening, measuring, cutting, placing alongside and placing in the work is $0.0129 a square yard. This is the high figure; the low figure would be $0.011 per square yard. We might justly eliminate the cost added for placing in the work because with the amount of concrete laid per day four men

are needed for spreading, etc., whether the fabric is used or not; then the cost would be under $0.01 a square yard. The contractor's cost for the first week of the work was $0.014 per square yard, which may be attributed to the newness of the work and the lack of familiarity with the operation.

The method of straightening the fabric is to place the straightening machine. furnished by the manufacturer of the reinforcing fabric, on the subgrade, as shown in Fig. 1. It is anchored by pins driven in front of the runners and bent over pins of ¾-in. steel driven into the grade at the rear of the runners, to keep the machine from tipping up. A shaft with two cones is placed in the center of a roll of fabric, which is placed on the machine in front of the straightening rolls, so as to unwind from the top. All tie wires but one are cut; then a tie wire is so placed as to hold the fabric while one circumference is unwrapped. The end of the fabric is pushed through the rolls and the last tie is cut. The trucks, on return trips to the aggregate bins, pull the fabric through the straightening rolls, the fabric coming out in a long, perfectly flat sheet, free from waves. Another roll is prepared at once. Between the pulling operations the men cut and distribute the fabric, set forms, etc. The use of the truck is not taken into the cost of the straightening operation because the time consumed is negligible—less than ½ min. more than ordinarily required to make the trip.

The operation of placing (Fig. 2) is simple. The steel fabric once unrolled is perfectly flat and in much better condition than when the reinforcement is shipped in sheets because these are bound to become bent and twisted out of shape and to need straightening before they can be laid. The concrete has been deposited on the grade, spread by the shovelers and evened off 2 in. below finished grade by the plow-handled template shown in the illustration. The welded steel fabric is then placed to overlap 4 in. and the concrete deposited over it roughly, spread and screeded by the angle-iron screed shown in the foreground. The striking off of the concrete for the steel fabric cannot be considered an additional cost because the number of men is the same when laying the same amount of concrete whether or not the fabric is used.

## Colloidal Chemistry and Sewage

WHAT those handling sewage problems need from colloidal chemistry was noted as follows in a recent paper presented to the American Water Works Association by F. W. Mohlman, chemist, and Langdon Pearse, sanitary engineer, of the Sanitary District of Chicago:

(1) A standard definition of the limits of size of colloids in sewage. (2) A standard method for the determination of sewage colloids. (3) The study of the effect of the hydrogen-ion concentration on the removal of colloids, correlated with other determinations and observations which will prove the validity of such $P_H$ determination. (4) Tests of the practical application of precipitants which have been found effective in laboratory experiments. (5) Investigation of the principle governing the retention of moisture by sewage sludge.

As yet, in the removal of colloids by tank treatment, but little has been accomplished in a practical way by settling alone or by the use of colloiders. Chemical precipitation by alkaline precipitants removes some of the colloidal matter, but adds so much to the bulk of the sludge that the process has not proved popular and is restricted in its present application to special cases.

# Flood Control Reservoirs on the Minnesota River

### Dams in Narrow Valley to Form Three Reservoirs with Gates for Manual Regulation of Level—Special Structures

RETARDING reservoirs in the valley of the Minnesota River, in Minnesota, constitute the only practicable means of flood protection for this valley, according to a recent report to the State Department of Drainage and Waters by Adolph F. Meyer, consulting engineer, Minneapolis, Minn. Manual operation of gates will be required, as the river is often out of its banks for several weeks, and automatic retarding basins are applicable only for flashy streams. Complete protection of all valley lands is not possible, as there

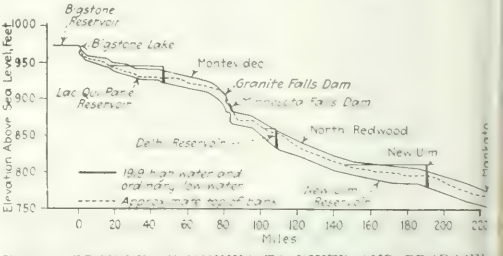



FIG. 1 PROFILE OF MINNESOTA RIVER AND PROPOSED FLOOD CONTROL RESERVOIRS

are no sites available for reservoirs on the tributary streams, so that some land must be sacrificed for reservoirs. Levee construction and channel straightening and enlargment are not applicable to this narrow valley the area subject to overflow averaging only about a mile in width. Floods have been a source of trouble for the past thirty years, but the problem was not taken up actively until after the exceptionally destructive flood in the spring of 1919, which led to the engagement of Mr. Meyer.

Protection of the valley lands from the exceptionally large floods occurring only once in 25 years is not considered practically economical. Protection of most of the lands from frequent flooding, on the other hand, is concluded to be worth twice its cost, the best paying project being that which protects against all floods except those which may be expected to occur at intervals of ten to fifteen years. This purpose can be attained by reservoirs of moderate capacity, having high-water levels only a few feet above present flood levels. The area benefited will be three times that of the area depreciated by being within the reservoir sites. Further the benefit per acre for the former will be greater, as an average, than the depreciation in the latter area.

Three large reservoirs are proposed, with a total storage capacity of 18,500 million cubic feet, as shown by the profile, Fig. 1. The first is Big Stone Lake 4,000,000,000 cu.ft. between summer navigable stage at 965 ft. and ordinary high water at 972 ft. This dam would be near Ortonville and the Whetstone River would be diverted into the reservoir. The second reservoir, with dam near Montevideo, is at Lac qui Parle and Marsh Lake, with 9,000,000,000 cu.ft. capacity below El. 945; both the Chippewa River and the Lac qui Parle River would be diverted into this reservoir. The third site, with dam at New Ulm, is the valley above

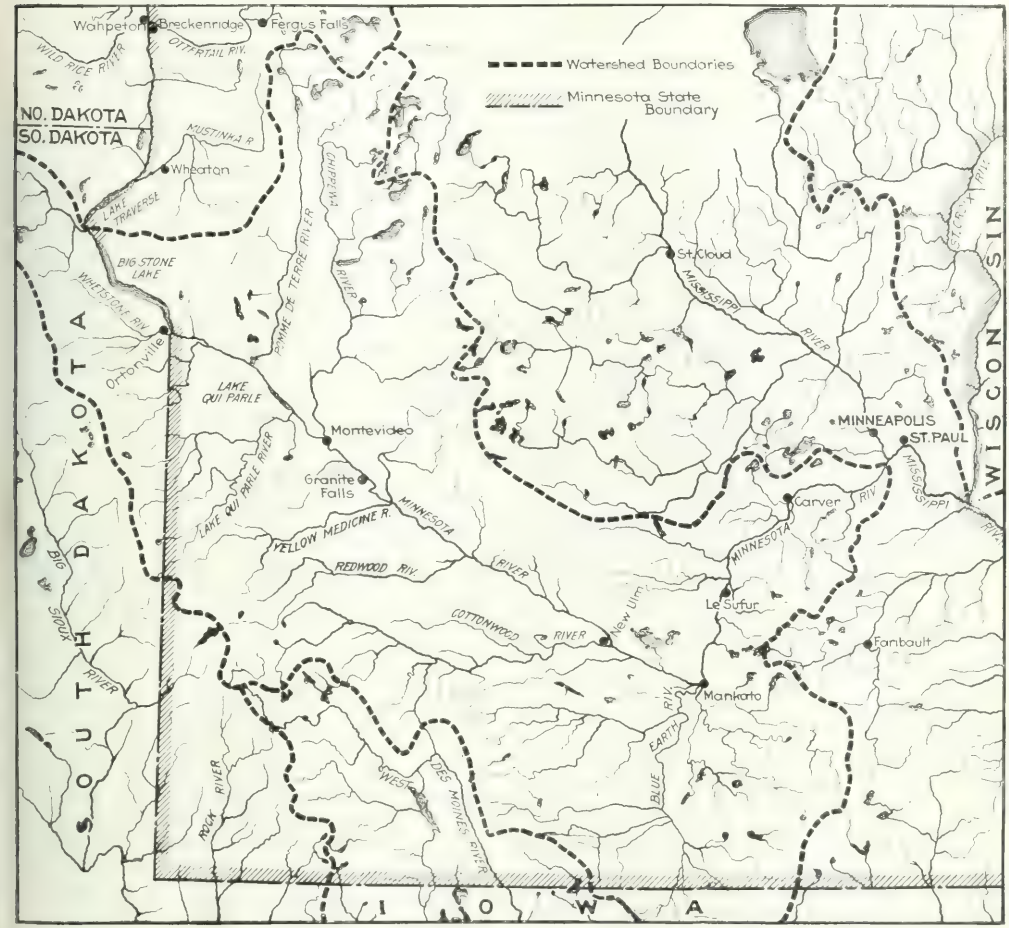



FIG 2. DRAINAGE AREAS OF MINNESOTA RIVER AND ITS TRIBUTARIES

the mouth of the Cottonwood River, with a capacity of 5,500,000,000 cu.ft. below El. 910. A water power dam at Delhi is practicable, but it is considered doubtful whether the benefit to be derived from enlarging this project into a flood prevention reservoir would warrant the cost. For successful results, Mr. Meyer says the three reservoirs must be planned and operated as a single system for flood prevention purposes and not for power or navigation.

For water power, the only specific provision is storage of about 1,000,000,000 cu.ft. in Big Stone Lake, but part of the 18,500,000,000 cu.ft. stored for flood prevention may prove of considerable incidental benefit to water power. The dams will be on glacial drift, except the one at Delhi and possibly that at New Ulm, but they will be low and of reasonable cost. They will not require large spillways, as the total storage capacity will be adequate during extreme floods. An approximate estimate of cost is $2,000,000, on the basis of present prices.

The drainage basin of the Minnesota River, shown in Fig. 2, contains about 16,600 sq.mi. It is mostly under cultivation but varies widely in topographical, soil and cultural conditions. In general, the tributaries entering from the north drain more gently undulating lands than those from the south, the latter being extremely flashy. The following is from the report:

The general direction of flow of the main stream and its tributaries is the same as the path of most of the rain-producing storms that pass over this drainage basin. The largest and lowest tributary, the Blue Earth River, has a fan-shaped drainage area. This causes rapid and high concentration of run-off at the mouth of this stream at Mankato. This ordinarily undesirable circumstance, however, actually operates to reduce somewhat the flood crest of the Minnesota River at Mankato, the extreme flood flow from the Blue Earth River having usually passed Mankato before the flood waters from the upper tributaries arrive. In the same way, the flood crest of the Cottonwood, the third largest tributary, reaches the main stream before the flood waters from above Montevideo reach New Ulm. These effects are due to the natural retardation of the upper flood waters in Lac qui Parle and Marsh Lake, which more than counterbalances the undesirable movement of rainstorms downstream.

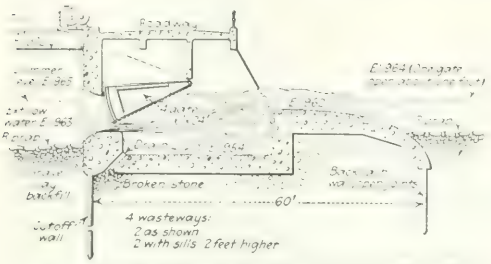



FIG. 3. CONTROLLING WORKS AT BIG STONE LAKE

Below Mankato the Minnesota River Valley, and particularly the lower portion, serves as a reservoir of considerable magnitude during most floods. The valley lands below Carver are so low that they are about as subject to floods from the Mississippi River as they are subject to floods from the Minnesota River. In this lower part of the valley the Minnesota River is virtually a lake formed by sandbars at the mouth and is gradually filling up with sediment. Although the proposed project will offer some protection from Minnesota River floods to the valley lands between Carver and the mouth of the river, it cannot protect these lands from floods caused by backwater from the Mississippi River when this stream reaches a flood stage at St. Paul.

FLOODS IN THE MINNESOTA RIVER AT MANKATO, MINN.

| Flood | Discharge Above 15,000 Cu Ft per Sec (Bank Full) Cu Ft per Sec | Days | Volume Discharged Billion Cu Ft |
|---|---|---|---|
| 1903 May 26 to June 4 | 38,700 | | 9 54 |
| 1907 June | .... | 18 | |
| 1908 May | 32,000 | 23 | |
| 1908 June 21 to July 15 | 43,800 | 25 | 25 05 |
| 1909 March | 31,400 | 22 | 14 42 |
| 1916 March 20, April 29 | 30,200 | 23 | 16 81 |
| 1917 March 31, April 19 | .... | 20 | 11 35 |
| 1919 March 15, April 28 | 30,500 | .... | 19 85 |
| 1919 June 17, July 10 | 35,900 | 24 | 19 00 |

Many of the destructive floods are local in character. Flood-producing conditions seldom if ever occur simultaneously with equal intensity over such large and diverse areas as those included within the Minnesota River drainage basin. Early spring floods caused by the melting of accumulations of snow come nearest to being general through the entire valley. The most destructive floods, however, are those which occur during the crop season. Since they are largely due to flood flows from individual tributaries, these summer floods are normally much more severe in one part of the valley than in the remainder. If these floods are to be prevented by retarding the flood waters until the available channels can carry them away, then reservoirs must necessarily be located in various portions of the drainage basin.

Records of the greatest floods in the river are given in the accompanying table, the most severe in every respect being that of 1908. Although the flood of 1903 was second in height attained it was only seventh in volume and was of such short duration that it is not included in the seven floods which exceeded 18 days.

FIG. 4. SPILLWAY ON WHETSTONE RIVER DIVERSION

An important characteristic shown by the table is that the summer floods usually reach higher levels than the floods of early spring, but that there is relatively little difference between spring and summer floods in regard to duration or volume of water discharged.

## Dams and Controlling Works

For the Big Stone Lake reservoir it is proposed to close to the south end of the lake with a low earth dam having controlling works where it crosses the channel of the Minnesota River, this channel being enlarged below the dam to a capacity of 400 sec.ft. Four sluiceways 6 x 24 ft. would be formed in a concrete structure of the design shown in Fig. 3, the discharge being controlled by Taintor gates. The maximum discharge capacity would be about 8,000 sec.ft. An unusual feature of the design is that the discharge from the gates

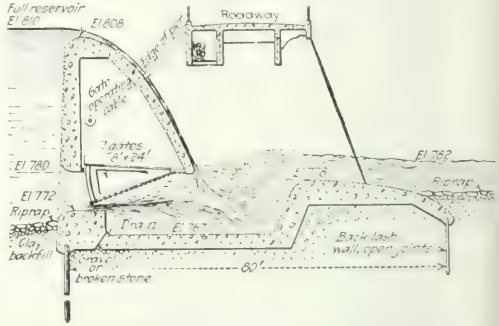



FIG. 5. CONTROLLING WORKS FOR RESERVOIR AT NEW ULM

enters a water chamber and flows upward and outward over the downstream edge, this chamber acting as a stilling pool to prevent erosion below the dam. It is proposed to supplement manual operation of the gates by automatic opening when the lake level reaches flood stage, this being effected by a small turbine having an open intake at flood level.

Diversion of the Whetstone River into Big Stone Lake by a new channel will be a necessary part of the work. On account of the large fall in the diversion channel, the flood water from this river is to be dropped over a spillway dam and sent under a railway embankment, at high velocity, through two culverts 15 x 30 ft. in section, with flaring mouths to slow up the water as it enters the reservoirs, as shown in Fig. 4. For the Lac qui Parle or Montevideo reservoir, only a low earth dam will be required, with new channels diverting the Lac qui Parle and Chippewa rivers into the reservoirs. Controlling works of a similar type to those at the upper reservoir would be used, giving a maximum discharge capacity of about 20,000 sec.ft. At the New Ulm reservoir the controlling works would be of the same general type, modified as shown in. Fig. 5, and having seven sluiceways 8 x 24 ft. to give a maximum discharge capacity of about 40,000 sec.ft.

## General Principles of Regulation

On account of the rapidly increasing channel capacity from Big Stone Lake to Mankato, it is held that the size of flood protection reservoirs per square mile of tributary drainage area should increase upstream. The channel below Big Stone Lake, for example, has a

capacity only about 10 per cent that of the channel below Montevideo, even though the drainage area tributary to the lake is 20 per cent that of the Minnesota River at Montevideo. Further, it is held that such reservoirs should be relatively larger for small basins than for large ones, because the smaller the area the larger the rainfall and run-off, in inches depth over that area, which will occur with given frequency. Mr. Meyer explains that the project here proposed is in accord with the above principle.

Thus the New Ulm reservoir has a capacity of 5,500,000,000 cu.ft., or 128,000,000 cu.ft. per square mile, and its capacity is sufficient to store the equivalent of a sheet of water 0.55 in. deep over the tributary drainage basin between New Ulm and Montevideo. The Lac qui Parle reservoir, with a capacity of 9,000,000,000 cu.ft., or 180,000,000 cut. ft. per square mile, can store a sheet of water 0.77 in. deep over the tributary drainage basin between Montevideo and Big Stone Lake. Finally, the Big Stone Lake reservoir, with a capacity of 4,000,000,000 cu.ft., or 310,000,000 cu.ft. per square mile, can store the equivalent of a sheet of water 1.33 in. deep over the drainage basin which is tributary to it.

In regard to the control of these three reservoirs, within the limits of their capacity or exclusive of spillway discharge, Mr. Meyer explains that:

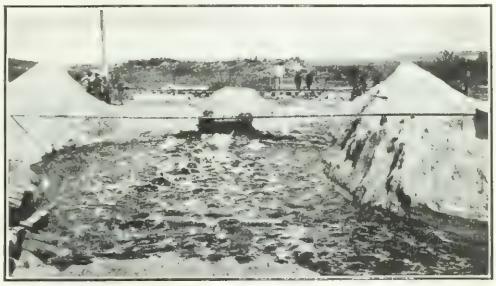
> In the operation of the proposed reservoirs, within the limit of their capacity, no water should be discharged from any one of them until it is full, or the stage in the reservoir next below it is falling, indicating that the inflow is less than the outflow. In general, this means that the upper reservoirs should be filled first and emptied last; or in other words, the storing of water should continue in the upper reservoirs until wasting has begun in the reservoir next below. During sudden freshets on the tributaries between any two reservoirs the wasting of the flood waters from the reservoir above should be suspended temporarily.

### Systematic Maintenance for Fender Logs

Floating fender logs are used in the Port of Los Angeles to prevent the abrasion of fender piles and to distribute the shock of vessels bumping against them. The cost of maintaining these logs has been materially reduced by following a systematic program in inspection and upkeep. The method followed is summarized in the following: Logs selected for this purpose are preferably of cedar or occasionally of Douglas fir, not less than 2 ft. in diameter and 40 to 60 ft. long. The log is turned in a lathe at the mill so as to give a smooth surface free of bark and imperfections. (The saving in transportation due to reduced weight offsets about two-thirds the cost of turning the logs.) Holes are drilled near each end large enough for 3-in. pipes. A section of galvanized pipe slightly longer than the diameter of the log is placed in each of these holes and, after making lengthwise cuts in the projecting ends of the pipe with a hacksaw, the cut sections are bent back and driven into the log so as to hold the pipe in place. Through these pipes are threaded the galvanized iron chains which attach the log to the wharf and keep it right side up. The latter is accomplished by weighting the lower ends of the chains. As the tide range is 8 to 9 ft. chains of 13-ft. length are used. Before going into the water the log is thoroughly oiled with linseed oil or a vegetable oil substitute. The log is turned over at regular intervals so that sun and air may kill the marine growth and stop borer action on the submerged parts.

## Santa Ana River Made to Cut New Outlet to the Sea

THE development of harbor facilities by Orange County at Newport Bay on the Southern California coast was not considered practicable until further damage by the Santa Ana River, which from time to time has deposited large amounts of silt in the bay, had been prevented. For example, in a 4½-month period a few years ago, the river left silt in the harbor estimated to total 900,000 cu.yd. Decision was therefore made to



INSHORE END SHOWING CULVERT UNDER RAILROAD

divert the stream directly and permanently into the ocean at a point about 5 miles upstream from its entrance to the harbor, at a point where the natural channel comes close to the shore line. An interesting feature of the work was that it was planned in such a way that only about 3 per cent of the total excavation required was made artificially, the river itself being made to do the remainder. This not only greatly decreased the cost of the work, but made it unnecessary to find means of disposal for the excavated material.

In order to provide a direct outlet to the sea at the desired point, it was necessary to cut a channel through a sandspit about 700 ft. wide, whose top was about 15 ft. above low water. To construct a channel of capacity adequate to provide for all floods that might be expected was estimated to require the removal of about 100,000 cu.yd. of earth. In addition to this, the tracks of the

OUTLET CUT BY FLOOD. NEW BRIDGE PIER IN FOREGROUND

Southern Pacific and Pacific Electric Railways, which traverse the spit, required to be taken over the new channel and raised about 5 ft. The two railways entered into a joint arrangement whereby a single bridge sufficed for both, and the harbor commission paid $20,000 toward the railroad reconstruction required. The harbor com-

mission agree to maintain the channel and its revetment, and the railroads agree to build and maintain the bridge.

The first step in the diversion of the river, was of course the provision of a new and more direct outlet to the sea. Some time before the flood water season fresnos were used to cut a ditch through the sandspit at the point where the new outlet for the river was desired. This ditch was made 10 to 12 ft. wide at the bottom, with side slopes as steep as the material would stand, and was excavated to a level of about 4 ft. above mean low tide (as low as mules could work on account of ground water), except for a barrier at the ocean end of the ditch just high enough to exclude tide waters. A total excavation made in this way amounted to about 3,000 cu.yd. Any considerably greater amount of excavation would have made it necessary to find some means of disposing of the material. It was impossible to complete the inshore end of the ditch as the Southern Pacific Railroad (also used jointly as a shoo-fly by the Pacific Electric Railroad), was still in operation on the old tracks across the new channel.

The second step in the diversion of the river, was the construction of an earth fill dam in an advantageous location between the new river mouth and the bay where a high bluff near the channel made only a short dam necessary. Though this dam will be a permanent structure, it will have only slack water against it, and is only about 300 ft. long with a height of 14 ft. where it crosses the deepest part of the channel. It was easily consructed at low cost with material scraped into place from the hillside nearby.

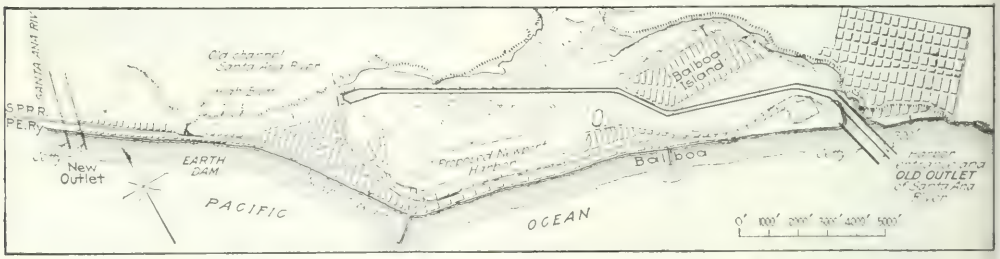
When the run-off from the first storm of the season came, the new bridge had not been completed, and the old Southern Pacific tracks across the new channel (on solid fill) were still in use. There was therefore, no available outlet, and the water pounding up against the dam and the railroad embankment, rose rapidly until within about 5 ft. of the top of the dam. The railroad hurriedly constructed a 3 x 5 ft. culvert under their track, from the river into the new channel above mentioned. As the storm had ceased, this culvert proved adequate to prevent further rise of the impounded water, and gradually drained off the accumulation.

The flood waters discharging through this culvert under a head of about 2 ft. rapidly cut the channel to the required depth and width, and carried into the ocean all material which caved into the flood waters, as the cross-section of the channel was rapidly enlarged by the stream. As finally excavated by the flood, the channel now has an average bottom with of about 50 ft. The channel is about 600 ft. long from mean low tide level at the ocean end to the river bank on the land side of the sandspit.

To prevent the closing up of the ocean end of this new river outlet, and to prevent its being moved along the shore line by wave action, rock jetties were built on both sides of the point where the stream now enters the ocean. The east and west jetties extend about 370 ft. and 670 ft. from the shore line respectively, and are 500 ft. apart. The direction of these jetties and their length, were determined from a careful study of local conditions. The jetties extend oceanward to a rock ledge at a depth of approximately 12 ft. below mean low water at their ends, and have a uniform elevation of 10 ft. above mean low water, with a top width of 10 ft. These jetties were built up as rubble rock mounds, being built of large and small rip-rap and spalls in such proportions as to afford the maximum density with an armoring of large blocks of 6 to 8 tons on the outside. The rock of these jetties was extended northward to form a revetment of the banks of the channel, this revetment being carried down to approximately low tide level, in a trench previously excavated for the same.

In commenting on the capacity of the new outlet the engineer in charge states: "The present channel is realized to be inadequate to handle a major flood without enlargement but the results already secured with a moderate run-off, have shown that when such a major flood occurs, it will not only take the course desired, but that it will complete the excavation between the levees."

The work has been designed and carried out under the direction of Leeds and Barnard, consulting engineers, Los Angeles.




OLD AND NEW OUTLETS OF SANTA ANA RIVER IN CALIFORNIA

## Illinois Commerce Commission Act

The Illinois act of 1921 creating the Illinois Commerce Commission is now in force and supersedes the former Public Utilities Act. One of the most important changes effected by the new law is the so-called "home rule" provision, under which the voters of a municipality may, by a majority vote, remove their local utilities from state control to the control of the city council or commission, subject to appeal from local decisions to the Illinois Commerce Commission. Any appeal from the orders of the commission shall be taken to the circuit court of the county in which the principal offices of the utility are located. The old law provided that appeals should be taken to the circuit court of Sangamon County, in which the capital city—Springfield—is located. The new law increases the number of commissioners from five to seven besides providing for eight assistant commissioners. The new law specifically exempts from civil service all employees except stenographers, and gives the governor power to appoint members of the engineering, accounting and rate staffs of the commission.

# Building Column Fire Resistance Shown by Test—II

By R. E. Wilson
Engineer, Associated Factory Mutual Fire Insurance Co., Boston, Mass.

*Conclusion of article pp. 106-110, of issue July 21, 1921*

3. *Limestone or Limestone Gravel.* Concrete in which these materials are used for coarse aggregate gives by far the best results. No spalling and very little cracking occurred during the tests. All of the 4-in. limestone protections withstood the 8-hr. test and while still exposed to fire sustained ultimate loads of about three times the working load. To obtain the full value of this kind of protection the material should be clean and should not contain more than 5 to 10 per cent of clayey impurities nor more than 10 per cent of free silica.

(Tests subsequently conducted at the Pittsburgh Laboratories of the Bureau of Standards indicate that the fire-resistive properties of coverings made of siliceous gravel concrete can be appreciably increased by placing a reinforcement of expanded metal lath in the concrete. This procedure may sometimes be necessary where it is impracticable to use other kinds of aggregates.)

The sand used with the various coarse aggregates is of minor importance provided it meets the requirements of a good concrete sand, but, for best results the use of highly siliceous sands should be avoided in combination with limestone or limestone gravel.

The proportions of the concrete mixture appeared to affect the fire resistance to some extent where full protections were employed and for this reason a mixture not leaner than 1:6 is recommended.

The tests indicated no appreciable advantage in shape of covering, whether round or square. This fact is interesting because it has been somewhat commonly believed that the round covering is preferable due to corner cracking of the square coverings. Although this cracking occurred in the tests it did not apparently affect the results to any extent and where concrete subject to severe cracking and spalling was used no apparent retardation of this action was observed with the round covering.

Wire ties are recommended with all types of concrete protection and were found to be especially desirable where the concrete is subject to cracking and spalling as in the case of siliceous and sandstone aggregates. They are also needed to hold in place portions of concrete damaged by fire when subsequently subjected to the action of hose streams as was demonstrated in the fire and water tests.

A single covering of metal lath and plaster at least 1 in. thick may be used on steel columns to obtain a degree of fire resistance somewhat greater than that of unprotected timber or cast-iron columns, and two coverings, each at least ⅞ in. thick, were found to double the amount of resistance. This material, while having no load-carrying capacity, preserves its integrity very well under the action of both fire and hose streams. The mixture proportion used in the tests (1:½:2½ cement, hydrated lime, sand) is recommended, and though the details of application are unimportant the thickness of covering appreciably affected the results. For this reason the heaviest layer thicknesses which it is practicable to apply should be used. The effect of the air space between coverings, while not fully determined, is not believed to be of any appreciable value.

*Tile Coverings*—The amount of fire resistance afforded by single-layer coverings of 2-in., 3-in., or 4-in. hollow clay tile was found to be comparatively small, and even with medium hard semi-fire clay tile (which was the best kind employed in the tests) it is equivalent to only that of a single layer of metal lath and plaster. If it is desired to use tile and a greater amount of fire resistance is necessary, the tests showed that this can be obtained by placing concrete filling in the spaces between the column and tile after the tile is set. The use of tile without this filling is not recommended except in case of medium hard semi-fire clay, since with the other kinds of tile tested the cracking and spalling under fire allows the heat to reach the steel and the application of hose streams carries away large portions of the impaired covering. When concrete filling is used the column so filled is essentially a partly or fully protected column with an additional protection of tile. The concrete not only serves as a protection but also aids in holding the tile in place by adhesion and for this reason should always be placed after the tile is set.

### Fire-Clay Resistance

Semi-fire clay of medium hardness has the best fire resistive properties, developing little cracking and spalling under fire. Hard-burned semi-fire clay, surface clay and shale follow in the order named, the latter cracking severely with spalling of outer shells early in the tests. The overall thickness of the tile appeared to have no appreciable influence on the results, and the mechanical strength was of no importance. This latter fact is of particular interest since some specifications based on mechanical strength would rule out tile of the better fire-resistive properties.

As a result of comparable tests, the use of metal ties in the horizontal joints is recommended as better than use of outside wire ties, and with tile subject to severe cracking and spalling the former method adds appreciably to the period of fire resistance. Outside plastering is not believed to be of much value, though this point was not determined for plastering which had aged over six weeks.

*Brick and Gypsum*—A covering of common clay brick laid flat with brick filling to give a nominal protection of 4 in. in thickness was found to afford a fire resistance equivalent to 2 in. of concrete with aggregates of trap, granite, sandstone or hard-coal cinders. The brick remained in place throughout the test though fluxing after 4½ hr. Brick laid on end and edge to give a 2-in. protection afforded only about one-quarter as great protection as brick laid flat, the large decrease being due to the instability of the units.

Solid gypsum block with gypsum filling and metal ties in the horizontal joints makes a very satisfactory covering material, the 2-in. blocks giving fire resistance periods equal to those obtained with the better kinds of tile with concrete filling and the 4-in. equivalent to a 3-in. protection of concrete made with trap, granite, sandstone or cinder aggregates. Failure is due to checking, shrinkage and disintegration of the blocks under fire with consequent loss of stability of the blocks, and not to normal heat transmission through the covering. In the latter respect gypsum showed itself to be by far the best insulating material. Its action under the application of hose streams in the fire and water tests was quite satisfactory, the strength of the blocks being well retained below the region of calcining.

*Cast-Iron Columns*—Unprotected cast-iron columns offer about twice as much resistance to fire as unpro-

tected structural steel columns and nearly as much as timber columns. No variation is caused by end restraint. The application of hose streams to heated columns, although inducing large permanent deflections, does not cause the columns to lose their load-carrying ability. Filling the interior with concrete increases the resistance offered to an amount approximately equal to that of timber columns. Protections of metal lath and plaster, concrete or hollow clay tile increase the fire resistance very materially, the action of the various coverings being similar to that with steel columns.

*Lally Columns*—The plain Lally column (concrete-filled steel pipe) was found to offer approximately the same amount of fire resistance as a cast-iron column. The reinforced Lally column has nearly twice this amount of resistance.

### Timber and Concrete

*Timber Columns*—Timber columns with cast-iron cap and pintle or steel-plate cap bearings have fire resistance periods of 2½ to 3 times that of unprotected structural steel and slightly greater than that of unprotected cast-iron columns. The full fire resistance of the column itself is not developed with either type of cap, failure being due in every case to excessive heating of the wood at the upper bearing under the metal cap with resultant crushing and brooming of the fibers and ultimate cracking or slipping of the caps. This indicates that with a column cap of a material that will sufficiently protect the bearing surface, a timber column will withstand considerably longer fire exposure before failure and periods from two to three times as great could be expected. It is understood that fire tests being made by the National Lumber Manufacturers Association with a newly devised cap confirm this deduction.

Protections of a ¾-in. layer of gypsum wall board and of a single 1-in. covering of cement plaster on metal lath which also covered the cap increased the fire-resistance periods from about 50 to 200 per cent respectively. In applying such coverings, however, consideration should be given to the danger from dry rot, and steps taken to prevent possibility of deterioration of the timber from this source.

*Reinforced-Concrete Columns*—The reinforced-concrete columns tested included both square and round vertically reinforced and round hooped reinforced types with steel covered by 2-in. integral protection. The concrete mixture was 1:6 with coarse aggregates of both trap rock and of limestone, and definite conclusions are made for these two materials only. The action of the concrete was quite similar to that of the same kinds of concrete as used for protections of steel columns, no spalling and but a very few fine cracks developing throughout the tests.

The fire resistance offered by the columns varies with the kind of aggregate used and is equivalent to that of the 4-in. concrete protections of similar aggregates on steel columns. The limestone has been given the full 8-hr. rating, as reinforced-concrete columns of this aggregate withstood the 8-hr. fire test and immediately sustained loads of two to three times the working load. In no case was there any apparent effect due to form of reinforcement or shape of column and neither the square nor round columns showed appreciable cracking.

In the fire-and-water test series concrete columns with siliceous gravel aggregate were included, and its action was similar to that observed in other tests of this material. Considerable crushing, cracking and spalling occurred with both square and round coverings of this material, and in one case the spiral hooping was exposed before the end of one hour.

### Conclusion

In conclusion it may reasonably be stated that the test conditions are believed to have conformed quite generally with those which are obtained in good building practice. It is appreciated that the number of tests in certain groups was not sufficient to obtain the full range of variation. It is believed, however, that the reductions made in assigning fire resistance periods are sufficient to allow for all differences which may occur if reasonable care is taken to suitably identify materials and classify them in the proper groups and also to obtain a good grade of workmanship. The loading and bearing conditions obtained are considered as severe as those found in usual practice except that in some cases it may not be possible to duplicate the full bearing conditions of the concrete coverings. This advantage is, however, slight, as concrete will develop bond in a comparatively short length and whatever difference may occur is discounted by the reductions applied in assigning periods. In placing all coverings, however, they should be applied so as to obtain as full and continuous bearings as possible.

The fire exposure as determined by the standard time-temperature control curve which was employed is considered to be fully equal to, and probably greater than, that to which the building columns would be subjected in practice except where large quantities of highly combustible material are involved. The exposure was of high intensity and continuous throughout the test, a condition which would seldom be duplicated or exceeded even under most conflagration conditions.

With proper attention to the various features which have been noted above, it is believed that columns and coverings of the various types tested will be able to safely support their designed working loads throughout building fires of durations corresponding to their rated fire resistance periods and in the great majority of cases the columns so exposed will not have been permanently injured.

## Fish Sales a Byproduct of a Drydock

According to the "Panama Canal Record" the large dry dock at Balboa has an unexpected profit in the way of fish. When the gates of the dock are opened for the docking of a vessel a number of fish usually swim in; and when the dock is pumped out they are left stranded on the floor, as only small ones can go through the grating over the pump intakes. Those which are edible are usually gathered by the men at the dock, and the inedible ones are thrown out. During a recent docking a school of fish swam in. When the dock was unwatered the floor was covered with them. In addition to those which the men took, and some 650 lb. taken by the Commissary Division, between 2 and 3 tons were dumped over the gates into the open sea. They were scooped into large buckets which were swung up and over the gates by a crane operating from the side wall of the dock. Most of them recovered and swam away. The Commissary Division realized 490 lb. of cleaned fish, which were sold as second-grade stock at 11c. a pound.

# Proportioning Concrete By Voids in the Mortar

## A Proposed Method of Estimating the Density and Strength of Concrete and of Proportioning the Materials by the Experimental and Analytical Consideration of the Voids in Mortar and Concrete

By Arthur N. Talbot
Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.

*Abstract of paper presented to Annual Meeting of American Society for Testing Materials, Asbury Park, N. J., June 22, 1921. The exact title of the original paper is as given in the subtitle above.*

THE following paragraphs are given to show the purport of the paper, to indicate something of the methods of the tests and of the analysis, and to outline principles affecting the relation of the ingredients to the strength and density of the concrete.

1. For a given amount of cement per unit of volume of concrete in place (the quality of the cement and the quality and nature of the aggregate remaining the same, but the gradation of the aggregate varying), the greater strength is found in a concrete that has the smaller amount of voids and a lesser strength in one having the larger amount of voids (the voids being taken as the space occupied by the water and air). A definite relation exists between the amount of the voids and the strength of the concrete. The percentage of voids may, therefore, be taken as an index of the strength of the concrete.

2. For different amounts of cement and different gradations of the aggregate (the quality of the cement and the quality and nature of the aggregate remaining the same), the strength of the concrete varies with the ratio of the amount of cement used in a unit of volume of concrete to the voids in this volume (or the reciprocal of this ratio may be used), and the strength may be taken to be a function of this cement-voids ratio. A relation which is found to be still better is that between the strength and the ratio found by dividing the absolute volume of the cement by the sum of the voids in the concrete and the absolute volume of the cement, which may be termed the cement-space ratio.

3. If the amount of mixing water be varied in such a way as to change the bulk of the concrete, the strength will still be a function of the cement-voids ratio of the resulting concrete.

4. For the usual concrete mixtures the bulk of the coarse aggregate is less than the bulk of the concrete, or, in other words, the bulk of the mortar in a given volume of concrete is greater than the voids in the coarse aggregate alone (using the term mortar to include the cement, fine aggregate, and water). For such mixtures the voids in the concrete may then be considered to be made up of the water and air voids in the mortar. The density of the mortar for the consistency used in the concrete is, therefore, an important factor in determining the strength of the concrete.

5. If the amount of the water and air voids in the mix of mortar to be used in making the concrete is known, the voids in a resulting concrete may be calculated and the corresponding cement-voids ratio or cement-space ratio may be used as an index of the strength of the concrete.

6. By determining the voids in mortars made with a given fine aggregate but with varying proportions of cement, a characteristic mortar voids curve giving the relation between the mortar voids and the ratio of fine aggregate to cement may be made up for any given fine aggregate, and information will then be available on which to base calculations for voids and strength of concrete made with definite proportions of cement, fine aggregate, coarse aggregate, and water.

7. By determining the voids in various mortar mixes made with different fine aggregates of the same character and thus obtaining characteristic mortar voids curves of the given fine aggregate, comparisons may be made of the relative densities and probable resulting strengths of concretes made up with these mortars and with assumed volumes of coarse aggregate.

8. Knowing the characteristic mortar curve of a fine aggregate, (the general nature and quality of the aggregate otherwise being known), the proportions of the mix required to give a specified strength (including the amount of cement, fine aggregate and coarse aggregate) may be calculated, with a fair degree of accuracy.

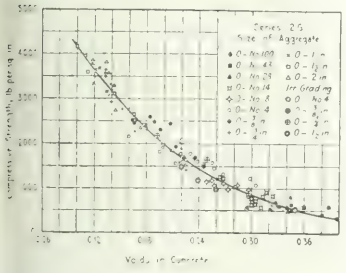



FIG. 1. RELATION BETWEEN VOIDS IN CONCRETE AND COMPRESSIVE STRENGTH

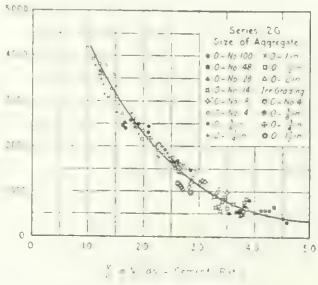



FIG. 2. RELATION BETWEEN VOIDS CEMENT RATIO AND COMPRESSIVE STRENGTH

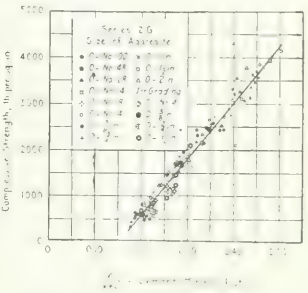



FIG. 3. RELATION BETWEEN CEMENT-SPACE RATIO AND COMPRESSIVE STRENGTH

9. The foregoing principles and methods are most readily applied by the use of the absolute volumes of the cement, fine aggregate, and coarse aggregate; but if the voids in the fine aggregate and in the coarse aggregate in a dry state or in the condition obtaining on the work are known, or the relation between the weights of the aggregate by bulk and by solid volume, the bulk of the fine aggregate and of the coarse aggregate required to make a unit of volume of concrete may be readily determined from the absolute volumes given by the calculations already referred to.

10. If the mixture is such that the voids in the aggregate are not fully filled by the mortar, the mortar voids will not be the measure of the voids in the concrete; but if the voids in the concrete are known, the ratio of the cement to the voids in the concrete will still be an indication of the strength of the concrete, except in the more extreme cases.

11. The amount of voids in a specified mix of mortar may be used to determine the acceptability of a given fine aggregate.

12. The method may be used to design the mix of the concrete whatever the amount of cement used and whatever the ratio of coarse aggregate to fine aggregate, though when

the mortar does not fill the voids in the coarse aggregate this feature must have consideration.

13. In making the mortar test of a fine aggregate, the voids should be determined for increasing amounts of mixing water. The amount of water that gives the minimum volume of the mortar (greatest density and least voids) may be termed the basic water content. The characteristic mortar voids curve made up from values of the voids for minimum volume of mortar may be termed the basic characteristic mortar voids curve. The basic water content permits a very good consolidation of the particles of the mass when put into the mold; more water swells the mixture, as it also adds to the mobility of the mixture. For other water contents, giving the wetter consistencies, such as for example a 1.20 basic water content, characteristic mortar voids curves may be made up from the voids obtained with the specified water content ratios in the tests already

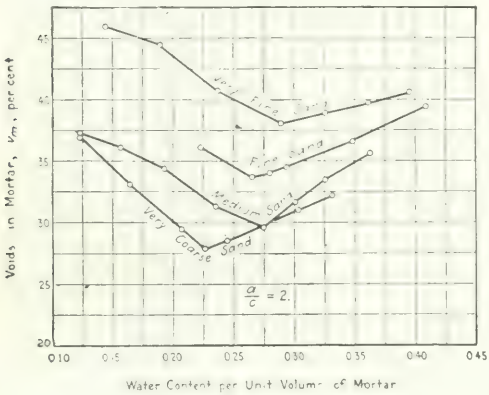



FIG. 4. RELATION OF VOIDS IN MORTARS TO WATER CONTENT FOR $a/c = 2$

is included. The same proportion of cement by loose volume was used in all the specimens—one part of cement to 5 parts of mixed aggregate. Due to differences in the bulking of the mixture the amount of the cement in the resulting concrete varies somewhat (a result which is always present in concretes proportioned by loose volume), ranging from say 0.17 cu.ft. of cement by bulk per cubic foot of concrete for the finer mixtures of each maximum size of aggregate to 0.21 cu.ft. per cubic foot for the coarse mixtures of each size, or in terms of the absolute volume of the cement from 0.08 to 0.10 cu.ft. of cement per cubic foot of concrete. The concrete was all of a normal consistency, giving 0 to ¾ in. of slump for all the mixtures for which the slump test was found applicable and the same apparent degree of wetness for the very coarse mixtures. The results of all the very coarse mixtures are included in the points in Fig. 1—those in which the mortar part of the mixture does not fill the

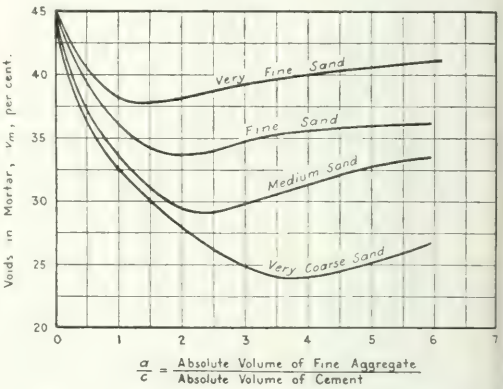



FIG. 5. CHARACTERISTIC MORTAR VOIDS CURVES AT BASIC WATER CONTENT

made. If a larger amount of water than the basic water content is to be used in the concrete, the characteristic curve for that proportionate water content should be used in the calculations. Generally, for the consistencies used in concrete work, the water content will range from 1.10 to 1.40 times the basic water content.

The foregoing principles have reference principally to the effect of gradation of particles and of the space in the concrete between particles upon the compressive strength of the concrete. Neither the structural strength of the aggregate nor the quality of surface which promotes adhesion (for which the word adhesibility may be coined) is taken into account; these may need separate consideration. The relations between strength of concrete and the amount of cement and voids in the concrete are of course subject to the variations inherent in fabricated materials. Their applicability is also affected by the errors of measurement involved in the processes of the tests.

### Voids and Compressive Strength of Concrete

In Fig. 1 are plotted the results of tests made at the University of Illinois in 1919 the ordinates represent compressive strength at 28 days and the abscissas voids in the concrete. In these tests including what would be termed mortar mixtures ten groups of aggregates were used. The range in size of particle for the several groups by sieve sizes was 0—No. 48, 0—No. 28, etc., to 0—1, 0—1½ and 0—2 in. In all cases there was a regular gradation from fine to coarse according to an adopted equation, but each group included eight or ten gradations. At one end of a group the fine particles predominated, at the other end the excess of coarse particles gave a "coarse mix." The series included, in all, 88 of these regularly graded aggregates. In addition to these, 12 irregularly graded mixtures of fine and coarse aggregate were used. A single mixture with 0—No. 100 sand

voids in the coarse aggregate and which are of less strength than the mixtures producing maximum density. A plotted point represents the average of three or four test specimens. It is to be noted that for a 1:5 concrete having 0.10 voids, the strength at 28 days was 4,000 lb. per square inch, for 0.35 voids the strength was only 500 lb. per square inch.

In Fig. 2 the same tests have been plotted in terms of the ratio of the voids in the concrete to the absolute volume of the cement used in a unit of volume of concrete. The points are seen to be more compactly placed. In Fig. 3 the same tests have been plotted in terms of the ratio of the absolute volume of the cement, $c$, in a unit of volume of concrete to the space around and about the particles of the aggregate (sum of the voids and the absolute volume of the cement, $v + c$). This ratio gives the proportoin of the space around and about the particles of the aggregate that is occupied by the cement and through which it is expected to act or be effective, and represents in a way the dilution of the cementing material.

### Voids in Mortars

Tests of mortars show that, for any given proportion of cement to fine aggregate, the voids in the mortar vary with changes in the volume of mixing water used. The value of the voids and their change with additions of water will depend upon the gradation of the fine aggregate, each aggregate having its own individuality. Fig. 4 shows the voids in mortars made with four typical sands—very fine, medium and very coarse—for a ratio of fine aggregate to cement by absolute volumes, $a/c$, equal to 2. The water content is given in terms of the volume of the mortar; for example, 0.25 cu.ft. of water per cubic foot of mortar. For each of these sands, with additions of water the voids decrease to a minimum and then increase. The point of minimum voids (minimum volume of mortar) is definite and readily fixed;

it is here termed the point of basic mortar voids, and the amount of water used per unit of volume of mortar is termed the basic water content. The water content in wetter mixes may be expressed in terms of the basic water content; a 1.30 basic water content would mean that the amount of water used per unit of volume of the resulting mortar is 1.30 times that water content per unit of volume of mortar which gives the minimum volume of mortar—the swelling of the mortar through the addition of water thus being taken account of. It will be noted in Fig. 4 that fine sand gives higher mortar voids than coarse and that the basic water content also differs. Mortars at basic water content are fairly near to what is usually considered normal consistency, or a little dryer.

By making the mortar-voids test for several mixes (several values of $a/c$ enough points may be determined to give the relation between voids in mortar and values of $a/c$ for

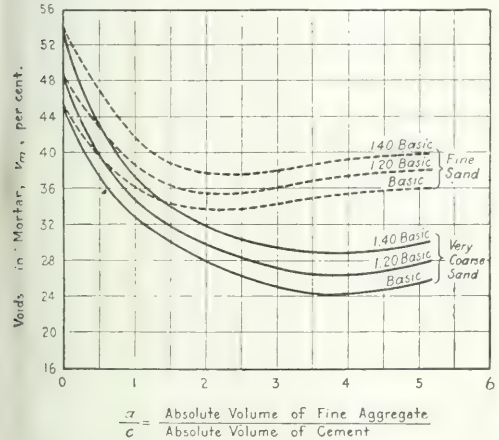



FIG. 6. CHARACTERISTIC MORTAR VOIDS CURVES AT THREE WATER CONTENTS

the given fine aggregate. The value of the voids at minimum motar volume (basic water content) has been taken from Fig. 4 and from similar diagrams for other mixes, and several such points were used in Fig. 5 for each of the four sands, giving what is termed the characteristic mortar voids curve at basic water content. In Fig. 6 characteristic mortar curves for the coarse and the fine sand are given at three water contents, the data having been taken from Fig. 4 and others like it.

Several characteristics of such curves may be noted. For a given water content the curves for different sands converge to a single point at the left, which represents the voids in neat cement at the given consistency. Two sands may not be expected to have the point of minimum voids at the same mix. The characteristic curve of a coarse sand generally shows a rapid increase in voids as the richness of the mix is increased from $a/c = 2$; this property of a coarse sand will be found to tend to limit the advantages of the coarse sand in rich concrete mixes or where a well graded coarse aggregate is available. The relative increase in voids with the addition of more water is less for a fine sand than for a coarse sand.

For a given fine aggregate, the water content required for a unit of volume of mortar may be taken for a number of mixes from curves such as those shown in Fig. 4 and then plotted to make a diagram such as that in Fig. 7. The three curves for each sand indicate the water content required for a unit of volume of mortar for the three conditions, 1.00 basic water content, 1.20 basic water content, and 1.40 basic water content. This water content curve may be made up at the same time that the characteristic mortar curve of Fig. 6 is prepared. The values take into account the bulking of the mortar with the addition of water. The curves in Fig. 7 bring out the variation in water content for different mixes and different sands.

Knowing the void properties of the mortar the application to the concrete mixture may be made by analytical considerations. The following notation will be used:

$a$ = absolute volume of fine aggregate in a unit of volume of freshly placed concrete;

$b$ = absolute volume of coarse aggregate in a unit of volume of freshly placed concrete;

$c$ = absolute volume of cement in a unit of volume of freshly placed concrete;

$d$ = density or solidity ratio of the freshly placed concrete;

$v_m$ = voids (air and water) in a unit of volume of the mortar or mixture of cement, fine aggregate and water as it exists in the concrete.

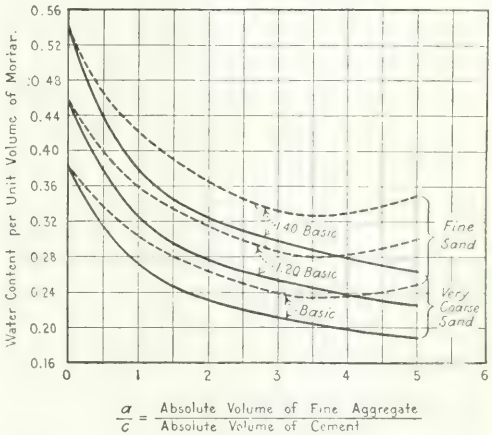



FIG. 7. WATER CONTENT FOR MORTARS WITH TWO SANDS

$v$ = voids in a unit of volume of the concrete. This, of course, will be equal to $1 - d$.

It is evident that

$$a + b + c = d = 1 - v \qquad (1)$$

Since the mortar and the coarse aggregate together make up the unit of volume, it is also evident that

$$\frac{c + a}{1 - v_m} + b = 1 \qquad (2)$$

A third equation derived from Eqs. 1 and 2 will be found useful:

$$v = v_m(1 - b) \text{ or } b = 1 - \frac{v}{v_m} \qquad (3)$$

These equations give the relations necessary for determining the density of concrete; they may be used to check one another. It may be necessary to assume tentative values of one or more of the variables, and then modify the values so that Eqs. 1 and 2 will be consistent with each other. The characteristic mortar voids curve for the fine aggregate to be used, should be known in advance, though approximate values may be sufficient for certain purposes. Some of the conditions or cases to which the analysis may be made to apply are: a given value of $c$ and a specified ratio of $a$ to $c$; a specified ratio of $b$ to $a$; specified values of $b$ and $c$; and a specified value of $v/c$. In the examples which follow the value of $v_m$ used is understood to have been taken from the characteristic curve of the particular fine aggregate that is to be used and for the ratio of $a$ to $c$ of the mortar mix, that curve being used which corresponds to the water content ratio giving the desired consistency. In case the ratio $a/c$ is not known at the start a tentative value may be taken and a second calculation made with a revised value of $v_m$.

[One application of many in the original paper is as follows.]

Given $c$ and its ratio to $a$. To find $d$ and the strength of the concrete.—

Assume $c = 0.1$ and $a = 0.25$. This $c$ corresponds closely to a 1:5 concrete mix and $a$ to a not uncommon relation between cement and sand. Consider that for $a/c = 2.5$ the value of $v_m$ is known to be 0.30.

$$\text{Then} \quad \frac{0.1 + 0.25}{0.70} + b \quad 1 \quad b \quad 0.50.$$

$$0.25 + 0.50 + 0.1 - d = 0.85.$$

The ratio $\frac{v}{c}$, then, is $\frac{0.15}{0.10} = 1.5$, and from a diagram such as Fig. 2, the strength of the concrete may be expected to be, say, about 3,000 lb. per sq.in.

[Other cases worked out in the paper are: given the voids ratio, find the amounts of aggregate and cement; to find the amount of cement required with different fine aggregates; given amounts of coarse aggregate and cement, to find the amount of fine aggregate and the density; given the amount of cement and the ratio of fine to coarse aggregate, find the amounts of aggregate and the density; given the water content curve for a mortar with a fine aggregate, find the water content for the concrete; find the effect of an increase in amount of mixing water upon the density of the concrete.—EDITOR.]

## MORTAR VOIDS TEST DATA

Tests to determine mortar voids and the voids and strength of the corresponding concrete test specimens have been carried on at the University of Illinois. About thirty fine aggregates, including artificial mixtures, have been used. They include a variety of material. The results of the compression tests are not yet available. To show the variety and the individuality of the fine aggregates, the characteristic mortar voids curves of a number of these fine aggregates have been plotted in Fig. 8; these are given for minimum mortar volume or basic water content. The nature of the fine aggregates and the location or source of the supply are given in Table I, as well as the specific gravity,

TABLE I. FINE AGGREGATES OF FIG. 8

| No | Description | Specific Gravity | Fineness Modulus | Surface Modulus |
|---|---|---|---|---|
| 0 | Ottawa standard sand | 2.65 | 2.99 | 12.6 |
| 1 | Sand from Joliet, Ill., screened through fine sieve | 2.76 | 0.92 | 60.8 |
| 5 | Sand from shore of Lake Michigan | 2.64 | 1.40 | 40.2 |
| 6 | Limestone screenings from Milwaukee, Wis. | 2.76 | 2.40 | 37.0 |
| 7 | Glass from Joplin, Mo. | 2.60 | 3.80 | 13.2 |
| 10 | Dune sand from Gary, Ind. | 2.68 | 1.00 | 51.6 |
| 11 | Crushed slag from Chicago, Ill. | 2.70 | 4.11 | 12.8 |
| 12 | Crushed granite from Berlin, Wis. | 2.61 | 3.41 | 23.5 |
| 13 | Platte River "gravel" from Fremont, Neb. | 2.63 | 3.23 | 19.9 |
| 14 | Glass sand from Mapleton, Pa. | 2.64 | 1.83 | 33.4 |
| 15 | Crushed slag from Lorain, Ohio | 2.64 | 3.70 | 17.9 |
| 16 | Granulated slag from Buffington, Ind. | 2.51 | 2.69 | 22.7 |
| 17 | Sand from Atlantic City, N. J. | 2.75 | 0.96 | 53.4 |
| 18 | Sand from San Diego, Cal. | 2.71 | 3.50 | 13.7 |
| 20 | Washed sand from Elgin, Ill. | 2.72 | 2.81 | 20.2 |
| 21 | Sand from Medicine Hat, Canada | 2.66 | 1.16 | 15.1 |
| 23 | Sand from Greenup, Ill. | 2.63 | 1.41 | 41.6 |
| 24 | Sand from Attica, Ind. | 2.69 | 1.34 | 16.6 |
| 36 | Artificially graded sand between No. 28 and 4 sieves | 2.69 | 3.70 | 8.7 |

fineness modulus and surface modulus of the sample. Table II gives the sieve analysis of these fine-aggregates, the sieves used being Tyler standard sieves. It should be noted that in the concrete test specimens proportioned and made up from the data of voids of these characteristic mortar curves and by the analytical methods already described, the voids of the specimens checked fairly closely with the predetermined values.

## OBSERVATIONS

Generally speaking, the greater the value of $b$ (the absolute volume of the coarse aggregate), the greater the density of the concrete (as is shown by Eq. 3), up to the point where the voids in the coarse aggregate are not filled by the mortar. Further, the better the grading of the coarse aggregate, the less its voids and the greater the maximum value of $b$ that can be used in a concrete. For the tests in Series 2G already referred to, well graded gravel was used, and the greatest density and greatest strength for ¼—1-in. coarse aggregate were obtained with $b = 0.59$; for ¾—1½-in., with $b = 0.65$; for ¼—2-in., with $b = 0.63$—larger values of $b$ resulted in greater voids and smaller strength. The highest density obtained was 0.90. These high values of $b$ give a very harsh coarse mix, not easily worked and not applicable in concrete work except under unusual conditions of placing and tamping. There is, of course, some lack of adjustment through the larger particles of the mortar getting between the particles of the

TABLE II. SIEVE ANALYSIS OF FINE AGGREGATES

| No | Percentage by Weight Passing Each Sieve — 100 | 48 | 28 | 14 | 8 | 4 |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 100 | 0 | 0 |
| 1 | 34 | 74 | 99 | 100 | 0 | 0 |
| 5 | 1 | 60 | 99 | 100 | 0 | 0 |
| 6 | 23 | 37 | 52 | 67 | 84 | 98 |
| 7 | 3 | 9 | 20 | 32 | 57 | 100 |
| 10 | 6 | 95 | 99 | 100 | 0 | 0 |
| 11 | 5 | 9 | 16 | 25 | 45 | 89 |
| 12 | 15 | 21 | 28 | 39 | 61 | 96 |
| 13 | 3 | 19 | 42 | 57 | 72 | 88 |
| 14 | 3 | 32 | 93 | 99 | 100 | 0 |
| 15 | 9 | 15 | 24 | 34 | 55 | 93 |
| 16 | 7 | 15 | 37 | 76 | 98 | 99 |
| 17 | 9 | 95 | 100 | 0 | 0 | 0 |
| 18 | 1 | 7 | 24 | 48 | 75 | 94 |
| 20 | 2 | 12 | 51 | 71 | 86 | 98 |
| 21 | 1 | 5 | 32 | 61 | 79 | 92 |
| 23 | 7 | 54 | 99 | 100 | 0 | 0 |
| 24 | 4 | 10 | 25 | 51 | 78 | 97 |
| 36 | 0 | 0 | 0 | 50 | 80 | 100 |

coarser aggregate (a wedging action it is sometimes called), and the voids in the concrete may even be thereby increased somewhat over the analytical values.

For these reasons there must be a limiting value of the bulk of the coarse aggregate that may be put into a unit of volume of concrete; this may be 75 to 90 per cent of the volume of the resulting concrete, according to the gradation and shape of the coarse particles and the method of placing the concrete. A well graded gravel coarse aggregate may have 0.35 voids and a density or solidity ratio of 0.65. If the requisite mobility of the concrete may be obtained when the bulk of the coarse aggregate is 90 per cent of the volume of the concrete, the upper limit of $b$ for this aggregate would then be 0.59. For an aggregate of fairly uniform size the voids may be 0.45 and the density 0.55; $b = 0.51$ would be the corresponding upper limit for this. A still smaller amount of the coarse aggregate will give a more easily worked concrete; the need for mobility or workability will influence the choice of the limiting value of $b$, the limit thus depending upon the nature of the work.

Tests to determine just what the limit of $b$ should be for any given aggregate and any given working condition may readily be made. Well rounded pebbles will give a higher allowable value then elongated ones. The limit for broken stone may be expected to be lower than for gravel, the difference depending upon the angularity of the pieces. From this upper limit the value of $b$ may, of course, range down to nothing. When the value of $b$ used is less than the upper limit, differences in the grading of the coarse aggregate, of course, will not result in any change in the density of the concrete, provided the absolute volume of the coarse aggregate remains the same, and a coarse aggregate of uniform size will give the same density as one that is well graded.

For a given value of $b$ the volume of the motar given by Eq. 2 is $1 - b$. The value of $a$ (the absolute volume of the fine aggregate) that fits in with a given value of $b$ will depend upon the absolute volume of the cement $c$ and upon the mortar voids $v_m$. In general, the finer the sand the greater the mortar voids and the less the volume of the fine aggregate that would be used. It will be found, however, that the extent of the difference will depend upon the nature and shape of the characteristic mortar voids curve.

The data of the tests show that at minimum volume (basic water content) the voids in the mortar are not entirely filled with water, the proportion varying with the nature of the fine aggregate and the richness of the mix and ranging from 65 to 90 per cent or even somewhat more. Seventy-five to ninety per cent are common values.

The leaner mixes generally have more air voids than mixes near that which gives the lowest percentage of voids; richer mixes than the latter tend toward the value for neat cement paste, about 15 per cent of the total voids.

When a larger amount of mixing water than that giving minimum mortar volume is used, the proportion of air voids is decreased. A concrete having 30 to 40 per cent more mixing water than basic water content has the voids practically filled with water. This 30 or 40 per cent additional water content is accompanied by an increase in voids in the concrete of generally only 10 to 20 per cent of their value, though some of the sands gave a larger increase than this. For the wetter mixes the water content is a fairly good measure of the voids in concrete.

Minimum voids and basic water content give a rather dry mix, but it is evidently close to the point of maximum strength of concrete. Expressing the desired water content as a co-efficient times the basic water content would appear to be a definite and reasonable method. A specific co-efficient, however, when used with different values of $b$, or with fine aggregate of widely different quality, may not be expected to give the same mobility or workability. Both the slump test and the flow table give different results for a mixture high in coarse aggregate and for one low in coarse material, even though the degree of wetness of the material is apparently the same. The mobility of the concrete is dependent upon the amount of coarse materials as well as upon the wetness of the mix.

### Possible Method of Specifying Aggregate Quality

The ease of making the mortar void test and the definiteness in the location of the point of minimum volume and in the increase of voids with the addition of water suggests the value of this method as a means of rating fine aggregates so far as the effect of the size of particles is concerned. There is such a variety of fine aggregate available in different parts of the country, very divergent in character, and the needs in concrete construction are so divergent that difficulty has been found in specifying a gradation or a size of particles that is generally acceptable. The test of a sand to determine the mortar voids, with characteristic mortar curves at several water contents, such as are shown in Fig. 6, will enable a study to be made of the concrete-making properties of the sand, and it may be rated or judged from these curves. In making up specifications for fine aggregate, generally only the voids at minimum mortar volume for a definite richness of mix need be considered. The requirement may take one of several forms:

1. A maximum limit of voids for a given mix may be specified, say for a ratio $a/c$ of 2½. The value of this specified maximum may then be fixed for a given locality or a given purpose, according to the materials available.

2. A maximum limit of voids for a given mix may be specified for use with the specified proportion of cement to aggregate; a fine aggregate with mortar voids exceeding this, up to a given limit, may be used, provided the amount of cement per unit of volume of concrete is increased sufficiently to give a concrete coming within a cement voids ratio which would be specified.

3. The limit of voids may be set quite high and the requirement made that for the fine aggregate used the amount of cement and the proportions of the cement, fine and coarse aggregate, and water shall be such that the cement-voids ratio of the resulting concrete shall come within a specified limit.

If the general quality of the fine aggregate in other directions than size and gradation were not known, as in a sand which may be weak in structure, or which may have a poor surface for adhesion, or in a new and untried light aggregate, a strength test should be made in such way as to give a comparison with mortar or concrete made with a fine aggregate of known quality. For such a test the two fine aggregates should have the same gradation of particles.

The laboratory procedure in making the tests herein reported did not differ materially from ordinary practice.

The observed voids in the concrete test specimens checked rather closely with the predetermined values obtained by calculation from the mortar curves. The average variation from the expected value for 60 sets of test specimens examined was less than 1 per cent of voids, the observed value most generally being above the calculated value. In some of the specimens with the larger values of $b$ it was found that the mortar did not fill the voids throughout the specimen.

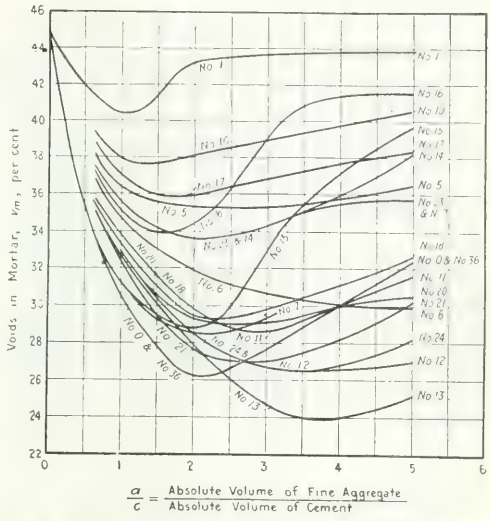



FIG. 8. CHARACTERISTIC MORTAR VOIDS CURVES FOR A VARIETY OF FINE AGGREGATES

As the sum of the solids in the concrete test specimens was found most frequently to be less than unity, it may be considered advisable to modify Eq. 2 by making the second member of Eq. 2 say, 0.995 or 0.99 instead of 1, or perhaps a better plan would be instead to give a coefficient of say, 1.01 or 1.02 to $b$ in the first member of the equation. Such a modification would provide for increase in voids due to the separation or wedging of the particles of the coarse aggregate by the mortar, something which is especially likely to be present when a large proportion of coarse aggregate is used. It was found also in making calculations with data of another laboratory that the sum of the mortar volume and that of the coarse aggregate seemed to be 0.99 or even less, though part of the difference may be due to difference in testing methods.

With reference to the sieve analyses of the fine aggregates, it may be said that they do not bring out all the differences in the characteristics of the fine aggregates shown in Fig. 8; they of course show general differences in gradation. From physical considerations it seems evident that a sieve analysis, or a function derived therefrom, cannot be expected generally to measure or determine the voids in the concrete, because (1) a group of particles of about the same size near the upper or lower size, or at some intermediate size, may be sufficiently in excess of its proportionate amount of volume to interfere with the law of voids which may govern with regularly graded particles, (2) the sieve analysis does not take into account the bulking of the particles when wet, nor the difference in the amount of bulking for particles of different size, and (3) the sieve analysis for the reason given in (1) cannot take into account the changes in bulk due to a change in the amount of the cement used in the mix.

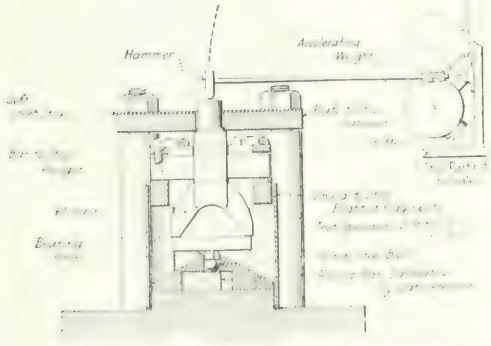
It follows then that while such devices as fineness modulus, surface modulus, and surface area may give a fairly satisfactory way of representing the voids function in material having certain regular gradations of size used with a certain proportion of cement and having certain degrees of bulking, they cannot represent at all generally the variety of differences in grading and bulking and the variety in the

cement proportions that are found in the general run of aggregates and concrete mixtures.

The mortar voids test takes account of the factors which give uncertainty to the sieve analysis function. If the requirements for structural strength and surface adhesibility be otherwise guarded, it will enable new or untried materials to be judged. It is of interest in showing what range of mortar richness will produce best results and what conditions will permit the use of what may have been thought to be a poor aggregate. Doubtless further study and experience will develop many limitations and suggest modifications and standardization of methods. It is evident that for the condition of mortar not filling the voids in the coarse aggregate there must be a limit to the applicability of the voids-strength relation. The shrinkage of wet mixtures and rich mixtures must be taken into account in the measurement of voids. Only physical conditions are here considered and any difference in conditions that affects the chemical action of setting and hardening is a separate factor. In practical use the fine material of the coarse aggregate will have to be counted in with the fine aggregate, and the coarse material of the fine aggregate as part of the coarse aggregate. When using coarse aggregate of the smaller sizes it may be found desirable to use a screen smaller than ¼ in. as the limit between fine and coarse aggregate. The variations inherent in fabricated materials must be expected to affect the accuracy of the findings, as will the errors of measurement involved in the testing processes.

## A New Impact Test for Steel

AS A means of measuring the yield strength of hardened steel under a blow or suddenly applied load, C. E. Margerun developed a peculiar form of impact testing machine for naval service, in which he measures the force which a hammer-blow exerts in bending a short beam-like specimen. A diagram of the apparatus is given in the accompanying illustration, taken from a paper read by the author before the American Society for Testing Materials last month. The hammer by which the blow is delivered to the upper end of the load applying yoke is so arranged as to be capable of striking at




APPARATUS FOR TESTING "SHOCK STRENGTH"

any predetermined velocity up to 32 ft. per sec. The span of the yoke is 1⅞ in. The pressure exerted during the bending of the test specimen is measured by the indentation of a hardened steel ball in a 1¼ x ½ x 10-in. piece of forged chrome nickel steel quenched and drawn to about 270 Brinell. Such a test bar will record about 200 impressions. It is calibrated by making a number of impressions under static loads from 7,500 to 12,500 lb. The precise velocity of the hammer is in most cases not of material influence on the test.

# Extension of Tall Steel Building Involves Unique Operations

### Column Shifted To Give Symmetry to Face of New Structure—First Floor Lowered—Work Done With Building Occupied

A BOLD and unique operation was included in the extension of the 20-story American Surety Building, New York City, the floor space of which has been more than doubled by additions to the east and south.

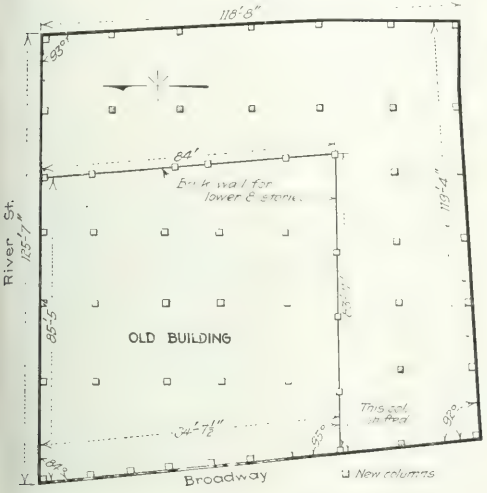
FIG. 1 LOOKING NORTH TOWARD SOUTH WALL OF BUILDING DURING CHANGES

Wall removed in upper floor preparatory to making addition. Trinity Church in foreground and Equitable Bldg. in rear.

In order to maintain the architectural symmetry of the extended building the steel column at the southwest corner of the old building was shifted throughout its full height of 20 stories northward a distance of 2 ft. 11 in. Though this was the crucial operation there were other interesting items in the work, such as the lowering of the entire first floor about 4 ft.; the difficulties encountered in construction because of the presence of a brick bearing wall in the lower eight stories of the east and south walls of the old building; and the preparation of the column foundations for the extension. All of these operations were influenced by the fact that the building was occupied the entire time. The operations from the

standpoint of relative interest are described in the following paragraphs.

*Column Shifted*—Because of the prominent location of the building—Broadway and Pine Sts.—it was decided that considerable expense was justified in maintaining the same bay width across the entire Broadway face of the extended structure so that the architectural detail of the old building could be maintained in the extension. This plan necessitated the shifting of the



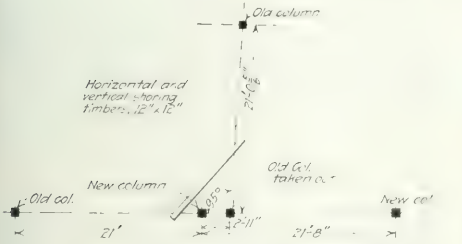




FIG. 2. GROUND FLOOR PLAN AND DETAILS OF COLUMN CHANGE

southwest column a distance of 2 ft. 11 in. To do this the steel on the south wall was exposed, the operation beginning at the top of the building. The masonry was picked away from the steel for a distance of about 10 ft. in from each wall at the corner, temporary partitions being put up as fast as the steel was exposed.

When the temporary walls had been installed the column was shored from sub-cellar to roof, the system of shoring being shown in Figs. 2 and 3. The timbers used in shoring were 12 x 12 in. placed on screw jacks. Shoring started at the bottom with the use of eight timbers and the number was gradually diminished until, at the top, two were used. These timbers were located in clusters of equal number directly to the north and east of the old columns. When shored and wedged the column connections were burned off, work being done from the top downward. The girders were burned off at the new position of the column, and enough of the girder was left upon which to frame the new connections. This done the column was removed, new steel in extensions being erected in the meantime. As fast as the old column was removed connections were prepared on the new steel for the column. When the removal of the old column was complete erection of the new column in the new location was started. After the steel had been erected above the fifteenth floor removal of the shoring began so that work upon the stone facing could begin.

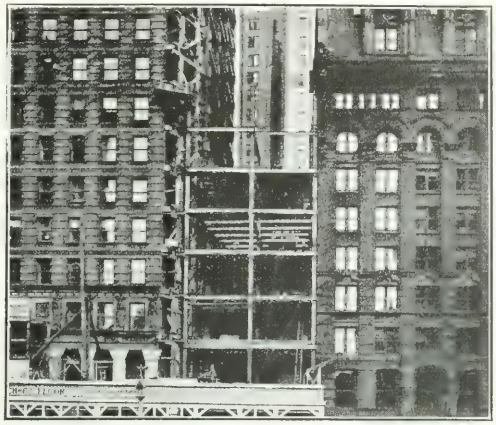


FIG. 3. OLD COLUMN OUT—SHORING DETAIL SHOWN

*First Floor Lowered*—In order to give a level entrance from the street to the corridor of the reconstructed building the entire ground floor was dropped

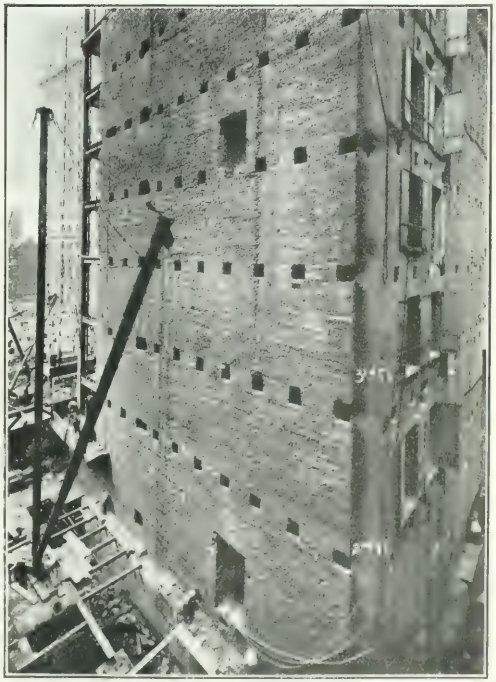


FIG. 4. MASONRY WALL RECESSED TO TAKE TEMPORARY BEARING OF NEW STEEL

approximately 4 ft. All the steam, plumbing and electric mains for the building were fastened to the underside of the first floor, and it was necessary, before starting to lower any of the floor, to drop all of this mechanical equipment and support it from the basement floor. In lowering the floor it was impossible to drop it as a unit as it was occupied and the corridor had to be kept open until the new elevators were put into operation. The north section was first lowered, then the south section, the section occupied by the corridor and elevator shafts being the last dropped. The north and south sections were lowered

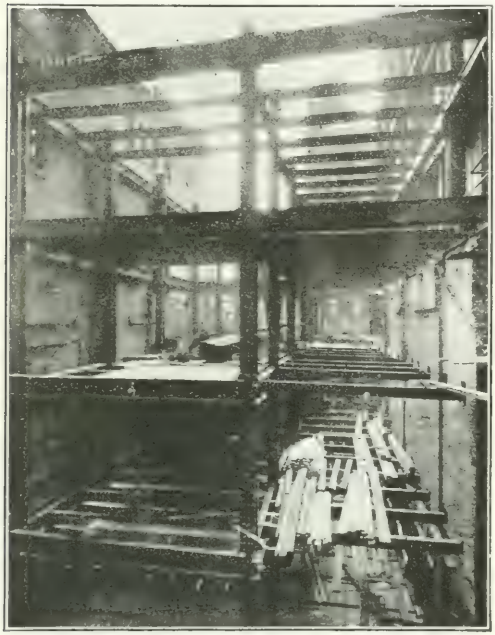


FIG. 5. NEW STEEL CARRIED ABOVE MASONRY WALL

panel by panel, floor beams were taken out and care was exercised that in no case more than one girder connection was cut on each column at a time. Concrete floor arches were then poured and the operation was duplicated in the south section, after the tenants had moved to the north section.

These two operations left the corridor of the building at its original elevation. During the time the two sections were being lowered the new steel for the section under the elevators and main corridor was being fabricated. Steel under the corridor was therefore put in and floor arches poured under the then existing floor construction of the corridor. All that remained to be done in the corridor then was to tear out the old construction as soon as the elevators in the new building could be put in operation and the old ones discontinued.

*Removal of Bearing Wall*—The old building was constructed about 25 years ago, being one of the first tall steel buildings in New York City. Though it was thought to be entirely of steel when the steel on the south wall was exposed it was found that below the eighth floor a brick bearing wall of an average thickness of 4 ft. had been constructed, the floor steel taking bearing in this wall, but the columns continuing through it to their footings. No other steel than the columns and occasional 15-in. channels was found in the south and east walls below the eighth floor.

Before the wall could be removed it was necessary to carry the new steelwork up beyond the eighth floor, making connections between the new portions of the building and the old at that height and then working downward, putting in steel and taking out the bearing wall. The bearing wall was notched at each floor so that floor steel could rest in the wall before it was possible to connect it to beams.

In the extension of the building the demolition of the eight-story Schermerhorn building to the south was necessary. Inasmuch as tenants in that building had leases that did not expire until long after expansion of the Surety Building was decided upon, the decision was made to prepare column foundations in advance of demolition. The new column foundations are clusters of six 15-in. steel cylinders, concrete filled. The cylinders were driven to refusal or rock, the penetration being from 67 to 79 ft., very few of them being driven the minimum distance. Hydraulic jacks were used for driving, until possession of the first floor was gained, when the additional headroom allowed the use of steam and air hammers. The same system of foundation work was carried out to the east of the old building.

Inasmuch as the cut-off elevation of the cylinders was below water level in many cases, the cylinders were generally allowed to project several feet above the cut-off elevation, being burned off at the proper level after being filled with concrete.

All of the steel uncovered in the old building was found to be in excellent condition. Only occasional rust spots were found, it being entirely unnecessary to replace any of the old steel because of deterioration. The only new steel members placed in the old building were a few heavier columns in the two upper stories, put in to take the load imposed by a two-story steel penthouse.

When excavation for the sub-basement began the contractor encountered considerable difficulty in removing old engine beds and boiler pits in the basement of the old building. During the past 25 years various changes had been made in boiler installation and each change resulted in new concrete. Two concrete machinery beds that had to be removed were 15 x 30 x 15 ft., and 10 x 15 x 10 ft. in size.

The general contract for the reconstruction work was held by Cauldwell, Wingate & Co., with D. E. Moran as consulting engineer. The foundation work was done by Spencer, White & Prentis, under the direction of the general contractor and Mr. Moran. The architect for the work was Herman Lee Meader. Richard Deming, vice president of the American Surety Company, superintended the work for the surety company.

## Court Holds State Cement Plant Legal

At the request of the Governor of South Dakota the judges of the Supreme Court of that state have passed upon the legality of a state-owned and operated cement plant. The opinion of the court is that this would be legal. (180 N. W., 957.)

## *Impressions Here and There*

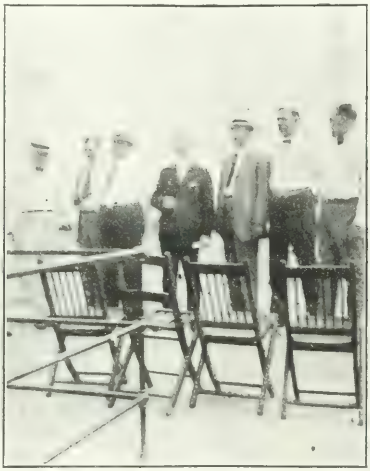
### Down the St. Lawrence Waterway

INSPECTING engineering jobs is a favorite pastime for engineers. This is quite right and proper even though at times it does get pretty close to the old joke about the motorman taking his day off riding on the street cars. Seeing how the other fellow does it is the beginning of knowledge, provided the critical faculty is not overexercised and disparaging comparisons not overemphasized. Such inspections, though, are generally in company with other engineers—the byproduct of conventions or the express object of an engineering meeting, so that in addition to practical education they serve to develop that class consciousness that so many of our active thinkers would have us regard as the profession's salvation. It is a good thing, on the other hand, for every engineer every so often to separate himself from his own crowd and travel as a spectator over big engineering works in company with men who are not engineers—men to whom the commonplaces of construction are wonders and the elements of design and function mysteries.

Such an opportunity was afforded a few engineers two weeks ago when they were invited to attend the excursion of the Great Lakes-St. Lawrence Tidewater Association on the steamer "Cape Eternity" from Niagara down the St. Lawrence to Quebec. Over 150 men made up the party as guests of the Canadian government, to view on the ground the potential St. Lawrence waterway and power development on which the International Joint Commission is about to report and which is to be much in the public eye in the near future. It was a serious expedition, albeit a good-natured and happy one, with representatives of the Northwest that is seeking a cheap waterway outlet for its grain and other freight, with New Englanders hungry for cheap power but skeptical of the economics of the grand scheme, with Canadian cabinet ministers and their great ex-premier Sir Robert Borden, with six governors and four of the ex variety, with senators and congressmen, merchants, manufacturers and farmers—and perhaps half a dozen engineers. Few had ever seen the St. Lawrence except as tourists; all were interested in its power and navigation possibilities.

In a way the trip was propaganda. The Westerners planned it and the Canadian government acted as host. The rest of the party came "for to admire and for to see." But it was shrewdly planned propaganda, honestly put forward by men who believe in this great project and who want to convince those who may be most benefited but who are "from Missouri" as to those benefits, or, as they more politely put it, "are still of an open mind." Inspection of the waterway itself and the sites of the proposed structures was skillfully varied with views of the completed or partly completed harbor and power works of the Canadian governments and with addresses and lectures on the features and possibilities of the complete scheme. What has been done was used to illustrate what can be done, and good feeling promoted by most bountiful hospitality by the Canadian cities along the route.

The trip started at Niagara with an inspection of the Queenston-Chippawa power development now being completed by the Province of Ontario. Engineers realize that this is the biggest piece of construction on the continent and one of the boldest financial ventures ever undertaken by a government, but to most of those of the party it was a revelation. They were all properly impressed with the magnitude of the project, on which some 8,000 men were working the day of the visit, though somewhat skeptical of its economics and doubtful of the market for the 500,000 hp. it will produce. From there they were taken over the new Welland Canal which, delayed by the war, is still far from completion but which is sufficiently far along, especially in the great locks, to show that the upper link in the



NOTABLES ON BOARD "CAPE ETERNITY" EN ROUTE DOWN THE ST. LAWRENCE

At left (lower row)—Sir Robert Borden, Sir Henry Drayton, Canadian Minister of Finance; W. A. Bowden, chief engineer, Canadian Department of Railways and Canals; Hon. Frank Keefer, M. P. (Upper row) Members of Canadian and Ontario Parliaments.

Middle—Ex-Gov. Frank Lowden, of Illinois; Gov. McMasters, S. D.; Gov. Allen, Kans.; Gov. San Souci, R. I.; Gov. Hartness, Vt.; Ex.-Gov. Milliken, Maine; Gov. Preuss, Minn.

Right—Senators Townsend, Mich., Lenroot, Wis., McKinley, Ill Ransdell, La.

30-ft. opening of the Great Lakes to the sea is on the way to being an accomplished fact. At the Lake Ontario end of the canal the "Cape Eternity" was boarded and the party stayed on her to Quebec, with stops at Toronto, where a great industrial development is masquerading as a harbor project, at Montreal long enough to see what a real river harbor can be made and at Quebec to view the more limited harbor work required at a city where industrial development is meagre.

During the boat trip frequent meetings were held aboard ship. Col. W. P. Wooten, the United States army engineer and W. A. Bowden, the chief engineer of the Canadian Department of Railways and Canals, explained their joint report to the International Joint Commission on the engineering necessities of a St. Lawrence waterway. William S. Murray outlined the features of his recently made Super-Power Survey of the Northeastern part of the United States. R. S. McElwee and A. H. Ritter lectured on the economic features of a St. Lawrence navigable to ocean ships, in brief abstract of their recently issued book on that subject, which incidentally was distributed as a gift to each member of the party. In lighter and more genial vein were the numerous speeches of international amity, drawn from the inexhaustible fount of oratorical talent aboard the ship. Appreciative as they were of the importance of the fact, the party after a while began to await with laughing expectancy the certain reference to the "4,000 miles of boundary for a hundred years without gun or fortress." Meanwhile all the lower part of the voyage was made along the rapids and through the locks which must be improved to make deep-water navigation, with an interlude in the way of a lightly clad swimming party participated in by governors, congressmen and other distinguished citizens. If they get by the censor certain moving pictures taken of this episode will make good campaign material.

### What Was Learned

Taken all in all this was a remarkable trip. It had some of the elements of a junket. A few aboard were out only for a good time, but the great majority were serious minded men on whom will rest either the responsibility for forwarding legislation or of informing the business men of their community of the faults or virtues of the St. Lawrence scheme. The echoes of the trip will be heard in the halls of Congress and the Canadian Parliament and in the public discussions from North Dakota to Maine. It was the opening gun in the campaign which is to be waged as soon as the International Joint Commission makes its report in October and which may result in the expenditure of half-a-billion dollars and the revision of the trade routes of the continent and the power plan of the whole Northeast.

As to the scheme itself, the excursion showed those who made it certain things. They learned that Canada, with the exception of some of Quebec, is for the opening of the St. Lawrence; they learned that Ontario, far advanced in government ownership, is convinced of the necessity for enormous water-power development by the state; they saw cheap power offered to the citizens who so far are not convinced of any added charges camouflaged as taxes; they saw a great wide river for the most part as easy of navigation as the open sea but they saw also canals and locks through which the comparatively small "Cape Eternity" progressed slowly and with difficulty; they saw a dam site whose difficulties loom tremendously in the engineering eye only as a place where engineers say a dam can be built, and they accepted that assurance with calm confidence.

This last observation leads us back to the reflections in the opening paragraph. Engineers need to get out with the men who in the end dictate or control the work the engineers do. They need more to learn how engineering work is regarded. On the St. Lawrence trip the statements of the engineers as to engineering problems and solutions were accepted without question; there was an almost touching belief that nothing is impossible. No engineer present could escape the feeling of responsibility which the profession must assume. But the regard for engineering opinion stopped at what the layman considers the limit of engineering knowledge, that is, the design and construction of engineering works. When it came to economic questions, such things as the navigability of the proposed waterway, the diversion of freight, the effect of rates, in effect the ultimate questions on which the St. Lawrence waterway must stand or fall, the engineer was not considered. All he was for was to say where and for how much certain things should be built; the business man and the professional economist must make the ultimate decision. Possibly this is as it should be. This is not the place for an argument on that, but all the discussions on the "status of the engineer" so emphasize the larger and wider field of the engineer's work that this observation, made under most favorable circumstances, is set down for what it is worth.

July 22, 1921. F. C. W.

## California Water Powers Tabulated

A compilation of data on all water powers in California has recently been made under the direction of H. D. McGlashan, district engineer of the United States Geological Survey at San Francisco, which shows a total of 1,107,139 installed horsepower in water power plants of that state. Plants with a capacity less than one hundred horsepower are not included. The information is arranged in two classifications so that it can be studied either by counties or by drainage basins. A summary of the data is presented in the table above.

DEVELOPED WATER POWER IN CALIFORNIA

| | Public Utility Plants | Municipal Plants | Mining Plants | Total or Average |
|---|---|---|---|---|
| Installed horsepower | 989,314 | 101,140 | 16,685 | 1,107,139 |
| Number of plants | 87 | 15 | 28 | 130 |
| Average horsepower per plant | 11,371 | 6,743 | 596 | 8,516 |
| Number of water wheel units | 240 | 28 | 70 | 328 |
| Number of turbines | 62 | 14 | 10 | 86 |
| Number of impulse wheels | 168 | 14 | 60 | 242 |
| Average horsepower per wheel unit | 4,301 | 3,612 | 238 | 3,375 |
| Storage used in acre-ft | 1,554,321 | 124,540 | 9,400 | 1,688,261 |
| Average head developed, in ft | 647 | 542 | 418 | 587 |
| Maximum head developed, in ft | 2,131 | 1,266 | 1,250 | ..... |
| Minimum head developed, in ft | 12 | 10 | 24 | ..... |

## Electrification in Australia

Progress on the electrification of the suburban system of the Victoria Government Railways at Melbourne, the capital city of Victoria, Australia, was interfered with to such an extent by the war and the industrial difficulties which followed it, that the work will not be completed until some time in 1923. The lines already in operation and others to be put in service in 1921 will comprise about half the suburban system. According to the annual report of the Railways Commissioners the electric services have given satisfaction and the complete scheme will provide a greatly improved system of rapid transit which will enable additional services to be afforded at less cost than for steam operation.

# Tests on Run-Off from Muck Soil in the Everglades

## Storage of Rainfall on Important Property—Ditch Size Must Allow for Subsidence Due to Drainage—Run-Off Formula

IN LAND drainage work where muck or peat soil is encountered, certain characteristics of such soil in regard to water storage and soil subsidence constitute a special factor as they produce conditions differing somewhat from those experienced ordinarily in the drainage of loam, clay or sandy soils. Experiments to determine the run-off from muck soil have been made by F. C. Elliot, chief engineer of the Everglades Drainage District, and the following is an abstract of a paper by him in the *Year Book* of the Florida Engineering Society.

Muck and peat soils have a high normal water content, due partly to their humous composition, which gives them a greater affinity for water than the common mineral soils, and partly to the large relative pore space accompanied by a high degree of capillarity. Part of this pore space is in the loose character of the soil itself and part in the cellular structure of the muck. Part of the water held by saturated muck is released readily by drainage and about an equal amount is quickly reabsorbed by drained soil when moisture is supplied by rainfall. Percolation and capillarity are important considerations in connection with water storage in the soils. Through drainage and cultivation these soils are subject to a marked degree of shrinkage.

Water storage in the soil and shrinkage or subsidence of the soil bear directly upon the problems of determining: (1) A satisfactory run-off factor, and (2) the ditch design best suited to afford the required run-off, to provide flood protection and to give satisfactory ground water levels for agricultural purposes. Experiments have been made for the determination of a reasonable and economical run-off for providing that degree of drainage considered advisable for the Everglades. In arriving at final results the following principal factors were investigated: (1) Storage or absorption value of muck soil under actual field conditions; (2) evaporation from such soil, including transpiration of water from vegetation; (3) the advantageous water level for the growing of crops, combined with a high degree of flood protection; (4) the effect of the water level and land tillage upon subsidence and the degree to which subsidence should be compensated for in ditch construction.

### Test Apparatus

For these experiments a sheet-iron box is used, 2 ft. square and 4 ft. deep, the seams being riveted and soldered to secure perfect water tightness. To the outside of the box is attached a water gage glass connected with the interior by a valve at the bottom and a pipe nipple at the top.

The glass has a gage divided into inches reading zero at the top and graduated downward for depths below the surface of the soil. The box rests near the ground and is inclosed and protected by a lattice against the rays of the sun. A section of muck soil in its natural condition was placed in the box, filling it level full. Augustine grass and Bermuda grass were planted and water added to bring the water table to a convenient starting point. In conjunction with the soil box a rain gage is observed. Soil water levels are recorded from test holes in the natural muck soil at the station. Water evaporation pans are also kept for comparison of evaporation between water surface and losses from evaporation and transpiration from the soil box.

In operation, the water gage is read and tabulated to show the level of ground water below the surface of the soil, records being taken each morning and after such rains as require additional measurements. Observation is made upon the growing vegetation. The rain water gage is read and recorded, and the level of water in the test hole is recorded. Water can enter the box only through rainfall, which is measured by the rain gage. Water can escape only by evaporation, which is measured, and by being drawn through the bottom valve, which represents drainage. Evaporation includes loss direct from the soil and by transpiration through the vegetation.

Evaporation is disclosed by the lowering of the water level and rainfall produces a rise in this level. The rain gage measures the amount of rain, and the water glass on the soil box shows the corresponding rise in the water level. By numerous repetitions there is disclosed a ratio between rainfall and rise of water and a ratio between evaporation and the lowering of the water level. For example, in the morning the soil box gage may show the water level at 32 in. During the day a rain of 0.6 in. is recorded. On the next morning the gage shows 29 in. Ignoring evaporation, it appears that three inches of soil were required to store or absorb 0.6 in. of rain.

To determine the evaporation which took place from the soil daily and for the month, the rainfall is gaged for the month and at the end of the period water is either added to or drawn from the box to restore the water level to the same level as at the beginning of the month. In addition to this water, allowance is made for rainfall. The water which entered the box having been measured, and the amount drawn off as drainage (if any) also being measured, the quantity not otherwise accounted for represents evaporation. Through these experiments the storage value of the soil is ascertained.

### Soil Storage and Shrinkage

*Soil Storage*—An important disclosure by the experiments is that muck soil has an important and valuable storage capacity when the water table is at a favorable level. The records of the soil boxes showed in the beginning that each 3 in. of soil above water level was capable of storing one inch of rain. After the soil became more compact by tillage and drainage the storage factor was reduced to 1 to 4 and finally 1 to 5, which latter has been maintained for the past three years. It is probable that a further reduction of storage value will take place in time, and conservative drainage design would take this into consideration.

Conclusions as to soil storage may be stated as follows: (1) The storage capacity of muck soil is a valuable drainage factor; (2) the value of this storage varies directly as the depth of soil above the water table; (3) storage capacity of the soil under favorable water table conditions will permit taking advantage of evaporation to assist drainage; (4) in designing a drainage system for muck land, account may be taken of the storage value of the soil, provided ditches of relatively deep section are used and at sufficiently close intervals to secure a good depth of water table and for restoring and preserving the storage value of the soil; this operation will approach subsurface drainage; (5) soil storage tends to equalize run-off and this effect will extend to the main canal system as well as to the lateral system; (6) deep soil above the water table is a tremendous protection against flood.

Levels taken over selected areas during a period of six years show that during the past six years subsidence of 2 to 3½ ft. has taken place generally over the upper Everglades on land drained or partly drained, varying according to depth of soil, character of muck, extent of cultivation and depth of normal water level. The soil was 10 to 12 ft. deep. A total subsidence of 4 to 6 ft. in 10 to 12 years more, under continued drainage and cultivation, does not seem improbable. Subsidence diminishes ditch capacity principally by the material reduction in ditch section through diminished depth of ditch and by reducing the slope or grade of the ditch.

Our experiments show that for soils of given depths the amount and rate of subsidence are affected largely by the depth of water table. The deeper this is, the greater and more rapid the subsidence, and the shallower the water level the slower the settlement. Therefore, too deep drainage should be guarded against, not only from the standpoint of subsidence, but also because muck, when it becomes too dry, has the peculiar property of resisting the reabsorption of moisture, the continual replenishing of which is necessary to plant growth

*Drainage Layout*—Based on observation of muck soil under the conditions met with in the Everglades, the following conforms to a satisfactory drainage layout for muck land such as described. Discharge capacities are represented by

$$D = \frac{12}{1 + 1.4A} + 16,$$

where $D$ equals discharge in cubic feet per second per square mile and $A$ equals area in square miles. Maximum water level in ditch, 1 ft. below ground surface; depth of lateral ditches, not less than 5½ ft.; reduction of water level before beginning of rainy season, to not less than 50 in. below ground surface. Lateral ditch intervals, not over half a mile. Farm ditch intervals, not over 660 ft.; depth not less than 4½ ft. Farm drains according to needs, 110 ft. interval suggested.

Ditches and canals must be made sufficiently deep to compensate for loss by subsidence. In virgin muck soil 8 ft. or more in depth the ditches should be cut 8 ft. deep in order to have 5½ ft. depth after three or four years of drainage and cultivation. This minimum depth must be preserved by maintenance. Where partial subsidence has already taken place, allowance may be made accordingly. Within reasonable limits ditches should be deep and narrow rather than broad and shallow. The sides should be steep; side slopes of ¼ to 1 stand very well in ordinary muck. The steeper the sides, the less trouble from weed growth, which is the most serious source of ditch deterioration in muck soil.

An examination of the rainfall records of stations nearest the Everglades since 1895 shows that a general drainage plan such as above described would have given the following results: There would have been two general floods in twenty-five years during which water would have stood on the ground two days, and six local floods of small area, four of which would have required less than two days for their reduction and two would have required four days for reducing the water to sub-surface conditions. Only one locality would have had two local floods in the above time, and some localities would have been subjected only to the two general floods resulting from extreme rainfall.

## Corporation Income Tax Returns Include Engineering Services

ENGINEERING is included in "professional and other services" in corporation returns reported in *Statistics of Income*, compiled from the returns for 1918 under the direction of the Commissioner of Internal Revenue. Corporation returns are divided into the three general classifications of public service, finance, and all others. The main division of public service is divided into domestic service, amusements, professional and other services. A tabulation representing "professional and other services" is reproduced herewith.

Inquiry of the Commissioner of Internal Revenue at Washington in regard to both engineers and physicians apparently being included under corporations develops the fact that the general classification was arranged to be broad enough to cover both returns of individuals and corporations so that the classification "Engineering, mechanical design, invention, scientific research, etc.," in its fuller aspect is given as follows: "Engineering, architects, agricultural, civil, chemical, consulting, electrical, marine, mechanical, mining engineers. Assayers' test or research laboratories, invention, mechanical design, metallurgists, mechanical experimentation or research. Scientific research. Surveyors."

Apparently no statistics have been developed indicating separately returns by individual engineers and by corporations.

INCOME TAX RETURNS OF CORPORATIONS RENDERING PROFESSIONAL SERVICE—1918

| Industries | Total Number of Corporations | Corporations Reporting Net Income: Number | Net Income | Income Tax | War Profits and Excess Profits Tax | Total Tax | Corporations Reporting No Net Income: Number | Deficit |
|---|---|---|---|---|---|---|---|---|
| Professional and other services: | | | | | | | | |
| Business services, advertising, appraisers, auditors, actuaries, etc. | 1,178 | 773 | $3,813,789 | $327,209 | $366,355 | $693,564 | 405 | $1,474,922 |
| Educational service, including art, colleges, schools, libraries, etc., teachers, etc. | 752 | 473 | 2,129,828 | 173,973 | 103,716 | 277,689 | 279 | 997,310 |
| Curative services, physicians, surgeons, etc. | 927 | 613 | 2,506,373 | 156,562 | 410,451 | 567,013 | 314 | 515,488 |
| Legal services, lawyers, patent attorneys, etc. | 910 | 683 | 2,700,117 | 228,174 | 69,311 | 297,485 | 227 | 257,628 |
| Engineering, mechanical design, invention, scientific research, etc. | 413 | 254 | 4,342,489 | 273,292 | 1,711,420 | 1,984,712 | 159 | 922,968 |
| All other service (not precisely defined) | 1,867 | 1,338 | 5,718,511 | 503,119 | 741,347 | 1,244,666 | 529 | 1,200,024 |
| Total professional and other services | 6,047 | 4,134 | $21,211,107 | $1,662,329 | $3,402,800 | $5,065,129 | 1,913 | $5,368,385 |

skirts of the city locating, operating and repairing all valves as they proceeded toward the center of the city. Mains were located with a wireless pipe locator. Many of the valves under pavements have been located with the dipping needle. To prevent breaking of stems from opening left-hand turn valves the wrong way a specially designed valve box is used for the right-hand turn valves with "open right" on the lid.

Results are beginning to show, said Mr. Holway. Recently a large circuit was closed in 28 min. which 15 months previously required four men two hours to close and then a perfect shutdown was not obtained.

## Overhauling a Neglected Water-Works Distribution System

PROPER maintenance of a water-works distribution system is a continuous process that must be conscientiously kept up. No better illustration of the deplorable condition into which a system can get and the strenuous work necessary to restore its efficiency could be found than that of the Oklahoma City plant described recently by A. S. Holway, superintendent, before the Southwest Water Works Association:

The principal feeder to the city had 16 ungated hydrants on it and a blow-off of one of them had caused an 18-hour shut down to the whole business district. No large connections were made between the domestic supply and a downtown fire system supposed to be high pressure but for many years carrying the same pressure as the domestic lines. Valves broken closed, many packed with oakum, were common. In going over three-fourths of the 165-mile system 84 valves have been found paved over and 65 valves could not be operated because the operating nut was against the valve box. In one section containing 254 valves, 47 were not shown on available maps, 11 were shown which did not exist and 60 needed repairs. In this same section 3,000 ft. of mains were located that were not shown on the maps and 2,350 ft. shown did not exist. The size of nearly 10,000 ft. of pipe was incorrectly given.

An old negro, Claude, was finally found to be the best source of information. He with an engineer was detailed to travel the streets east and west, stopping at every street intersection in the city. He told the engineer as well as he could recall from water-boy days, what mains and valves were at each intersection. Subsequent investigations proved that Claude's memory was fully as reliable as the maps.

One of the means employed to get the records back to normal was a systematic use of information from new tap orders which requested location and size of main tapped. Most of the information, however, was obtained from the work of the valve repair crew which started at the out-

# Flow of Water Through Galvanized Spiral Riveted Steel Pipe

By F. W. Greve
Assistant Professor of Hydraulics Purdue University

THE experiments performed in the hydraulic laboratory of Purdue University on galvanized spiral riveted steel pipes were prompted by the meager data available. The diameters of the pipes tested were 4, 6, 8 and 10 in. respectively. The objects of the investigation were to determine: (1) the variation of the friction loss with velocity for flow, both with and against laps; (2) the variation in accuracy of four types of piezometer rings; and (3) the friction loss compared with that in cast-iron pipes for like conditions of diameter and velocity.

The pipes were all of No. 16 gage. The average spacing of the rivets was $\frac{3}{4}$ in. for both the 4 and 6-in. pipes, 1 in. for the 8- and $1\frac{1}{8}$ in. for the 10-in. pipe. The rivet heads on the inside of the pipes projected $\frac{1}{16}$ in. from the pipe wall and were flattened to reduce the resistance to flow. True cross sectional areas were determined by weighing the amount of water necessary to fill a given length of pipe and dividing this weight by the product of the length and the weight of a cubic foot of water which was 62.32 pounds.

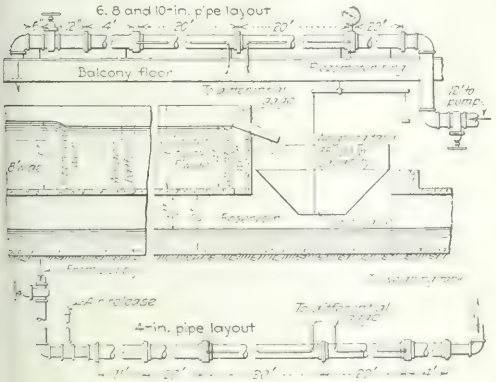



FIG. 1. LAYOUT OF PIPE LINES FOR TESTS

A spiral pipe line was composed of four sections, laid horizontally. Each of the first three sections was approximately 20 ft. long while the last was of 4-ft. length. Piezometer rings were inserted between the first and second and between the third and fourth sections from which rings the pressure was communicated through $\frac{1}{4}$-in. pipes to differential gages. The purpose of the first and last sections was to insure continuity of flow by having the water subjected to no change in velocity, diameter or rubbing surface when entering and leaving the tested lengths. The layout of the pipe lines is shown in Fig. 1.

The piezometer rings were made of cast-iron discs, 2 in. in thickness. In type A, a hole was bored through the disc equal in diameter to that of the spiral pipe. Type B differed from A in that it had a chamber machined out on the inner surface, $\frac{1}{2}$ in. wide by $\frac{3}{8}$ in. deep. The $\frac{1}{4}$-in. pipes were connected to both rings at four points—one at the top, another at the bottom and the last two diametrically opposite each other midway between the top and the bottom. Types C and D were the same as A and B, respectively, except that three of the holes were plugged, leaving only one opening at the same elevation as the center line of the pipe. Ring C was used in all tests. The other three were employed only in the experiments on the 6-in. pipe, to determine what change, if any, was produced on the differential gages by the several types of piezometer rings.

The water was supplied through cast-iron mains from a 6-in. direct-driven, centrifugal pump. The flow from spiral pipes passed either directly or indirectly through a cast-iron pipe into a large concrete channel, 5 x 40 ft. in plan and 6 ft. deep. The discharge from this channel was over a suppressed rectangular weir and moveable apron into a calibrated weighing tank of 20 tons capacity. A piezometer situated up stream from the weir was used to determine the condition of steady flow. Time was indicated on a calibrated stopwatch.

Fig. 2 shows the relation of friction head per 100 ft. of pipe to velocity for flow both with and against laps on logarithmic paper. The graphs are straight lines, indicating that the head lost varies directly as some power of the velocity. The graphs are nearly parallel lines, which demonstrates that the slope varies but little with the size of pipe. This figure also shows that the loss decreases with increase of diameter for any given velocity; that the loss is greater for flow against than with laps; and that the difference of loss with and against laps decreases with increase of diameter. That the effect of direction of flow becomes correspondingly less as the size increases is to be expected since the thickness of the lap is a constant for the pipes tested and, therefore, the ratio of this thickness, or projection, to the diameter decreases with diameter. Thus, the large sizes approach the conditions of smooth pipes.

TABLE I. VARIATION OF $m$ AND $n$ IN THE EQUATION $h_L = mv^n$

| Nominal Diameter, In. | True Diameter, In. | $m$ With Laps | $m$ Against Laps | $n$ With Laps | $n$ Against Laps |
|---|---|---|---|---|---|
| 4 | 4 13 | 0 115 | 0 138 | 1 86 | 1 91 |
| 6 | 6 01 | 0 0843 | 0 0875 | 1 91 | 1 95 |
| 8 | 8 12 | 0 0669 | 0 0739 | 1 92 | 1 89 |
| 10 | 10 21 | 0 0554 | 0 0597 | 1 82 | 1 80 |

The graphs are all of the form, $h_L = mv^n$. The value of the coefficient and exponent are given in Table I. The relation of $m$ to $d$ can be expressed by the logarithmic equation, $m = kd^x$. Table II shows the variation of $k$ and $x$ with $m$.

TABLE II. VARIATION OF $k$ AND $x$ IN THE EQUATION, $m = kd^x$.

| | With Laps | Against Laps |
|---|---|---|
| $k$ | 0 0488 | 0 0515 |
| $x$ | −0 799 | 0 926 |

The ratio of $n$ to $d$ can be best expressed by the cubical equation, $n = ad^3 + bd^2 + cd + e$. The limits of usefulness of the equation were found by determining the point of inflection when the second derivative of the equation was made equal to zero. The equation for flow with laps holds good for all values of $d$ equal to 4 in. and greater and is true for all positive values of $d$ when the flow is directed against the laps. The relations thus established furnish a means of computing $m$ and $n$ for any diameter of pipe. Heretofore, no data have been available to predict the friction loss in a pipe on which experiments have not been conducted.

The effect of different types of piezometer rings on the measurement of lost head in connection with the tests on the 6-in. pipe is shown in Fig. 3. It will be noticed that practically identical results are obtained no matter which type of ring is used.

A comparison was made of the friction losses per 100 ft. of pipe for both smooth cast-iron and galvanized spiral-riveted steel pipes. The losses for the iron pipe were computed from Williams and Hazen's "Hydraulic Tables." When the flow is directed with the laps, the 4-in. spiral riveted pipe shows a lesser loss than the iron pipe of like diameter. The reverse is true for all the larger pipes. However, the difference is small and in no case is it sufficient to warrant the spiral pipe to be classified as unfavorable because of friction losses.

The conclusions to be derived from the investigation

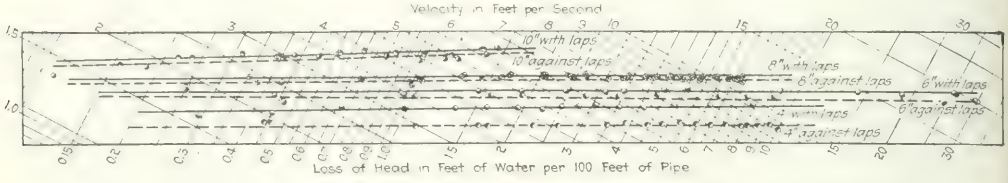

Velocity in Feet per Second
10" with laps
10" against laps
8" with laps
8" against laps
6" with laps
6" against laps
4" with laps
4" against laps
Loss of Head in Feet of Water per 100 Feet of Pipe

FIG. 2. RELATION OF FRICTION HEAD TO VELOCITY OF FLOW, BOTH WITH AND AGAINST LAPS

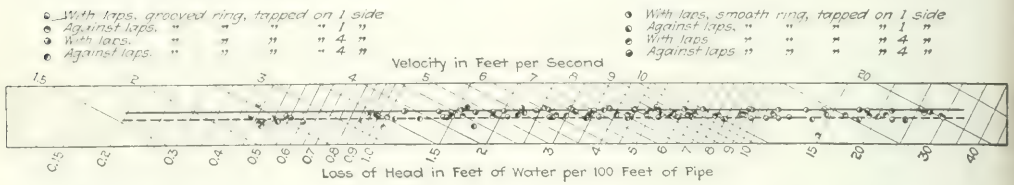

With laps, grooved ring, tapped on 1 side
Against laps, " " " " 1 "
With laps, " " " " 4 "
Against laps, " " " " 4 "
With laps, smooth ring, tapped on 1 side
Against laps, " " " " 1 "
With laps, " " " " 4 "
Against laps " " " " 4 "
Velocity in Feet per Second
Loss of Head in Feet of Water per 100 Feet of Pipe

FIG. 3. EFFECT OF DIFFERENT TYPES OF PIEZOMETER HEADS ON LOST HEAD WITH 6-IN. PIPE

are as follows: (1) The friction loss in galvanized, spiral riveted, steel pipes when the flow is with the laps is little different from that in smooth cast iron pipes. (2) Spiral pipes should be laid so that the flow is with the laps. (3) The friction loss may be expressed as, $h_L = mv^n$, where $h_L$ is the loss due to friction expressed in feet of water; $v$ is the true mean velocity in feet per second; $m$ is the value of $h_L$ when $v$ is 1 ft. per second; and $n$ is the slope that the graph expressing the relation of $h_L$ to $v$ makes with the horizontal. (4) The relations of $m$ and $n$ to $d$ are readily established, allowing the friction loss to be calculated for any size of spiral pipe when experimental data are not available.

A complete report of the investigation will be published in a bulletin of the Engineering Experiment Station of Purdue University.

### Underground Railway for Sydney

Construction of the underground rapid-transit line through the business district of Sydney, New South Wales, is to be resumed, work having been stopped in 1918 on account of war conditions. It is expected that bids will be called for in October and opened early in 1922. The estimated cost is about $12,000,000 at present rate of exchange. Plans have not been completed for the cantilever bridge of 1,600 ft. span which is to cross the harbor and connect two sections of the city. The cost of the bridge is estimated at $20,000,000. J. J. C. Bradfield is chief engineer of the Metropolitan Railway, which is a government enterprise. The rapid transit improvements were described in *Engineering News-Record*, July 8, 1920, p. 56.

## Simplified Method of Plotting Transit and Stadia Traverses

By Herbert N. Bradstreet
U. S. Mineral Surveyor, Mesa, Ariz.

IN PLOTTING transit and stadia notes of traverses for mapping an area, after a hard day's field work, most engineers have had to spend weary nights in computing latitudes and departures so that the traverse to be plotted, because those in charge believed a traverse could not be plotted by turning angles with a protractor. The writer recently had occasion to make a contour map of a brushy river bottom comprising several channels and covering an area ½ to ¾ of a mile wide and three miles long. In getting the salient points, he ran a half-dozen closed traverses. When it came time to make the map on a scale of two hundred feet to the inch, he determined not to compute any co-ordinates, but to lay out the map with a protractor.

Through his initial point, he drew a cardinal line and from this line, laid off the first azimuth and distance. Through the second point by means of large triangles, he passed a guide line parallel to the first cardinal line, and again laid off the azimuth and length of the second course. Thus, through each transit station, a line parallel to the cardinal guide line was drawn and the proper deflection made from it. By this method, small errors in deflection angles did not become cumulative, but resulted only in slight displacement of plotted points. By using care, he was able to carry this system of parallel lines downstream for a distance of two miles and back again on the other side of the river to the original cardinal guide line, and still have his guide lines parallel to each other and the final line coincident with the original guide line. Not only did the traverse close well within the requirements of the map, but in one case where a mistake was made of 100 ft. in reading the stadia shot, the plotted traverse showed an error of 100 ft., and by the direction the final plotted point lay from the objective point, indicated the error must be in one of two or three sides of the polygon.

The author believes considerable time and fatigue was saved and the place of error most quickly determined.

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## Solid vs. Pneumatic Tires for Trucks

Sir—We have heard from several sources propaganda directed at state highway engineers and county commissioners in the endeavor to induce them to restrict trucks engaged in the construction of highways to the use of pneumatic tires. The contention is that the pneumatic tire will not damage the incompleted road surface or subgrade to the same extent as a solid or cushion tire.

Let us, however, investigate the facts: Assuming a 7½-ton truck to be used, we find the weight on the rear wheels, taking into consideration the distribution of load, weight of the body and the like, to be a total of approximately 17,000 lb., or 8,500 lb. on each wheel. The biggest pneumatic tire yet developed, and which has not as yet proved a commercial success, is the 48 x 12-in. size, the manufacturers of which allow at present a load capacity of just 8,500 lb., *provided this tire is inflated to an air pressure of 140 lb.* This means that the weight per square inch of road contact will be 140 lb. and that the area of contact will be 61 sq.in.

This same truck would doubtless be equipped with 14-in. cushion or solid tires which would have a capacity of 12,000 lb., or 3,500 lb. more per wheel than the pneumatic. Tests have shown that the weight per inch of contact of solid-tired wheels is 105 lb. as against 140 lb. in the case of the pneumatic. We would, therefore, find that the area of contact of the non-resilient, solid tire is practically 81 sq.in. as compared with the 61 sq.in. of the pneumatic.

Inasmuch as road damage, rutting and the like is entirely a factor of weight per square inch of road contact, it is easy to see that the properly selected solid tire will in reality cause less road damage to a soft surface than will a properly inflated pneumatic tire. If we consider the semi-solid or cushion type of tire, in which the area of contact is considerably increased above that of the solid, we will find the ideal equipment for soft or uncompleted road surfaces.

This is an important matter and yet is one which has been too hastily investigated by many road commissioners. It is simply a question of elementary mathematics.

H. W. SLAUSON,
Engineering Service Manager, Kelly-Springfield Tire Co.
New York, July 13.

## Credit for Designing School in New York

Sir—I was interested in the article entitled "How One Consulting Engineer Got a Job," by Elwyn E. Seelye, in *Engineering News-Record*, June 2, 1921, p. 940. Mr. Seelye in that article gives the impression, first, that the work was handled by him alone, and, second, that the type of construction was worked out by him. Though interesting, the description diverges from the actual facts, which I will state.

The work described in the above noted article was handled under the firm name of Seelye & Fraser, since dissolved, in which the writer represented the Fraser part. The type of construction was used for the first time in New York schools two years previous, in P. S. No. 29. The alternate concrete design, based on beam and girder construction, adopted for the building, was worked out by me while I was connected with the Truscon Steel Co., in co-operation with their engineering department. Various other concrete alternates were advocated, but our scheme proved to be the most economical and was selected by the contractor. That the selection was right was proved by the fact that subsequently a majority of the twenty odd schools built used the same type, before P. S. No. 50, described by Mr. Seelye was even contemplated.

The contractor for P. S. No. 50, described in the article, became interested in concrete beam and girder type for schools when the matter first came up in connection with P. S. No. 29. In pushing the matter, I received a good deal of assistance and encouragement from him since he saw the possibilities and advantages of this type for school buildings. After securing the contract for P. S. No. 50, the contractor naturally turned to me with the suggestion of working up a proposition of a similar nature as had been used in P. S. No. 29. Mr. Seelye had no connection with the matter until the type of construction was decided upon.

Mr. Seelye claims to have been the first to eliminate the heavy structural steel auditorium girder. This was also done in connection with P. S. No. 29.

With working up the actual drawings I had no direct connection and due credit can be claimed by the designers of the firm for the work performed.

New York, July 8. EDWIN A. FRASER.

[The above letter was submitted to Mr. Seelye and he has replied as follows—EDITOR.]

Sir—I do not think that a rebuttal of Mr. Fraser's statement would add to engineering knowledge or interest your readers. ELWYN E. SEELYE.

New York, July 18.

## Cohesion in Earth

Sir—With reference to G. Paaswell's article on earth pressure theory, *Engineering News-Record*, April 21, 1921, p. 682, it appears to me that in deducing a conchoidal fracture surface from the theory of stress he uses the theory illegitimately. It seems to be mechanically impossible for the compression due to weight to cause tension on the planes given. Bursting stress involves a compressive reaction in the surrounding earth, not tensile reaction. Crosthwaite in England and Westerberg in Sweden have found friction angle to diminish with depth, but this is probably a question of water content.

HERBERT CHATLEY,
Shanghai, June 9. Whangpoo Conservancy Board.

## Uses for Condemned Wooden Ships

Sir—The decision of Mr. Lasker, the newly appointed chairman of the U. S. Shipping Board, to sell or destroy all the Board's wooden steamers before October 1, has just come to my notice. As it is very unlikely that many of these vessels will be sold, the destruction of the greater portion is to be foreseen and a discussion of means to prevent such total loss should be of interest.

In this connection I would suggest two plans, which to my knowledge have not been previously used or suggested. The first and principal one is the use of these vessels in the building or extension of ocean jetties.

I have had some experience with such work on the coast of the State of Washington, where extensive works of this kind have been constructed at the mouths of the Columbia River and Grays Harbor. The present method consists of constructing pile trestles from which the materials for the mattresses and rock are placed. All this work is done under great difficulties and danger, and very often sections of the trestle are lost through heavy seas. In case of later jetty extensions or in building groins to prevent undercutting of completed sections the rebuilding of the trestle is necessary.

As a substitute for the above method I suggest that, after steamers have been stripped of all salvage material, they may be loaded with rock, after possibly first placing willow mattresses on the bottom of their holds and sinking them in line or in a staggered position along the line of the proposed jetty, extension or groin. If the amount of rock thus placed be insufficient, additional quantities could be put in place by the use of cableways suspended from the masts of the vessels. Or it is very probable that additional rock could be deposited from barges laid alongside the sunken vessels on the leeside.

Another use for these vessels, though more limited, would be their employment in establishing foundations for lighthouses on sandy bars in exposed locations.

Paris, France, July 8. HARRY W. BOETZKES.

# HINTS FOR THE CONTRACTOR

## Built-Up Timber Sections Form Track for Steam Shovel

By C. W. Geiger

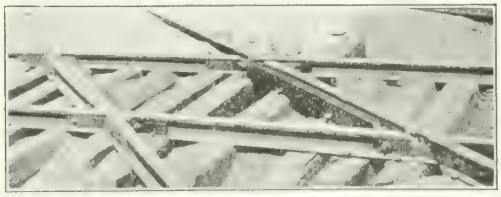
San Francisco, Cal.

PIECES of timber bolted together to form sections make a convenient track for steam shovel use and can be handled by the shovel itself as shown in the accompanying illustration. Each section is made up of six pieces of 6 x 8-in. timber and two shorter pieces of 2 x 8-in. plank. The planks are put in the center leaving a central hole for the passage of a chain without damaging the timbers. A hole cut in the timbers for this purpose would, of course, reduce the salvage value of the timber. The sections are ordinarily delivered to the job by a motor truck from which they are unloaded by the shovel itself, using a chain passed through the center hole and caught in the teeth of the bucket. When placing the sections in position on the ground it is more convenient to attach the chain to the rear of the bucket so the section can be placed well back toward the shovel wheels.

TRACK SECTIONS AS THEY ARE UNLOADED FROM TRUCK

## Railroad Crossing Made Up on the Job With Oxy-acetylene Torch

IN LAYING out the industrial track to be used in the construction of the Hetch-Hetchy dam for the San Francisco water supply, a crossing was built up on short notice with the aid of an oxy-acetylene torch. This was considered advisable because the job is about 120 miles by rail from San Francisco and the delay and cost incidental to getting the necessary special work was not warranted by the limited service and light traffic for which the crossing was being built. The gage is 36 in. and the rails weigh about 40 lb. per yd.

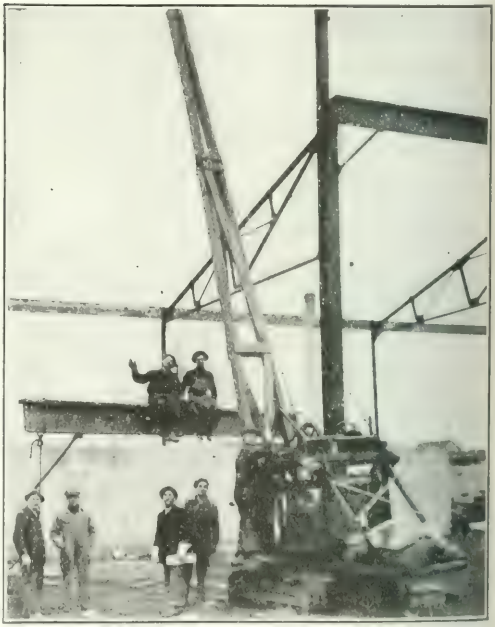


INDUSTRIAL RAILROAD CROSSING MADE UP ON THE JOB

The rails on the main line were cut only in the head (to make a flangeway for wheels on the crossing track) leaving web and flange continuous. Two short pieces of rail were then cut with the required angle on each end to fit in between rails on the main line. Adjoining rail ends on the crossing track were likewise cut on the proper angle. Four angle irons were used at each rail intersection. As a means of stiffening the crossing and at the same time providing a guard rail, short lengths of rail were cut so that when laid on one side, as shown in the accompanying illustration, they would fit in between the main line rails, head against web.

## Power Winch and A-Frame Transform Bucket Loader Into Crane

SIX men with the aid of the machine shown in the accompanying picture, completed a nine-day job with two lean-to trusses and one apex truss in less than a week's working time at the plant of the Barber-Greene Co., Aurora, Ill. Previous to the arrival of the structural iron workers a Barber-Greene self-feeding bucket loader was fitted up as a stiff-leg crane. The bucket elevator was removed and a power winch installed on top of the frame which houses the gasoline engine. At one side of the frame an A-frame was firmly attached with a platform at the opposite side weighted with sacks of sand to form a counter-balance. This measured 32 ft.



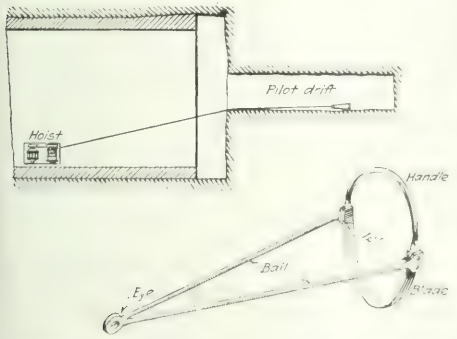
SELF-FEEDING BUCKET LOADER RIGGED AS A STIFF-LEG CRANE

from the ground. A pole was lashed to the A-frame to give the boom a height of 50 ft. in order to put up the apex trusses. The original drive by crawlers did not need to be altered, and by means of the accurate control possible with the crawlers, no difficulty in maneuvering was experienced even though it was not possible to raise and lower the boom. Power was furnished by a 25-hp. gasoline engine.

The bridgemen who worked with the machine were enthusiastic about its performance. The foreman, Charles Herbert, declared that it was better than a mule traveler and much faster than a gin pole. Six men, including the operator of the machine, comprised the crew. The five structural iron erectors were working for the Earl Mosely Construction Co.

## Power Draw-Knife Digs Detroit Sewer Tunnels

A DRAW-KNIFE pulled by cable from a single-drum electric hoist is proving highly successful on a number of the tunnel contracts for the new sewer system for Detroit, Mich. As observed on tunnel for a 11½-ft. brick sewer, a 10-hp. electric hoist was located as shown by the sketch. The procedure is, at night, to drive the pilot drift about 30 in. wide and 48 in. high. The length of the drift is about the regular



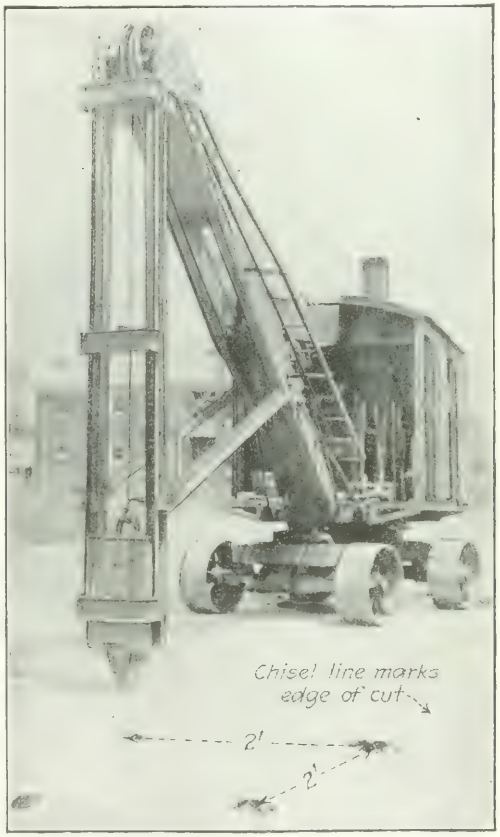

TUNNEL EXCAVATION WITH POWER DRAW-KNIFE

daily advance of the tunnel. Two men, a miner and a mucker, drive the drift. On the day shift, the drift is enlarged by making cuts with the draw-knife, or taking off shavings from the sides and bottom, the full length of the drift. One man operates the knife, carrying it forward as the cable is payed out and guiding its cut as the cable is handed in.

As indicated by the sketch the knife is an oval ring with the top part round and wrapped with cloth to form a handle and the remainder of the ring a flat blade of tool steel. To the opposite sides of the ring are attached two bail rods meeting in an eye to which the pulling cable is hooked. The knife cuts the clay in long ribbons which break as they fall; the muckers load the pieces with their hands. The knife works excellently in the smooth Detroit clay and best when this clay has enough sand to break up well as it is shoved down. With the knife, two miners and six muckers take the place of six miners ordinarily employed in hand excavation, with a material reduction in wages and an increase of 25 per cent in output. The hoist and knife cost about $700.

## Pavement Breaker Improvised from a Steam Shovel

AN ERIE steam shovel equipped with hanging leads and a pile hammer, with a chisel blade, is being employed in street railway track construction in Detroit, Mich., to break up the old pavement over the 16½-ft. trench required for the new structure. As indicated by the illustration the breaker is used to punch holes about 2 ft. apart, with such shattering as may result, and not to chop up the pavement completely into small




PAVEMENT BREAKER ATTACHMENT FOR STEAM SHOVEL

fragments. A steam shovel follows the breaker and tears out and loads the old pavement into trucks. If the asphalt surface is in good condition it is removed and reclaimed for reuse by the city street department, but otherwise it is loaded, with the concrete base and other excavated material, into trucks and wasted. The new construction is being performed by the Department of Street Railways under the direction of H. P. Hevenor, construction engineer, with W. R. Dunham as assistant in direct charge.

# NEWS OF THE WEEK

New York, July 28, 1921

## To Co-ordinate Highway Research Work

**Prof. W. K. Hatt Chosen by National Research Council to Direct Comprehensive Program**

The advisory board on highway research of the National Research Council has engaged, as director, William Kendrick Hatt, professor of civil engineering and director of the materials testing laboratory, Purdue University, Lafayette, Ind. His work as an investigator in organizing the timber investigations of the U. S. Forest Service, and in other engineering and scientific fields for the past twenty years, is well known. Director Hatt began his duties July 1, with headquarters in the building of the National Research Council, Washington, D. C.

The advisory board was established by the division of engineering of the National Research Council, with the co-operation of Engineering Foundation, as the result of a conference held in New York last November. By the terms of the by-laws the membership of the advisory board is composed of those organizations of national importance interested in design, construction, economics, maintenance and financing of highways, in materials and equipment therefor, and in vehicles used on highways.

OBJECTS OF BOARD

In addition to the fifteen member organizations, thirteen state highway departments and more than forty universities have signified their interest in the work of the advisory board and their willingness to co-operate. The purposes of the board, as explained in a recent statement by Alfred D. Flinn, its vice-chairman, are:

To assist existing organizations in outlining a comprehensive national program of highway research and co-ordinating their activities thereunder; to organize committees for specific problems; to act in a general advisory capacity; to serve as a clearing house for highway research information.

Three technical committees have been at work for a number of months. These are (1) On economic theory of highway improvement, Prof. T. R. Agg, Iowa State College, chairman; (2) on character and use of road materials, H. S. Mattimore, engineer of tests, Pennsylvania State Highway Department, chairman; and (3) on structural design of roads, A. T. Goldbeck, engineer of tests, U. S. Bureau of Public Roads, chairman.

The executive committee of the advisory board has the creation of additional committees under advisement, such as committees on vehicle design as related to a road, economics and cost of transport, financing highway improvements, traffic studies, and organization of construction plants.

Director Hatt's work is expected to stimulate experimental work. In consultation with the advisory board he will prepare a comprehensive plan of the field of highway research, including economics, design, construction and administration, and will arrange a program of committee work for those fields that need to be occupied.

The personnel of these committees will include active research workers within the State highway commissions, the universities, the governmental departments and other research organizations. A census will be taken of the research work completed and current, and the various research agencies will be invited to co-operate in an attack on those urgent problems upon the solution of which the future success of highway transport depends.

The program for highway research will not be limited to problems concerned with the construction and maintenance of roads from the ordinary engineering standpoint. It will also consider problems of economics of transport upon highways in relation to other transport agencies, relation of design of vehicles to character of road construction, and administration, involving traffic regulation, fees and maintenance.

## Prospects of New Federal-Aid Road Funds Appear Slim

*(Washington Correspondence)*

Senator Townsend, chairman of the committee on post offices and post roads of the Senate, practically is convinced that the appropriations committees will not entertain any proposition to grant additional funds for federal-aid highway work. Despite the fact that no appropriation probably will be authorized in the near future, Senator Townsend has called upon the committee to begin work on the highway bill which has passed the House. It is his expectation that the committee will amend that bill so as to embody in it the interstate road plan and the provision for a highway commission.

## Study Pueblo Reservoir Sites

Cooperation of the U. S. Reclamation Service in a plan to construct a storage reservoir for irrigation water 8 miles above Pueblo, Col., to safeguard the city against floods is being sought in Washington. Congressman C. B. Timberlake has advised the Denver Civic and Commercial Association that the Reclamation Service is now investigating the project. A survey was made several years ago.

## Detroit Gets Estimate for Water From Lake Huron

Since additional water will be needed for Detroit almost as soon as the 400-m.g.d. filtration plant now under construction is completed, Gardner S. Williams, Ann Arbor, Mich., has made a report on a supply from Lake Huron. A ridge between the lake and the city would necessitate pumping. Of two possible routes for a conduit the shortest one, 49½ miles in length, would have a maximum lift of 73 ft., the final elevation being 40 ft. above the source. The second and preferred route is 55 miles long, with a maximum rise of 170 ft., 22 miles from the lake, where a 2,000-m.g. reservoir would be located, permitting gravity flow from the remainder of the distance. Two 7-ft. concrete lined steel pipe lines are proposed for the 22-mile mains to the reservoir and a 10-ft. concrete-lined steel gravity line to a 400-m.g. service reservoir near the city. It is estimated that 800 m.g.d. will be required by 1939 if the population increases at as high a rate as it did from 1910 to 1920.

Lake Huron water shows only one-twentieth as many bacteria as the present supply and half as many as B. Coli.

The $30,000,000 estimated cost is made up as follows: Intake $1,025,000; pumping station, $2,108,000; force mains, $9,376,000; storage reservoir, $2,320,000; gravity conduit, $8,080,000; service reservoir, $1,620,000; contingencies and engineering at 20 per cent, $5,471,000.

Other plans are being studied by the water commission since further extensions of the plant at the present site are not considered advisable because of the concentration and congestion of force mains in the streets leading from the station.

## Holland to Visit European Tunnels

The New York and the New Jersey tunnel commissions last week concurred in a resolution authorizing Clifford M. Holland, their chief engineer, to make a trip to Europe for the purpose of inspecting vehicle tunnels and securing at first hand data which may be employed to advantage in the final details of design and operation of the Hudson River vehicular tubes, contracts for which are scheduled to be advertised next September. Mr. Holland will devote particular attention during his trip of observation to matters of lighting, interior finish, general operating methods, and the handling of traffic. He will probably sail from New York early next month and is planning to include London, Glasgow, Paris and Hamburg in his itinerary.

## War Finance Corporation May Resume Railway Loans

In response to recent inquiries concerning the War Finance Corporation in relation to the railroad situation, Eugene Meyer, its managing director, stated that he had nothing to say beyond the fact that there has been some general discussion of the possibility of Congress authorizing the corporation to resume the making of advances to railroads, or to the Director-General of Railroads in connection with his advances to the railroads. He pointed out that during the war the corporation, under section 9 of the war finance corporation act, had authority to make advances to the railroads under federal control "for the purpose of making additions, betterments, or road extensions to such railroad"; that this authority has now expired, and that it would be a question of policy for the Congress and the Administration to determine whether or not, from the point of view of the national welfare, it should be revived.

ADVANCES TOTALLED $205,000,000

"The War Finance Corporation," said Mr. Meyer, "made advances to the railroads during the administration of Director General McAdoo and later under the administration of Director General Hines. The total amount advanced was $205,000,000, all of which, with the exception of about $45,000,000, has been repaid. Some of the loans of the corporation were made to the railroads for the purpose of enabling them to repay the advances made to them by Director General McAdoo, thereby putting the Railroad Administration in funds. Large advances were made during the period from March to July, inclusive, 1919—subsequent to the failure of Congress to pass the railroad appropriation—upon the security of certificates of indebtedness issued by Director General Hines, and were all repaid when Congress met in extra session and passed the railroad appropriation. Among these advances was one for $50,000,000 to the Director General of Railroads."

Two propositions for wheat business are now under consideration by the War Finance Corporation, according to Mr. Meyer. One involves nine million bushels and the other an uncertain amount but probably as much or more.

The War Finance Corporation, Mr. Meyer stated, has not sought any extension or prolongation of its powers, but, if Congress desires the corporation to resume activity in connection with railroads and to broaden its powers for agricultural financing, it will respond.

## Drainage Congress at St. Paul

The National Drainage Congress is to be held at St. Paul, Minn., on Sept. 22 to 24. E. R. Jones, state drainage engineer of Wisconsin, Madison, Wis., is acting president on account of the death of Edmund T. Perkins; L. K. Sherman, Chicago, is director.

## Making Public Health Survey of Tippecanoe County, Ind.

A public health survey of Tippecanoe County, Ind., is being made during July and August by Dr. Murray P. Horwood of the Department of Biology and Public Health of the Massachusetts Institute of Technology. The survey includes water supplies, sewerage and sewage disposal, refuse collection and disposal, milk supply, sanitation of food stores and restaurants, housing, school sanitation and hygiene, organization and activities of the health department, vital statistics, anti-tuberculosis activities, hospital facilities and an analysis of the city budget. According to Dr. Horwood: "The purpose of the survey is to ascertain exactly the condition of the factors affecting the public health, and to formulate a program for the improvement of the public health based on the findings of the survey. The aim is to attack the tuberculosis problem not only by considering the disease itself, but by improving the general health of the community." The work is being done under the auspices of the Tippecanoe County Tuberculosis Association. The county named includes the city of Lafayette and the town of West Lafayette, the home of Purdue University.

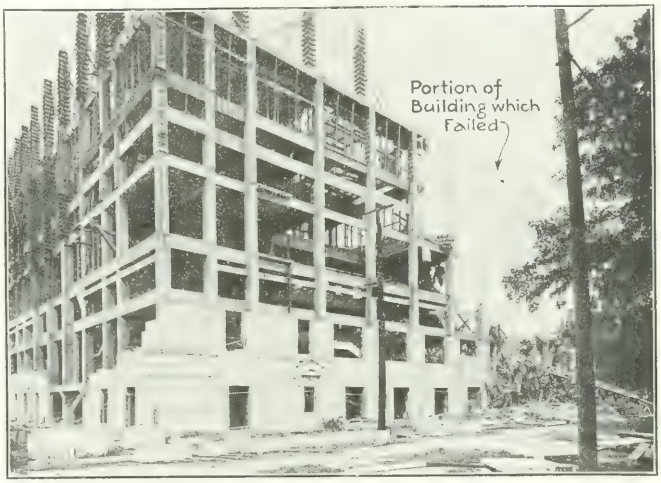
## Denver Commerce Body to Select Water Engineer

The Denver Civic and Commercial Association has selected T. B. Stearns, chairman; Major L. D. Blauvelt, Richard A. Parker, Arthur Ridgeway, H. S. Sands, D. G. Thomas and T. L. Wilkinson as a committee of engineers to recommend to the Municipal Board of Water Commissioners the name of "an engineer of national repution to make a survey of Denver's water plant and its needs".

# Masonic Temple Falls During Construction

**Reinforced Concrete Structure at Salina, Kan., to Cost $800,000, Nearly Completed When Failure Occurs**

About four-fifths of the $800,000 reinforced-concrete Masonic Temple at Salina, Kan., collapsed at 10 a.m. July 11. The building is 167½ x 125 ft. and 88 ft. high, with five stories. At the time of the failure the structural work was completed with the exception of the roof. No disturbance of forms had taken place in the east portion, under the auditorium ceiling, where the failure started, and no concrete had been poured in the supporting members since the first week in June. Shoring was being erected for the roof slab.




COLLAPSE OF MASONIC TEMPLE AT SALINA, KAN., DESTROYED FOUR-FIFTHS OF STRUCTURE

Workmen discovered undue buckling of the shores about an hour previous to the accident and reported this to the foreman, who immediately started eighteen or twenty carpenters strengthening the shores. A crash above them gave sufficient warning so that all the men got out except two on the roof. These men rode down with the wreckage but escaped with minor injuries, although it took four hours to release them.

The Condron Co., Chicago, is investigating the disaster for the owners. T. L. Condron states that the Eberhardt Construction Co., which had the contract, apparently had exercised more than usual care in the handling of material and placing of forms; also that the appearance of the concrete is good, but samples have been taken for test.

## States Get 30,303 Army Trucks

A total of 30,303 motor vehicles have been transferred by the War Department to the Bureau of Public Roads for distribution among the states for road building, the Director of Sales reports.

## Bolivia Retains Lavis to Advise on New Railway

F. Lavis, consulting engineer of New York City, has been appointed consulting engineer to the Bolivian Government and the Ulen Contracting Co. in connection with the construction of the railway between Atocha, Tupiza and Villazon on the Argentine frontier. By the construction of this line there will be established continuous rail communication over lines of the same gage between Buenos Aires and La Paz, a distance of nearly 1,500 miles, and by connection to the Antofagasta railway and the railways of Peru two additional transcontinental routes across the Andes will be developed.

The section to be completed is approximately 126 miles in length. The gage is 1 meter (3 ft. 3⅜ in.) and it is proposed to use 60-lb. rails. Part of the work is very heavy and 3 per cent gradients and curves of 100 m. radius will be required. Mr. Lavis according to present plans will leave New York for Bolivia early next month.

## Pennsylvania Plans Widening of Important Highways

While no immediate construction activities will result, the State Highway Department of Pennsylvania for the last two years has been making a study of traffic conditions on thoroughfares leading to important municipalities and eventually steps will be taken to increase the width of the arteries leading into the larger cities of the state. At the instance of the highway department the 1921 legislature enacted legislation which received the approval of the Governor and which will give the state highway department power to extend the width of important thoroughfares so that they will be adequate for the safety of road users.

It is not the purpose of the department, according to a recent official statement, immediately to widen these highways, but merely to make a survey of possible future traffic. The department hopes by this procedure to save the enormous expenditure which will necessarily be entailed in widening arterial roadways after improvements have been completed. The recent legislature gave the department authority to extend the width of highways to 120 ft. The great increase in motor vehicle traffic within the limits of the larger municipalities of Pennsylvania, department officials believe, will eventually necessitate the building of thoroughfares skirting these municipalities and wide enough to accommodate several streams of traffic going in both directions. Within a few years, it is predicted, it will be unwise to send heavy trans-Pennsylvania traffic into Philadelphia and Pittsburgh, for example, inasmuch as addition of this traffic will add to the congestion of the down-town districts. Consequently, the highway department is convinced that wide roads must be provided around the larger cities so that traffic may be accommodated.

## Two Large Bridges Opened to Traffic

On July 2 the new bridge over the St. Johns River at Jacksonville, Fla., a steel structure containing a vertical lift span, was opened to traffic. The structure includes nineteen spans, the longest of which is the 188-ft. lift span. Including approaches, the structure is 3,800 ft. long, and cost nearly $2,000,000. On the same day the Mound St. bridge across the Scioto River at Columbus, O., built to replace a bridge destroyed by the 1913 flood, was opened to traffic. This is a concrete arch bridge 1,050 ft. long, of nine spans, which cost about $600,000.

## Tennessee Governor Appoints Engineer License Board

Governor Taylor of Tennessee has just appointed the state board of architects and engineering examiners called for by the registration law passed last April. The board is composed of three architects and three engineers, as follows: N. W. Daugherty, Knoxville, civil engineer (six-year term); Prof. C. S. Brown, mechanical engineer, Vanderbilt University, Nashville, six years; A. L. Dabney, civil engineer, Memphis, four years; W. G. Sears, architect, Chattanooga, four years; Henry C. Hibbs, architect, Nashville, two years; B. S. Cairns, architect, Memphis, two years.

The appointment of this board marks the final step in the crusade of Tennessee engineers and architects for the passage of a registration law. The movement was begun in the fall of 1920 by the Engineers' Club of Memphis, when a committee, consisting of C. E. Shearer, A. L. Dabney, and Ralph Bosard, was appointed.

The law, as passed, follows the general features of the Engineering Council law, but the law makers cut out the requirement for registration of land surveyors largely because of objection from the rural sections of the state.

The law provides that, within one year after its passage, persons practising architecture or engineering in the state shall be required to submit evidence of qualifications to practice and shall be registered. The provisions of the act are carried out by the board of examiners appointed by the Governor. Board members are required to have had ten years' experience, five years in responsible charge of work, to be a citizen of the United States and a resident of Tennessee and to be thirty-five years of age. The license fee is $25.

Consulting engineers from out of the state associated with an architect or engineer in the state are exempted, provided they can qualify for such service in their own state.

Corporations or partnerships may practice engineering or architecture provided the person or persons connected with such corporation in responsible charge of such practice is or are registered as required.

## Department of Public Works for California

In accordance with measures passed at the last session of the California legislature, the state board of control has completed the reorganization program which was called for in the interests of economy and efficiency in government affairs. The new program provides for seven departments under which all work of the state will be done and which will replace eighty or more existing state agencies. Under the new program, which is to go into effect July 30, chief responsibility is vested in a department of finance. Other departments are: Civil service, institutions, industrial relations, public works, agriculture and education.

For the present it was not considered feasible to make an immediate and absolute change of the full scope implied by the naming of these several departments. Existing departments were rearranged, for the most part, so as to conform to the new plan and to interfere as little as possible with the present personnel and machinery.

The department of public works, for example, will have as its director or senior engineer the chief engineer of the state highway commission, who will add the new duty to his present work without change in salary. The department will have five subdivisions as follows: Highways, engineering, water rights, land settlement and architecture. The state engineer retains his title and continues his present duties under the general jurisdiction of the department.

## To Report on Lake Michigan Interstate Harbor

Bills providing for an interstate commission to report on the feasibility of a harbor at the Illinois-Indiana state line on Lake Michigan (to be called Illiana) and in Wolf Lake have been passed by the legislatures of both Illinois and Indiana. The commission is to be composed of two members for each state and a fifth appointed by the Chief of Engineers, U. S. Army. The Indiana bill provides that the Indiana members shall be appointed by the governor, but the Illinois bill specifies that the members shall be the director of the state department of public works and buildings and the superintendent of the division of waterways of that department.

Each bill appropriates $25,000 for the purposes of the commission and provides for the employment of engineering, legal and other assistance. The Indiana bill requires a full report to be made to the next general assembly of the state, but the Illinois bill does not specify the "next" assembly. This project was described in *Engineering News-Record* of Jan. 20, p. 120, but on the map the name of the proposed harbor was given incorrectly as "Indiana" instead of "Illiana." This project was suggested originally by Colonel W. V. Judson, Corps of Engineers, U. S. Army.

## To Vote on $4,000,000 Filter Project at Buffalo

At the election next November the voters of Buffalo will pass on a proposal to issue bonds for a 160,000,000-gal. water filtration plant at an estimated cost of $4,000,000, which shall not exceed $4,500,000. The proposed plant is to be located just south of the Colonel Francis G. Ward pumping station. The City Commission has appropriated $10,000 for investigation preliminary to the design of the proposed filtration plant, but no work will be done on the detailed plans until after the results of the November election are known. George C. Andrews is water commissioner of Buffalo, and Arthur W. Kreinheder is commissioner of public works.

## Federal Co-operative Reclamation Act Favorably Reported

On June 29 the Senate Committee on Irrigation and Reclamation favorably reported Senator McNary's bill (S. 2170) introduced June 27, "to encourage the development of the agricultural resources of the United States through federal and state co-operation, giving preference in the establishment of rural homes to those who have served with the military and naval forces of the United States." The bill provides for a revolving fund totaling $250,000,000 to be built up at the rate of $20,000,000 for the first year, $35,000,000 the second year, $45,000,000 the third year, and then $50,000,000 for each of the three succeeding years.

Although the title of the bill specifies federal and state co-operation, state action will be through the agency of legally organized reclamation districts. These districts are to be initiated in co-operation with the Secretary of the Interior and the validity of their organization must be confirmed judicially before the Secretary enters into a contract with the districts for the reclamation of lands. Bonds up to the estimated cost of the reclamation work, plus interest on the bonds during construction, and 2 per cent additional to pay various incidental expenses, are to be issued by the district and deposited with the Federal Farm Loan Board for disposition. The bonds are to run for periods of not over forty years and to bear interest at a rate to be fixed by the Secretary of the Interior, not to exceed 5 per cent. According to the report of the Senate committee it is expected that the district bonds will not be sold until "the land within a project will have attained sufficient value to warrant" their sale to the public. When such a sale is effected the money thus raised goes back into the revolving fund. The committee estimates that within the twenty years prior to the time that the Reclamation Service must begin repaying the proposed $250,000,000 fund the turnover of money provided by the districts, including interest, will amount to something over $1,000,000,000.

Under the bill ex-service men and women are to have the preference of purchase of lands thrown open to sale for a period of sixty days. The maximum farm unit under the bill will be 160 acres. Privately owned lands in excess of this unit are to be sold.

## U. S. Public Health Engineer Urges Filters for Milwaukee

Another report on Milwaukee's water supply urges filtration without delay. R. E. Tarbett, associate sanitary engineer, U. S. Public Health Service, is the author of the report, recently made public although dated May. In the main his conclusions agree with those of Harrison P. Eddy, given in *Engineering News-Record*, July 7, p. 26.

Mr. Tarbett's conclusions are: Chlorination is not now efficient, due to rapid changes in the bacterial content of the water. After the sewage disposal plant is built there will still be pollution, varying in intensity and therefore difficult to control by chlorination. Filtration is necessary to obtain a clear supply. Colloidal chemistry may help control the coagulation process but it will not materially effect the design. Experiments on coagulation are advisable. He urges that the city proceed along lines recommended by J. W. Ellms; that the U. S. Public Health Service cooperate in making coagulation experiments at Milwaukee, and do so at once so as not to delay construction; that the consulting engineer who supervises the preparation of filter plans for the city represent the city in these experiments and that the experiments form a part of a larger co-operative investigation to be be carried on by the Service and many coagulation and filter plants over the country.

Coincident with this report was another by Mr. Tarbett outlining the proposed co-operative experimental work at Milwaukee, Cleveland, Cincinnati, Louisville, Minneapolis, St. Louis, New Orleans, Shreveport, La., Birmingham, Ala., Columbus, Ga., Wilmington, N. C., Baltimore, Wilkinsburgh, Pa,. South Pittsburgh, Pa., New Castle, Pa., and Bangor, Me. The object would be to learn the effect of hydrogen-ion concentration in connection with coagulation and chlorination processes to the end that better methods of control and efficiency might result.

## California Highway Bonds Find Ready Market

An offering of $4,878,000 of 5½-per cent California Highway bonds made on July 15 was oversubscribed on the day offered. The bonds sold above par, the total premium being $19,550. The speedy sale as compared with the great difficulty or inability to sell bonds in previous yars is due to the higher rate of interest on the issue recently sold. Interest rates are now determined for each issue according to market conditions by a commission, the formation of which was announced in *Engineering News-Record*, Nov. 11, 1920, p. 962.

## Montclair, N. J., Commission Acts on Sewage and Water

The town commission of Montclair, N. J., on July 21 voted 4 to 1 to contract with the Passaic Valley Sewerage Commission for the disposal of the sewage of Montclair through the Passaic Valley trunk sewer, treatment works on the Newark Meadows and tunnel beneath Newark Bay and the Bayonne Peninsula to an outlet in Upper New York Bay near Robins Reef. At the same time the commission voted unanimously to offer the Montclair Water Co. $700,000 for its distribution system within the town of Montclair, in accordance with a valuation of Clyde Potts, consulting engineer, New York City.

The total estimated cost for Montclair to enter the Passaic Valley trunk sewer is $1,739,055, including deferred interest (explained below) and a supplementary outlet sewer to the trunk sewer.

### Items in Total Cost

Montclair's share of the cost of the trunk sewer and disposal scheme is $1,234,055, of which $947,670 is for the town's proportion of the $18,000,000 of obligations already incurred by the sewerage commission and $205,271 is interest computed to Feb. 1, 1922, on Montclair's share of original contracts entered into years ago, totaling $11,250,000 — Montclair having proposed heretofore to dispose of its sewage independently. Another item in the total of $1,234,055 is $81,114 as Montclair's estimated share of completing the Passaic Valley project in excess of the $18,000,000 of expense and commitments already named.

It is estimated that it will cost Montclair $330,000 to construct a relief sewer to the Montclair-Bloomfield outlet sewer and $175,000 for a supplementary sewer paralleling the Orange-Montclair-Bloomfield outlet sewer to the present river, Montclair having contract rights in the joint outlet for a capacity of only about 5,000,000 gal. a day.

### May Acquire Distribution Mains

Montclair has not yet provided funds for either the sewage disposal or water-supply project. As to the latter, under state legislation, the town proposes to offer the Montclair Water Co. the $700,000 for its distribution system already named, and in case that offer is not accepted to take the distribution system by condemnation. The company's book value for the distribution system is said to be $825,000. If the distribution system is acquired, it is the intention of the Town Commission to obtain a new water supply. Its present supply is from the Little Falls filtration plant of the Montclair and East Jersey Water companies. Mr. Potts stated in his report to the commission that Montclair might possibly arrange for a supply from either the Newark pipe line from the Pequannock River or the Jersey City conduit from the Rock-

away River, both of which pass through the town, or it might get water from the Wanaque River development for the city of Newark, now being carried on by the North Jersey District Water Supply Commission.

Dr. James T. Hanan is Commissioner of Streets and Public Improvements and William F. Bates is town engineer of Montclair.

### Gans Zeolite Water Softening Patents Upheld

The Gans patent for water softening by the use of zeolites has been upheld by the U. S. Circuit Court for the Western District of New York in a decision handed down on June 15 in The Permutit Co. against the Harvey Laundry Co. and the Refinite Co. The process and apparatus, as described in U. S. Patent 1,195,923, issued Aug. 22, 1916, to Dr. Robert Gans, of Pankow, Germany, covers water softening by passing water through a layer of zeolites or hydrated alumino-silicates, resting on a layer of sand and quartz, and the regeneration of the exhausted zeolites by passing through them a solution of salt (actually common salt, or sodium chloride). The defendants alleged lack of novelty, foreign publication, etc. The court upheld the patent on the ground of infringement and decreed an injunction and an accounting with costs to the plaintiff. Fuller particulars may be obtained from the Permutit Co., 440 Fourth Ave., New York City.

## PERSONAL NOTES

THEODORE HORTON, for many years chief of the division of sanitary engineering of the New York State Department of Health, became chief sanitary engineer in the Department of the State Engineer of New York on July 1. The change results from recent legislation virtually abolishing the division first named and transferring its work, so far as relates to passing on plans for sewerage and sewage disposal, from the State Department of Health to the State Engineering Department.

J. C. GARDNER has been appointed city engineer of Niagara Falls, Ont., Canada.

E. W. BALDWIN, resident construction engineer for the Sinclair Refining Co., Coffeyville, Kan., after a vacation in Colorado and Yellowstone country, will become an active member of the Mid-West Engineering Co., Coffeyville, Kan.

ARTHUR H. MORRISON, formerly with the Aberthaw Construction Co., Boston, Mass., has become associated with the Moulton Engineering Corp., Boston Mass.

CALEB M. SAVILLE, manager and chief engineer of the water department of Hartford, Conn., has been appointed a member of the Hartford Meadows Development Commission, authorized by the last legislature to reclaim a large area of land from floods by building dikes at an expense of $2,000,000.

R. A. CATTELL, formerly on the technical staff of S. Pearson & Son, London, England, in connection with the work of this firm as petroleum development managers for the British Ministry of Munitions of War and later engineer and chief of the construction department at St. Aimé, Algeria, Africa, of the Société d'Etudes de Recherches et d' Exploitation des Pétroles en Algérie, for whom S. Pearson & Son are technical directors, is now in the service of the U. S. Bureau of Mines in charge of the field office at Shreveport, La. He is the co-author with H. W. Bell of a report on the Monroe gas field in northern Louisiana which is now being published by the Conservation Commission of the State of Louisiana.

NELSON L. PROTHEROE, formerly superintendent for Villadsen Bros., Inc., general contractors, Salt Lake City, Utah, is now superintendent for the Lynch-Cannon Engineering Co., engineers and contractors, Salt Lake City, and will be connected with construction work in the Denver district.

J. PAUL BLUNDEN, formerly county engineer of Boone County, W. Va., has been appointed assistant division engineer, West Virginia State Road Commission, with headquarters at Martinsburg.

ROBERT L. E. WARD, municipal and civil engineer, formerly of Great Falls, Mont., has been made manager of the general engineering office recently opened by the Weiland Engineering Co. in Canon City, Col.

PROF. CHARLES A. HOLDEN, director of the Thayer School of Civil Engineering, Dartmouth College, Hanover, N. H., has been appointed by Governor Brown a member of the commission for the conservation of water power in New Hampshire. He was the correspondent for the State of New Hampshire for the water conservation committee of Engineering Council.

FREDERICK J. TROWBRIDGE, recently with Hugh L. Thompson, consulting engineer, has opened an office for the practice of civil engineering and surveying in Waterbury, Conn., and will specialize in plans, specifications, estimates, construction engineering and supervision, property and quantity surveys, landscape and industrial plant work.

A. H. OXHOLM, for the past 18 months European manager of an American firm of lumber exporters, has been designated by the Secretary of Commerce to be chief of the newly created lumber division of the Bureau of Foreign and Domestic Commerce.

RAY SPERR, county engineer, Keweenaw County, Mich., has resigned to accept a position with the Wisconsin State Highway Department.

VICTOR M. SUMMA, formerly in the service of the American Brake Co., St. Louis, Mo., has opened an office as general consulting engineer in St. Louis.

BURTON HAMILTON, formerly assistant city engineer, has been appointed city engineer of Alameda, Cal.

ROBERT S. HARSH of Alliance, Ohio, has been appointed state architect and engineer of Ohio and will be connected with the department of highways and public works.

BATCHELDER & SCALES, Indianapolis, Ind., is a new architectural and engineering firm organized recently by Ralph J. Batchelder, formerly designer for Allen & Collens, Boston, Mass., and Holebird & Roche, Chicago, Ill, and by Walter H. Scales, formerly chief designer of the Lackawanna Bridge Co., Buffalo, N. Y. Both have recently been partners of the firm of W. E. Russ & Co., Indianapolis.

THE ELCON ENGINEERING CO. has opened offices in Columbus, Ohio, to engage in general contracting and engineering, specializing in elevating and conveying equipment. E. S. Hetrick, president, has been connected with the engineering department of the Jeffrey Manufacturing Co., Columbus, for about 13 years.

## OBITUARY

JOSEPH HANSON, contractor of Tacoma, Wash., recently committed suicide in that city. He had been identified with building work in Tacoma for 17 years.

ADOLPHO OLIVERAS, contractor, died in Santa Monica, Cal., July 3. He was 66 years of age. Most of the highways in the Palisades district of Santa Monica and many of the coast roads were constructed by him. He also built the canals in the city of Venice, Cal.

R. H. GILLESPIE, president of the Traylor-Dewey Contracting Co., Allentown, Pa., died July 15, at White Lake, Sullivan County, N. Y. He was born in New York City in 1867 and attended Union College, Schenectady, N. Y. From 1888 to 1894 he was engaged in engineering work with various railroads during which time he was engineer in charge of construction with the Charleston, Cincinnati & Chicago R.R. and with the Little Falls & Dolgeville R.R. In 1896 he became assistant engineer, department of street improvements, 23d and 24th wards, New York City, and later he became assistant engineer, bureau of highways, Borough of Bronx, New York City. He also served as chief engineer of sewers and highways, Borough of Bronx, New York City, for about 12 years. He designed the collapsible forms and traveling concrete plant for the large Avenue A sewer, New York City.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

### Further Settlements in Wage Disputes Made

Further progress toward settlement of wage disputes in the building industry have been made during the past week. In Rochester, N. Y., there is an indication of an early settlement between employers and employees in some trades, due to the report of the impartial investigating committee and the activity of the mayor of the city. The strike was called on April 1, after the unions had refused to accept a 15 per cent reduction from the general $1-an-hour scale.

In Philadelphia 9,000 carpenters, who have been on strike since May 1, have agreed to a reduction of 22½c. per hour, the old scale being $1.12½. A 44-hour week replaces the 40-hour week and other adjustments in overtime have been made. It is the contention of the contractors that the action of the carpenters will practically bring to a close the strike of almost three months' duration, as only the plasterers and bricklayers remain out. Contractors announce that enough non-union men are available to carry on building.

The San Francisco situation remains unsettled. Press reports are to the effect that all labor unions plan a meeting for Aug. 11, at which time a vote is to be taken on the advisability of calling a general strike as a weapon against the growth of the open-shop movement.

### Department of Justice Appeals Bond Premium Case

An appeal has been taken from the recent decision of the Court of Claims to the effect that contractors were allowed reimbursement of the cost of premiums on bond, liability and other insurance. The Department of Justice has just entered an appeal in the Mason & Hanger and the Northeastern Construction Co. cases decided in the contractors favor under date of April 18, 1921. The appeal has been allowed by the court and unless prosecution of it is abandoned at least another year will elapse before final settlement will be possible.

Attorneys for members of the Associated General Contractors of America are confident that the Supreme Court of the United States will uphold the Court of Claims in its decision that contractors should be allowed reimbursement.

### California Metal Trades Post Notice of Wage Cut

Notices of wage reductions affecting some 25,000 men in fifty different trades have been posted by all members of the California Metal Trades Association. The reduction is to become effective Aug. 1, and averages about 10 per cent below the scale fixed Nov. 24, 1919.

## Irregular Employment, Inefficient Management, Labor Rules Cause Waste in Building

### Duplication in Estimating, Accidents, Etc., Secondary Causes, as Found by Committee on Waste Elimination

IN a report made public last week by the Committee on Elimination of Waste in Industry of the American Engineering Council, Sanford E. Thompson, of Boston, who made the investigations in the building industry, asserts that the greatest wastes in building occur through irregular or seasonal employment of skilled mechanics, through inefficient management on the part of the employer, and certain wasteful labor rules. As secondary causes for the waste in construction work are given duplication of labor in estimating and quite often in design, failure of architects to furnish check plans and specifications, and accidents which are particularly important in the building industry because of the extra hazardous nature of the work.

Irregular employment, the report reads, is due to seasonal fluctuations, bad weather, and strikes and lockouts. The point is emphasized in the report that a certain amount of education should be given the public in the matter of making a more equable distribution of construction work throughout the entire year, so that the average working day of the building trades mechanic could be lengthened and his lost time thereby reduced.

#### Management and Labor Wastes

As to inefficient management, the chief sources of waste in this particular are due to failure to furnish a continuity of employment, failure to plan work in sufficient detail, lack of proper co-ordination of scheduling, purchasing, and delivery with job requirements, lack of standards and adequate cost methods as a means of checking production, high labor turnover, general failure to develop and use a greater amount of mechanical equipment, and waste of material through careless handling and improper plant operation.

The labor regulations which are considered wasteful are classified according to those that (1) require skilled men to do work that could be performed by unskilled men; (2) restrict individual incentive through requiring uniform wages; (3) limit the number of apprentices; (4) reduce excessively the number of working hours; (5) restrict the output by prohibiting the use of labor-saving devices; and (6) impose jurisdictional regulation.

The report cites unemployment figures in the building trade in Massachusetts due to all causes and upon the assumption that these figures are correct and representative of the entire country it is found that if one-half of this unemployment could have been eliminated the value to the building industry, or its wealth to the country would have been increased as follows: 1915, $106,000,000; 1916, $91,000,000; 1917, $113,000,000; 1918, $85,000,000; 1919, $141,000,000; and 1920, $192,000,000. The lost or wasted time exclusive of Sundays, Saturdays and holidays is indicated in the accompanying table

TABLE SHOWING ACTUAL DAYS WORKED IN COMPARISON WITH EFFECTIVE WORKING DAYS POSSIBLE FOR VARIOUS TRADES

| Trade | Effective Working Days Possible | Average Days Worked per Year | Per Cent of Time Lost |
|---|---|---|---|
| Plasterers | 254 | 170 | 33 |
| Painters | 254 | 182 | 29 |
| Paper hangers | 254 | 182 | 29 |
| Plumbers | 271 | 200 | 26 |
| Iron workers | 273½ | 150 | 44 |
| Bricklayers | 275 | 182 | 33 |
| Stone masons | 275 | 185 | 33 |
| Electricians | 280 | 216 | 23 |
| Elevator constructors | 280 | 216 | 23 |
| Engineers | 280 | 200 | 29 |
| Firemen | 280 | 200 | 29 |
| Lathers | 280 | 190 | 32 |
| Composition roofers | 280 | 182 | 35 |
| Slate and tile roofers | 280 | 170 | 40 |
| Sheet metal workers | 280 | 185 | 34 |
| Stone cutters | 280 | 180 | 36 |
| Asbestos workers | 281 | 185 | 34 |
| Granite cutters | 281 | 180 | 36 |
| Cement finishers | 281 | 176 | 37 |
| Plasterers' helpers | 281 | 180 | 36 |
| Riggers | 281 | 175 | 37 |
| Steamfitters | 281 | 180 | 36 |
| Upholsterers | 281 | 225 | 20 |
| Laborers | 281 | 277 | 1 |
| Tile setters' helper | 282 | 200 | 29 |
| Tile setters | 282 | 200 | 29 |
| **Average** | **275** | **189** | **31** |

which is compiled from data taken from Philadelphia and vicinity and considered as representative average conditions. The days at work by the accompanying table average 189 per year for the various trades. The average of estimates reported to the committee by various contractors is 210 working days per year, which is considered as nearly right as could be expected. Over half the lost time, it is estimated, is due to bad weather and the balance chiefly in waiting for or looking for work. As an example of the extreme labor turnover which occurs in the building industry, the committee found one man who in the course of five and a half years had worked for 76 different contractors and was hired 108 times. During 1917 this man worked for eleven different contractors and was hired fourteen times in a period of nine months.

As to the means of reducing seasonal employment, the committee finds that, although efforts toward reducing have been local and often spasmodic, recent developments and conferences have shown the possibilities of vast improvement. The means of bringing about a reduction of seasonal employment may be outlined, says the report, by:

(1) Allowing a small margin of profit for both labor and capital during winter months; (2) developing methods of conducting work in cold weather; (3) arranging work to provide indoor operations in cold and stormy weather; (4) organizing a clearing house for co-ordination of activities; (5) increasing the usefulness of employment bureaus, and (6) educating the public.

Adherence to these practices would allow the contractor to figure on work at the same price throughout the year, thus stimulating winter construction and lessening unemployment due to the seasonal feature.

The report emphasizes the necessity for more effective co-ordination of construction activities. The Philadelphia plan, developed by the Building Trades Council under the leadership of D. Knickerbocker Boyd, and which advocates the establishment of a central bureau through which all construction programs in the territory are cleared is cited as a possibility for securing that needed co-ordination.

### Strikes Great Waste

"The strike is one of the greatest economic wastes to be found in the building industry," says the report. "If the greatest cause—the demand for an increase in wages—could be eliminated, strikes as a factor of waste would shrink into insignificance," continues the report. "The remedy that suggests itself is co-operation. Management and labor must forget the sore spots of past conflicts and through wholehearted co-operation fix by proper studies a minimum wage to correspond with a standard amount of production, with additional compensation for additional output. This would furnish an incentive to the man and would give recognition to the deserving mechanic. Unions must co-operate to the extent of eliminating the flat rate for all mechanics of a trade and also to the extent of modifying the restriction which forbids mechanics to accept piece work. With definite standards fixed and with the co-operation of both parties fair incentives can be introduced."

The need is also emphasized for the establishment of tribunals for the discussion and settlement of questions concerning wages, hours of labor, working conditions, and the other causes of strikes, lockouts, etc.

As to the waste occurring from bad management, the report asserts that "problems of construction management involve not merely the taking of the contract, the purchase of materials, the engaging of foremen to handle the work. They involve also the arranging of the work of the different trades, the scheduling of the operation and delivery of material, the planning of the work of individuals and groups of workmen, the design and maintenance of the perfect equipment, the maintenance of cost records, the knowledge of what constitutes a day's work, definite policies of employment, and the payment of the workmen in accordance with performance. All of these things are essential in well-managed construction operations."

The report suggests that there are not enough of the effective methods used in construction work which are employed in ordinary factory management; that contractors are too prone to leave the planning of their work to superintendents or often to foremen, and also that rule-of-thumb methods are still largely employed.

The report indicates that one method in which labor turnover could be materially diminished would be through the use of employment managers whose sole duty would be the examination of prospective workmen and co-operation with them while on the job. The theory is advanced that the high percentage of quits on the part of workmen would be materially reduced were the responsibility for hiring and firing employees placed in the hands of a competent and sympathetic employment manager.

### Plant Layout

The study of plant layout is another detail of construction management not taken full advantage of, says the report. In such studies it is pointed out that the engineers designing plant layout should co-operate with practical superintendents in order that the layout as designed may be thoroughly practical in operation. "The possibilities of saving by the application of more plant engineering are enormous," says the report, "since the cost of all operations are affected by the equipment used in handling materials, the location of the equipment and the efficiency with which it is utilized. The general failure of the industry as a whole to develop and use a greater amount of mechanical equipment is an established fact. Greater strides have been made in almost every other industry in the application of mechanical means as labor-saving devices and production stimulants. Contractors would do well to realize this and by direct interest develop this side of their industry."

The report asserts that union organization is more essential in building construction work than elsewhere because of the seasonal characteristics and the intermittent employment. It also says that some of the union rules affecting work are justified in furthering the quality and workmanship. However, many are absolutely wrong and uneconomical, asserts the report, and show a lack of recognition of the fundamental principles of economics which require that a man give his best in order to receive a fair return. "Many unions have exceeded the limits of fairness partly because of the leader's lack of appreciation of the fundamental need for high production, have formulated by-laws and in individual cases have formulated demands that have been a tremendous factor directly or indirectly in the restriction of output. This has resulted in increasing cost and reducing demand for building. It represents, in fact, one of the great sources of waste in the building industry. This policy has reacted, resulting in widespread opposition to unions. In fact some of the most successful building contractors employ non-union labor because of their opposition to unjust union rules and requirements." However, it is also emphasized in the report that unions are by no means alone in their restriction of output, but that contractors and builders and supply dealers affect the situation to as great a degree indirectly by maintenance of high prices, collusion in bidding, and unfair practices.

Another fundamental cause for low output, the report asserts, is that all members of unions in the same trade are paid the same wage. Jurisdictional disputes are another cause of restriction of output, though it is pointed out in the report that considerable progress has been made toward decreasing these through the activities of the National Board for Jurisdictional Disputes.

Despite the restrictive action of many of the union regulations, the committee found a growing evidence of a willingness to co-operate inasmuch as it received from many union organizations suggestions as to what could be done to eliminate waste, increase output, and decrease unit costs.

The committee finds that approximately $30,000,000 every year is actually paid to insurance companies for compensation and liability insurance in construction work. Even this figure does not represent the total loss. The report cites the opinion of an unnamed authority to the effect that the actual cost of insurance represents not more than 25 per cent of the total economic loss, which brings the total cost, due to accidents in the construction field, in the vicinity of $120,000,000 per year. The fact that a great many accidents could be avoided is partly indicated in the fact that in New York State, although four times as many people are employed in factories as in building and construction work, during the four years from 1910 to 1914 more fatalities due to accidents occurred in building and construction work than in factories. The fatalities in building and construction work in that period were 1,641 and in factories 1,285. The report also cites the opinion of an official of a large insurance company in which the assertion is ventured that by proper safety measures the waste due to accidents could be reduced 75 to 80 per cent in from two to five years of honest effort, and that construction labor costs could be cut 3 per cent through such measures. Another official estimates from actual accomplishment in safety measures a total of 12,000,000 days per year could be saved the in-

dustry by the application of safety methods.

Other miscellaneous wastes are the delays from lack of plans and details and waste of time, energy, and money through duplication of estimates and of designs.

The committee praises the work that the Associated General Contractors of America are doing in the way of standardization of contracts, ethics, labor, and methods. It is also mentioned in connection with its activities in endeavoring along with other national organizations to have established the quantity survey and payment for estimating in order to eliminate the loss through the duplication of estimating.

The report also finds that though standardization of dwellings has been tried and found rather impracticable, a great deal of loss is accounted for in lack of standardizing details of construction. Standardizing mill work, such as windows, doors, and other items entering into the average building, would, the committee believes, reduce the waste inherent in the "made-to-order" policy.

In the development of the building report approximately 106 builders and architects were consulted either personally or by correspondence. Two hundred and seventy-eight questionnaires, prepared especially for the building trades and designed to cover all items in the former questionnaires that applied to this industry, were given out and replies registered on 73 of these. Builders thus consulted were located all over the country, special attention being paid to representative cities such as New York, Boston, Philadelphia, Baltimore, Chicago, Cleveland, Atlanta, and San Francisco.

## Building in New York State on the Increase

As reported by the various building departments of the principal cities of New York State and compiled by the bureau of statistics and information of the New York State Industrial Commission, the estimated cost of building work authorized in the first ten second-class cities of the state increased 46 per cent from April to May, making a gain of 65 per cent over the amount reported in the same month of 1920. The estimated value of building work authorized in May was $50,952,804 of which $45,417,308 was to be expended for the erection of new buildings. The gain in authorized building work in May was almost entirely in New York City, as only two up-state cities reported an increase during the month. The May increase in estimated value of building operations in New York City was 53 per cent, while the gains in the two up-state cities were 23 per cent in Buffalo and 604 per cent in Troy. The decreases in the remaining cities varied from 4 per cent in Albany to 49 per cent in Utica.

## Division of Housing Begins Active Work

With the appointment of John M. Gries, of the Harvard School of Business Administration as the permanent head of the new division of housing created by Secretary of Commerce Hoover, the new Government agency is in a position to address itself immediately to its task of encouraging home building and home owning. The organization details of the division have been completed under the immediate direction of Franklin T. Miller, who resigned to undertake work outside of the department.

Before attempting to put emphasis upon any particular phase of the work, Prof. Gries expects to await returns from a questionnaire recently sent out. In a general way the division expects to give immediate attention to the matter of financing home-building projects. The question as to whether or not savings banks should apply a major portion of their deposits to home-building loans will be discussed with representatives of these banks.

## Ten Proposed Projects Total More Than $20,000,000

During the past week or so *Engineering News-Record* has received news of the proposed construction of ten large projects which will entail the expenditure of more than $20,000,000. Most of the projects are miscellaneous buildings, though one of them is a hydro-electric development in Canada, which will cost when complete $3,000,000. The largest proposed contract is for the construction of college buildings for the Ellis College for Girls at Newtown Square, Pa., the total cost to be in the neighborhood of $5,000,000. The other projects are schools in Schenectady, $1,000,000; a hospital in Perrysburg, N. Y., $1,200,000; a hotel in Washington, Pa., $1,000,000; a hotel in Worcester, Mass., $1,000,000; extensions to Vanderbilt University, Nashville, Tenn., $4,000,000; the construction of exchanges for the Bell Telephone Co. at Montreal, $1,000,000; a bank and office building in Baltimore, $2,000,000, and a hotel at Cleveland, $1,000,000.

## Unemployment Slightly Increased

According to the *Labor Market Bulletin* published monthly by the bureau of statistics and information of the New York State Industrial Commission, the May reports from state employment offices indicate a slight increase in unemployment over April. The ratio of workers seeking employment to each 100 places open which was 135 in April rose to 137 in May. The industries or occupations which show an increase in the proportion of persons looking for work to positions available are agriculture, building and construction, clerical work, domestic and personal service, hotel and restaurant work, and wholesale and retail trades.

## Cement and Aggregate Production in 1921 Close to 1920

The approximate production of finished portland cement in the United States during the first six months of 1921 ending June 30, was 42,468,000 bbl., according to an estimate made by the United States Geological Survey. This production represents 94 per cent of the quantity made in the corresponding period of 1920 and over 42 per cent of the total production in 1920. The shipments during the first six months of 1921 were slightly in excess of 40,600,000 bbl., or about 98 per cent of the shipments for the first half of 1920 and 42 per cent of those for the whole year 1920. The stocks on hand, which amounted to more than 11,000,000 bbl., are slightly above normal, comparing with approximately 9,000,000 bbl. on June 30, 1920, and 8,941,046 bbl. on Dec. 31, 1920.

The statement of the Geological Survey is to the effect that the year 1921 began with mills producing at a moderate rate and shipments considerably less than production, but month by month both production and shipments of finished cement increased at a rapid rate, shipments exceeding production in May and June. Production in June was slightly greater than in June, 1920, and also a little above the average for that month during the last five years. The shipments in June of more than 10,500,000 bbl. were larger than those of any preceding June.

### Aggregate Production

As to the production and shipments of aggregate, both the sand and gravel producers and the slag and crushed stone manufacturers have so far this year enjoyed a rather relatively high degree of activity. Slag has shown the lowest production as compared with 1920, the estimate made by the National Slag Association being that for the first six months of 1921, 1,250,000 tons of slag were produced as against 2,500,000 during the same period of 1920.

From figures supplied by the United States Geological Survey and the American Railway Association, the estimate is made by the National Association of Sand and Gravel producers that 23,305,950 tons of sand, gravel and crushed stone were shipped over the railroads during the first six months of 1921. These figures compare with 28,331,200 tons during the first half of the year of 1920 and with 31,823,340 tons shipped during the first six months of 1913. Records show that the 1921 shipments were 82 per cent of those of the 1920 figure and 74 per cent of the 1913 figure. The estimates given for 1913 and 1920 are based on 40 per cent of the production of sand and gravel and crushed stone reported for the entire year, as it is believed that 20 per cent more materials are shipped during the last six months of the year than during the first half. The estimate for 1921 is based on a report obtained from the American Railway Association, which shows that 466,117

cars were loaded with these materials up to July 1, the average loading being approximately 50 tons to the car.

### Bids on Ohio Highway Projects Are 86 per Cent of Estimates

Bids opened by the Ohio Highway Commission on July 21 and 22 revealed the fact that the total low bid on the fifty-two projects was about 86 per cent of the engineer's estimate. The total estimate amounted to $3,406,697 and the total low bid $2,922,794. The work covers construction, reconstruction and repair of roads, grading, and drainage installation projects and the construction and repair of bridges. About 100 mi. of roads are to be repaired or constructed if all the contracts for which bids were asked are let.

### Reduced Demand for Coal Cars Increases Car Surplus

Due principally to a reduction in the demand for coal cars in the Eastern district, an increase of 2,525 in the number of surplus cars during the seven-day period which ended on July 15, was shown by reports received from the rail carriers of the country by the car service division of the American Railway Association. The total number of surplus cars on that day was 372,050, compared with 369,525 on July 8.

Surplus coal cars on the latter date numbered 173,617, which was an increase of 12,011 within a week, while surplus box cars totaled 135,633, compared with 145,112 cars on July 8, or a decrease of 9,479 within that period. This increase was due largely to the increased demand for grain cars in the wheat sections.

In addition to the 372,050 surplus cars, reports just received by the car service division show that on July 1 there were also 354,611 freight cars out of repair, or 15.4 per cent of the cars on line. On June 15 there were 346,861 bad order cars, or 15.1 per cent of the cars on line.

### Production of Western Lumber

For the week ending July 16, 107 mills in western Oregon and western Washington report lumber production at 49,852,574 ft. b.m., which is 35 per cent below normal. New business totaled 44,998,272 ft. b.m., and shipments totaled 46,592,018 ft. b.m.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 7, the next on August 4.

| | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products:** | | | | | | | | | |
| Structural shapes, 100 lb | $3.03 | $4.00 | $4.50 | +$3.03 | $3.31 | $4.65 | $4.25 | −$4.10 | $5.00 |
| Structural rivets, 100 lb | 4.40 | 5.25 | 5.75 | −4.03 | 5.20 | 5.50 | 5.80 | 5.50 | 8.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.93 | 3.25 | 3.75 | −2.93 | 3.53½ | 4.02½ | 2.35 | 4.00 | 4.25 |
| Steel pipe, black, ⅜ to 6 in. lap, discount | 51% | −52 6-5% | 45% | 58½% | 53 9-5% | 36% | 49.80% | 47½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 49.10 | −43.33 | 57.50 | 49.10 | 57.80 | 62.00 | 80.00 | −63.00 | 75.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@2.70(del.) | +2.75 | 2.80 | 2.17 | -2.41 | 3.10 | 3.09 | 3.10 | 2.75 |
| Gravel, ¾ in., cu.yd. | 2.25 | −2.25 | 3.00 | 2.25 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1.25 | −1.35 | 2.50 | 2.25 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.90 to 2.00 | 2.25 | 2.80 | 2.50 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 47.00 | 38.00 | 35.00 | 55.00 | −35.00 | 47.00 | 27.00 | −22.00 | 120.00 |
| Lime, finishing, hydrated, ton | −16.49 | −19.00 | 25.00 | 20.00 | 29.00 | 32.00 | 25.40 | 24.00 | 28.00 |
| Lime common, lump, per bbl. | 3.79 | +1.50 | 2.75 | 1.65 | 1.50 | 3.10 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | −10.00 | 12.65 | 12.00 | 17.00 | 14.00 | 18.00 | 14.00 | 18.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .13 | .09475 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | 1232 | - 14 | .13 | .07410 | 092 | .10 | .14½ | .12 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | +.80 | +.85 | .97 | +.87 | +.91 | .96 | .96 | .79 | .84 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | 35 | ..... | 1.00 | 50 | .50@.63½ | .81½ | .75 | ..... |
| Common labor, non-union, hour | ..... | 25 | .35@.45 | −.40 | 50 | .37½@.50 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or −. For steel pipe the prevailing discount from list price is given: 4-inch means no discount; 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted alongside dock. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is 15c. additional. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

### Changes Since Last Week

The cement situation in New York is unchanged since our last report; demand is small, awaiting lower prices by the manufacturers. We quote cement in Atlanta 25c. higher than last week. The Canada Cement Co., Montreal, advises us that there has been a price change in Montreal, the first in a year, the price being $2.75 per bbl., net, with 10c. off for payment within 20 days of shipment. In considering Canadian prices the exchange rate must be kept in mind, to-day's rate being 14 per cent.

The steel market remains dull, with demand awaiting more favorable quotations. It should not be overlooked, however, that steel is relatively cheaper than are concreting materials. Warehouse prices are the same in New York and Chicago, $3.03 for shapes, $2.93 for reinforcing bars. Cast-iron pipe is $43.33 in Atlanta, as against $59.22, and Seattle reports a $2 decrease.

Common lump lime in Atlanta has advanced from $1.45 per 180-lb. bbl. to $1.50, although strangely enough hydrated lime is lower.

Fir is down $1 in both Minneapolis and Seattle. The price of linseed oil is again rising throughout the country.

Non-union common labor is down 5c. per hour, in Chicago, being now obtainable at 40c.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 87 — NEW YORK, AUGUST 4, 1921 — Number 5

## Art and the Engineer

TO CONFOUND those aesthetes who see only dirt and grubbiness and raw utility in what the engineer does, there are artists like Jonas Lie and Joseph Pennell who find their inspiration in the useful works of man. And though engineers are the most practical of men there are few among them who do not respond to such artistic appreciation of the things they build and of the way they build them. While the worship of the beautiful can profitably be made the major interest of life only by a minority of the world, no one likes to think that incident to his day's work he is adding to the altogether too great ugliness of things in general. In his secret heart, then, the engineer takes pride in such sketches as the one that graces our cover this week because it is evidence that a master eye sees in what is a distinctly engineering achievement enough of beauty to put to its perpetuation the skill of a master hand.

## Centralizing State Engineering Work

THE transfer on July 1 of "strictly engineering work" from the New York state departments of health and of conservation to the office of state engineer, noted on p. 207, is a step in the centralization of state engineering work the results of which should be worth observing. One feature of the new legislation that demands careful watching of results is having plans for water supply and sewerage projects go to the state engineer for examination and report while the issuing of permits will continue to rest with the commissioners of conservation and health. This seems likely to result in divided responsibility, with possible duplication on the one hand or of inefficiency on the other. It will afford a chance for conflict in either case, or else make the two commissioners mere rubber stamps. The danger of conflict or of inefficiency is one of the future rather than the present, since there has been a transfer of personnel as well as of duties, but that presents no safeguard for the future and has no bearing upon broad questions of state administrative organization.

## Dividing Engineering and Sanitation

THE changes at Albany mentioned in the foregoing note seem to be based on the assumption that sanitary engineering work can be divided into engineering and sanitation, for the old division of sanitary engineering in the State Department of Health is abolished, the "strictly engineering work" transferred to the state engineer and the remainder entrusted to a newly-created division of sanitation, under the Department of Health. We think the wisdom of such a surgical operation will be doubted by sanitarians and engineers alike. We believe that the consensus of well-informed workers in the health-protective field is that the approval of plans for water supply and sewerage and also the whole range of inspection designed to ensure the proper sanitary operation of such works should be in the same hands—engineering hands. Whether the single responsible department should be that of health or of engineering, is another matter, but to attempt to separate sanitary engineering into sanitation and engineering seems an anomaly, and divided responsibility seems bound to lead here, as everywhere else, to confusion, as well as to either duplication or else deficiency of effort, with possible tragedy. The transfer of much of the engineering work of our states to a single engineering department is a commendable object. How far it should go is open to argument. Its justification must rest in concentration, not division, of closely related duties and responsibilities.

## Human Touch in Society Affairs

ENGINEERS are inclined to be staid individuals. After they have been out of college for five years they acquire a hardened dignity that is difficult to dent. As a consequence engineering society programs show little variation from a serious, technical trend. If the chairman of the program committee, however, could be reminded of the fact that these staid engineers 15 or 20 years back were howling sophomores and racy seniors, he would not fear to put a little humor into a couple of the year's programs. We do not know what sort of argument is followed by the program committee of the Providence Engineering Society, but the result is good. Last November it held a smoker in order to organize a local section of the Pipe Stokers' Union, the requirements for membership being "mental muscularity, a belief in good fellowship, a sense of honor in humor, and a love for lullabies." Rigid tests in all requirements were given the applicants and a free ticket to the annual banquet to the one making the best showing. The March smoker was the occasion of a "supposium" on the production of free power, and prizes were awarded those with the best suggestions of how to get something for nothing. Entering into the same spirit, the president, at the annual dinner, enlivened the serious and dignified gathering by some ideas on a new society house. These are reproduced, in brief, on another page and will, we believe, be of as much interest to the wide circle of readers of *Engineering News-Record* as it was to those privileged to attend the Providence dinner. Boys like to be boys even though they wear the silvery wreath of fifty or more winters.

## Pontoon Bridge Across the Hudson

FROM both the technical and the economic points of view the project, described in this week's news pages, for spanning the Hudson River with a temporary pontoon bridge to be located just north of the New York City limits is of decided interest. Structures of this general type are a well-developed feature of military engineering practice, but their use for commercial pur-

poses, while not without precedent in this country and Europe, is distinctly out of the ordinary. The main feature of the proposed Hudson pontoon is the employment of a number of the U. S. Shipping Board's wooden vessels—which the ending of the World War converted into "white elephants"—as the floating supports of the main bridge structure. The technical feasibility of the Hudson pontoon structure has been indorsed by Gustav Lindenthal, the distinguished bridge engineer. While no engineering details have as yet been made public, it is understood that the plans contemplate a provision of possibly 40-ft. clearance, for tugboat, barge, and small craft traffic, by means of tower supports extending above the ships' decks to carry the bridge girders. At the main river channel a lift span is contemplated. As a speedy, temporary method of facilitating interstate vehicular traffic the pontoon bridge has much to recommend it. It will be several years before the Hudson River vehicular tunnel, for which ventilating shafts at one end are now under construction, can be completed. By existing ferry routes much time is lost and traffic congestion is great. The pontoon bridge, however, is a means to an end rather than an end in itself. With traffic moving across the Hudson on such a structure there would be afforded a convincing argument in favor of a permanent method of crossing.

### Delivering Mixed Concrete

CENTRAL concrete mixing plants with long distance delivery of the wet, mixed concrete have many advantages for road work, but the possibilities of segregation in the mix with remixing required at the site have always acted against their wide use. In the Imperial Valley work noted on another page, the difficulties apparently have been overcome with such success that it is proposed to continue the method on other jobs. If mixed concrete can be successfully transported over the construction roads of that district, roads which for roughness and general hopelessness have no equal in the country, certainly it should be possible to do so anywhere. The solution lies in a proportioning of the concrete so that it reaches its proper consistency after the jolting of its ride and not as it leaves the mixer. Unfortunately there are not yet rules, empiric or otherwise, whereby the engineers can design the concrete mixture so as to insure such a consistency, although the Imperial Valley job tends to show that a maximum density mix is also one which transports most effectively. The main lesson is that by proper study and experimentation mixed concrete can be moved long distances over rough roads and safely and economically placed.

### Rail Specifications Again

AN ATTEMPT to harmonize existing differences between rail makers and rail users and to break the rail specification deadlock by submitting a new specification for consideration of both parties has been made by a neutral authority, as recorded on p. 202. For several years there has been a desire for specifications which will ensure rails of better quality and less subject to failure, but unfortunately differences of opinion have resulted in a deadlock. According to a statement issued some months ago by G. J. Ray, chairman of the rail committee of the American Railway Engineering Association, the rail manufacturers have offered no constructive assistance in the preparation of the committee's specifications, but have negatived their introduction by refusing to accept orders based on these specifications. In both the A. R. E. A. and the American Society of Testing Materials there has been consideration of the advisability of issuing two standard specifications; one for general use and the other with certain special requirements for which additional charges would be made (see *Engineering News-Record*, March 24, 1921, p. 515, and June 30, 1921, p. 1127). These latter specifications would be for the use of railways which consider that the specially-made rail would be worth the extra price. Now comes Robert W. Hunt, the veteran rail expert, with a proposed new specification which he has submitted to railway engineers and manufacturers in the hope of securing mutual approval. That improvement in rail manufacture is needed is evident, and it will be interesting to note how the two parties to the controversy and deadlock will react to this authoritative neutral proposal. A discussion of the same subject in another aspect appears farther on in these columns.

### Fall Highway Lettings

IN THE news columns of this week's issue will be found a letter which Secretary of Commerce Hoover has just sent to the governors of the various states urging the award of road construction contracts in the fall of the year. The economic desirability of the course of action outlined by Mr. Hoover has long been recognized and highway engineers and contractors, for years past, have favored the award of contracts well in advance of the opening of the construction season in order that the work might be intelligently planned, organization perfected and the necessary materials provided for. *Engineering News-Record* has continuously emphasized this point of view in its editorial pages. In spite of the arguments advanced for it, however, the practice of advertising in mid-winter has generally not been followed by the states. The weight of Mr. Hoover's influence, however, may help in getting results. During a period of unemployment, such as now exists, added force is given to the plea for early highway lettings. Many men, now out of work, would thereby be provided with jobs. The highway programs in many states are now reaching proportions so large as to make eleventh-hour contract lettings indefensible.

### Further Railroad Relief

MUCH UNCERTAINTY in the railroad situation should be dispelled by passage of the bill to carry out President Harding's recommendation for legislative relief to railroad credit by funding the railroads' indebtedness to the government for capital expenditures made during Federal control. Payment of undisputed claims has been withheld by the Government to offset the carriers' indebtedness for capital-account expenditures. Thus the companies have virtually been forced to pay cash for capital account out of current earnings. Even in prosperous times this would be extraordinary railroad financing. The half a billion dollars involved is a sum large enough to cause the carriers great embarrassment if they are required under present conditions to meet the obligation by employing directly their own credit. But the bill is not a subsidy and requires no appropriation by Congress. It merely enables the War Finance Corporation to take over the railroads' obligations in the hands of the Railroad

Administration, accept the railroads' securities and use them as the basis of securities of its own which it will proceed to dispose of. In other words, the railroads are to be temporarily aided by the credit of a government corporation during a period of transition.

## Research to the Fore in Rail Matters

THROUGH the deadlock in the development of rail specifications that came into being within the past few years and which was pictured clearly by George J. Ray, chairman of the rail committee, at the meeting of the American Railway Engineering Association last spring, one line of progress in rail improvement seems stopped for the time being. There appears to be no one item in the quality-testing of rails on which buyers and sellers are sufficiently agreed to supply a starting-point for further advance in shaping specifications so that they will assure good rail. Meanwhile, however, research concerning the defects of steel rails and the determinative factors of rail-steel quality goes on, though it is necessarily slow work. In the results of this research seems to lie the main hope for rail improvement at the present time.

In a sense the specification deadlock represents an indictment of our knowledge of testing. Testing as applied to rails, it will be appreciated, means determining quickly by the examination of a piece of rail whether other rails made at the same time in the same mill will give safe service in track during a long period of years. Obviously this is a difficult and delicate problem, but it is of quite the same character as the problems involved in all other acceptance testing. Such testing has been developed into a large and resourceful art, and with respect to most classes of material it yields surprisingly effective results. But in the case of rail, the tests that we use do not appear to be dependable indicators of whether the rail will be good or bad in service. The testing engineer does not know, in other words, how to tell a good rail except by its service. This means that the art of testing fails, for the present, in the particular application in question. The situation suggests that our knowledge of testing needs to be developed beyond its present stage.

At the same time it is well to note the fact also that the rail maker does not know how to *produce* good rails, because, like the testing engineer, he does not know how to tell a good rail. He does know, it may be conceded, how to make good steel—steel good for certain other kinds of service—and also how to roll well, but this is only indirect knowledge so far as rails are concerned, in the absence of information on how rail service is correlated with good steel or careful rolling. It is known that special care in the mill, and special effort, or inspection to assure such care, will result in good rails. Further, it is obvious that the avoidance of hit-or-miss variations in the finished rail produces a desirable result, and that uniformity of process is a favorable factor by resulting in uniform material. Nevertheless, uniformity is not a primary desideratum; it is possible to produce uniformly *unsuitable* material. First the methods must be known that are sure to produce the desired good material. Only after this is uniformity of value.

These limitations on both sides of the rail-testing situation have naturally led railway engineers to seek rail improvement by the rather arbitrary process of making the selection more severe. The motive for doing this, it should be carefully remembered, is not that present rail is unsatisfactory, but that a large quantity of good rail is accompanied by a certain small (perhaps very small) proportion of bad rail, which in the interest of good railway service it is important to eliminate. Because of the elusive nature of the defects involved, the buyer is driven to the hopeful assumption that more rigid application of tests for strength, ductility, and uniformity of composition will be likely to strike mainly at the poorest of the rails produced. And his argument is the more plausible because of the demonstrated fact that rail service is largely a function of the morale of the rail producer's organization—and more severe specifications when properly applied will tend to raise this morale.

The process holds promise, but it is obviously costly and uncertain. It involves, moreover, a number of technical points in testing that are subject to great differences of opinion, among them the question of how to obtain a representative sample, and the question of what range of conclusions may be drawn from the results obtained with the sample. It is not surprising under the circumstances that there has been disagreement between rail buyers and rail makers over this policy of increasing the severity of testing and increasing the percentage of rejection of rail, without increase of selling price—disagreements that probably would not arise in the same form or degree were it certain that the more rigid requirements will really eliminate the bad rails.

On the other side of the controversy it is necessary to take account of the fact that apparently it costs no more to produce good rail than to produce bad rail. As against the results now being attained, under an efficient system of production it should cost no more to make 1,000 good rails than to make 999 good and one bad rail. An increase of price for dependably good rail therefore appears illogical. The rail buyer seems to take this view, and correspondingly his objective is to force the rail maker to produce only good rail without charging a punitive price therefor.

The deadlock now existing has its root in facts of this kind. It involves the desire of the one party to impose more restrictive test requirements without real certainty that they will sift out the few bad from the many good rails, and the determination of the other party not to submit to such requirements without large increase of price. Either side—for both sides are beyond question anxious to make and use only good rails—could break the deadlock, did it only know precisely the nature of defective rail quality and how it may be identified in tests. In the absence of this knowledge, however, direct improvement of rail purchase specifications seems blocked for the time being.

Research then, is the road to progress, as already stated. Once this is fully understood by all interests concerned in rails, it may be expected that the contention over rail specifications will be shelved, and that, except for further discussion of satisfactory methods of sampling, the current market specifications will be left standing. If at the same time all effort in the field is concentrated on research into the underlying scientific and metallurgical problems, especially if means be provided for prompt interchange of all new observations and conclusions, rail development is likely to enter a new epoch.

# Concrete Hauled Three Miles From Central Mixing Plant

**Twelve Miles of Pavement Laid on Desert from Two Mixer Set-Ups—Day Labor Plan—Same Method to Be Used Elsewhere in California**

A 12-MILE concrete paving job, which is nearing completion on the main line of the California State Highway south of the Imperial-Riverside county line, is being served from a central mixing plant which was moved only once during the work. That is, the concrete mixer was set up first at the 3-mile point and, when the first six miles of road had been built, was moved to the nine-mile point, thus requiring a maximum concrete haul of three miles. At the present rate, using only a single 8-hour shift and despite the unusual and difficult conditions under which the work had to be carried on, the entire 12 miles will be completed within 5½ months. The operation of the central mixing plant has been so successful that plans are being made to move the equipment to another location in southern California where the same method will be applied to road work on which speed in construction is an important factor.

DUMPING LATCH BOXES ON THE SUBGRADE

Note [illegible] hooked to trucks on box by means of which box is overturned. The hook is used for raising the box after overturning

The desert work was undertaken by the commission on the day labor plan only after advertisement for bids had failed to bring any offers. The lack of interest on the part of contractors was ascribed to the fact that the territory traversed is some 200 ft. below sea level in a hot, arid climate which is not at all attractive to labor and which makes it necessary to exercise more than ordinary care to secure good concrete. Still further special requirements were introduced by the fact that water had to be pumped as much as 14 miles to supply part of the work, the nearest railroad station was at Mecca, 25 miles away and the nearest machine shop was at El Centro, 60 miles away.

The commission established a main or headquarters camp to accommodate about 130 men at a point such that it was a central location for the paving work, the crusher, the screening plant and other phases of the operation as a whole. The men were permanently quartered in this main camp and were transported by motor trucks to and from their work morning and evening. The decision to use motor trucks for all transportation in connection with this work was influenced by the fact that the commission had a considerable stock of war equipment on hand. About 37 motor trucks were kept on the job. Of these 6 to 8 were kept as spares and those in service were distributed according to the requirements for hauling sand, gravel, cement and concrete. A repair shop for the trucks was maintained at the headquarters camp.

To secure suitable rock, a rock crushing plant driven by a gasoline engine was installed near the north end of the job. Here suitable material could be quarried from hard rock which was found in sizes convenient for handling after a little bull-dozing. A feature of operating a rock quarry at this point was the necessity for using a hammer to break off of the rock the coral deposit from a few inches to several feet in thickness which was formed some thousands of years ago, according to geologists, when this area was below the surface of an arm of what is now the Gulf of California.

The sand screening plant was located in a dry stream bed, or "wash" close to the road and not far from the center of the 12-mile stretch. The quality of the sand was satisfactory as to grading except that it contained about 17 per cent of "fines." The specifications called for not more than 6 per cent of material that would pass a 100-mesh standard sieve, so in order to use this sand it was necessary to install a 6-in. air blower with which to force a current of air through the stream of material as it fell from the screen (with ⅜-in. circular holes) to the bunkers. This did not drive out a sufficient percentage of fines until the coarse material had first been separated, so the air current would not have to force its way through a stream containing the heavier material. As finally arranged, the most successful method of eliminating the fines was to separate the coarser material from the sand by means of a 10-mesh

screen placed under the upper section of the ¾-in screen and about 2 in. from it. Materials passing the 10-mesh screen were caught in a hopper having an outlet ¾ in. wide by 18 in. long immediately below which was the blower jet, 2 in. high by 20 in. in horizontal width. The fines were blown through a closed chute to a convenient waste pile. The air-cleaned sand was conducted into the same bin as the material between ¼ in. and ¾ in. in size and was remixed while being drawn off into trucks. The resulting sand satisfied the specification requirement.

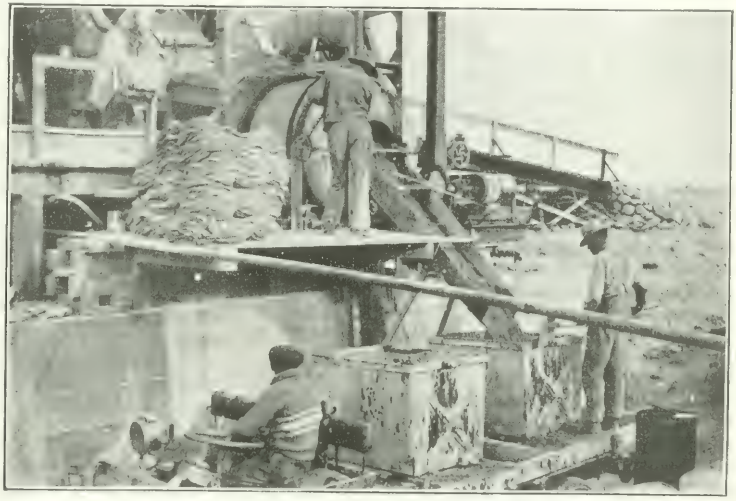
For the most part the road traverses a sandy formation and as the climate is very arid the first problem was to get enough water onto the subgrade so it could be well compacted. As the rough grading was being done, a water pipe from 4 in. to 2 in. in diameter was laid along the road and faucets were put in at 100-ft. intervals so that the subgrade could be well sprinkled. Most of the sprinkling was done at night, using hose in 100-ft. lengths. The main pumping unit delivered 60 gal. per minute against a pressure of 300 lb. per square inch at the pump. The rough subgrade was compacted from 1 to 3 in. with a 12-ton roller and by repeated sprinkling it was found possible to get the soil thoroughly wet to a depth of 12 to 15 in. before the concrete was placed.

At both locations the central mixing plant was so arranged that sand and gravel, delivered by trucks, could be dumped into bins whence bucket conveyors elevated them to bunkers over the mixer. In order to keep down the height of these bunkers a depressed driveway was excavated under the mixer spout and the trucks used for delivering the concrete drove down into this driveway to receive their load. Two 4-sack batch boxes were hauled on each truck. A 4-sack batch mixer was set to discharging directly into these batch boxes on the trucks. Each truck waited, after receiving one batch, for the mixer to turn out the second batch. This wait amounted to a little over one minute. Working without interruption, this mixing plant would turn out 125 cu.yd. of concrete in 8 hours. A 1:2:4 mix was used.

A platform was built in the depressed driveway on a level with the truck body to serve as a station for a workman whose duty was to prevent any stoppage in the movement of concrete down the spout from the mixer and to swab the square corners of each batch box with oil before it received its charge. Oil drained from gasoline engine crank cases was used for this purpose. The oiling was found to be well worth while as it made possible a quicker and more complete emptying of the box.

After experience with a central mixing plant the chief problem, the engineers point out, was to so plan the work that separation of cement and aggregate would not occur while the concrete was in transit from mixer to pavement. Factors affecting this are the roughness of the road over which the concrete is hauled, time of hauling, amount of water used in the mix and the grade of sand used. With some experiment it was found entirely feasible to haul properly proportioned concrete a distance of three miles over very rough construction roads, the trip occupying 25 minutes, without causing the separation of material. When the haul exceeds 0.8 mile, one to two pounds of hydrated lime per sack of cement is added to assist in preventing segregation of the aggregate.

It was found that if a slight excess of water was present, separation would occur. For example, a quart or two of water left in the batch boxes after rinsing them out was found to dilute the mix enough to cause separation. When separation has actually occurred, the reports of engineers on this work state that the condition of the concrete is so changed that the fact is at once apparent. Batches in which separation had occurred were not used in the pavement.



FILLING BATCH BOXES AT CENTRAL MIXING PLANT
Note that truck roadway is depressed. Can in foreground contains oil for swabbing out boxes before concrete is loaded

At the point where the paving was in progress a locomotive crane on crawler treads moved along the subgrade just ahead of the fresh concrete. This crane lifted the batch boxes from the trucks and dumped them on the subgrade just ahead of the tamping machine, the unloading of the two batch boxes requiring an average of about 1 min. and 40 sec., the time being measured between the stopping and starting of the delivery truck.

On this job ¾-in. transverse rods were placed in the pavement on 18-in. centers and ½-in. longitudinal rods are placed along the headers, one on each side. A template dragged along the subgrade by the locomotive crane served the double purpose of template and storage car for the reinforcing bars. Ordinarily about 500 lb. of reinforcing steel was kept loaded on the template, thus being in a convenient location for the men placing

the reinforcing steel at the same time that the template was properly weighted. The material from irregularities in the subgrade scraped up ahead of this template was thrown out onto the shoulders by shovel men. The reinforcing steel was held at its proper height in the pavement by the usual pipe supports. Fine wires, running from bar to bar at 4-ft. intervals, were tied to the steel as it was laid so as to hold the bars in their proper transverse position.

Floats were used to finish the concrete behind the belt attached to the tamping machine. A very convenient float was found to be a piece of light sheet metal curved up at the edges, attached to a wooden handle.

Because of the percentage of fines in the material which it was difficult to keep very low, and because of the extreme arid conditions under which the pavement was laid, difficulty was experienced in preventing hair cracks on the surface. A preventative that proved eminently successful was the use of burlap in 6-ft. widths laid across the pavement and sprinkled very soon after the concrete was finished. The strips of burlap were prevented from blowing off by rocks or earth shoveled on the ends of the strips just outside the headers.

The burlap was cut in lengths 3 or 4 ft. longer than the pavement width for this purpose. So effective was this means of preventing hair cracks that where the burlaping was stopped at the noon hour not infrequently hair cracks would occur during the hour up to the very edge of the burlap, but were never found under the burlap itself.

Expansion joints 1½ in. wide were put in the pavement at the end of each four-hour run. These joints were formed by transverse headers which were afterward replaced with a mixture of sawdust and hot asphaltic oil well tamped into place. The sawdust mixture was chosen because in the extremely high temperatures on the desert something that will not melt is required in the joint, and because this material, when squeezed up in ridges by the closure of the joint in hot weather, was soft enough to be rolled down by pneumatic tires without causing jolting.

Because much of the road was built across débris cones below the mouths of canyons where the water course shifted from year to year, very few culverts were installed, but instead "dips" or depressions in the pavement were put in to allow the occasional flood waters to go over the pavement. These dips varied from 30 ft. to several hundred feet in length. In their lower portions where actual submergence was expected, the pavement width was increased 3 to 5 ft. and the down-stream edge was terminated in a 45-deg. slope with a 6-in. toe wall at the bottom.

The work is being done on the day labor plan by the California State Highway Commission. Austin B. Fletcher is chief engineer and W. W. Patch is division engineer in charge of the work described in the foregoing.

### Magnetic Testing of Coil Springs

In a series of tests of large coil springs by the magnetic-induction method, T. Spooner and I. F. Kinnard found during the past year that magnetic retentivity gave a satisfactory indication of the hardness of the springs. The figures checked closely with micrographic and Brinell-hardness examinations of the pieces. Details of the tests were reported by the investigators before the American Society for Testing Materials recently.

## Handling Sugar Refinery Wastes

POLLUTION of St. Mary's River in Indiana by the Holland-St. Louis Sugar Co. refinery, causing a nuisance, is to be abated. Following an investigation by Pearse, Greeley & Hansen, consulting engineers, Chicago, in co-operation with the State Board of Health and State Conservation Department a plan of action has been approved by the state officials whereby the refinery will dispose of the various wastes without offense. Lagooning to permit a flow commensurate with proper diluting capacity of the stream, chemical precipitation and screening are all to be used.

Four wastes are to be handled: (1) Beet carrying and wash water, 2 m.g.d.; (2) diffusion battery and pulp-free water, 0.2 m.g.d.; (3) lime press cake, 37 tons as a solid 50 per cent moisture cake or 0.15 m.g.d. when diluted with water to make a liquid that will readily flow; (4) Steffans house wastes, 0.2 m.g.d.

The first waste contains beet tails, taps, roots and earth, but little organic matter. Since its biological demand is zero it will be kept separate from the other wastes, passed through fine screens and discharged continuously into the river.

The second waste contains much organic matter in solution and considerable in suspension. Methods were devised for coagulating and settling the solids so that the supernatant liquid could be discharged into a storage lagoon and from there into the river at a rate more or less proportional to the stream flow so that the stream would at no time be excessively polluted. Finally a method was worked out with the company superintendent for re-using these wastes. The treatment comprising liming and carbonating in a manner similar to the treatment applied to the main volume of juice in the plant and then re-using the liquid in the diffusion batteries. The non-sugars are precipitated and filtered out, leaving as a waste a lime press cake which will not greatly increase the volume of such cake already produced.

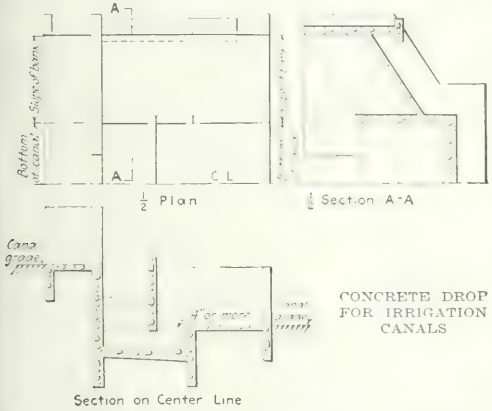
The lime press cake, the third waste, may be handled either as a relatively solid cake or as a thick liquid. In the first instance it would be removed by narrow gage railroad to a dump, but the method is objectionable because of the difficulty of obtaining labor during the concentrated 100-day "campaign." The company favors mixing the cake with water used in cleaning the presses and pumping it to lagoons for storage until the volume of flow in the river is sufficient to afford ample dilution.

The fourth waste is exceedingly strong in organic matter, although low in suspended solids. It results from a process used to recover additional sugar from the molasses after the first direct recoveries have been made. This will be evaporated in multiple-effect evaporators and the final syrup ignited for the recovery of potash. Before ignition the syrup will probably be barrelled and sent to a fertilizer works. This process of recovering potash is not new and has been used at this plant. In 1918 a fire destroyed the building in which it was housed and on account of the low price of potash the process had been abandoned. It is unlikely that the process will pay for itself but as a disposal method it will be reasonably economical. Biological processes have not been considered feasible because of the short period of the campaign, which starts in October when the stream flow is low. The biological process requires several weeks to ripen during which period most of the damage in the way of pollution would have been done.

# A New Curtain Wall Drop for Irrigation Canals

By H. M. Chadwick
Chief Engineer, Rogue River Valley Canal Co., Medford, Ore.

SIMPLE drops of the curtain wall or confining-chamber type for making vertical changes in the grades of the irrigation canals of the Valier-Montana Land & Water Co. have proved as successful as some of the more elaborate designs and have advantages in both economy and simplicity. This simpler design is to be used also on the new work of the Rogue River Valley Canal Co., in Oregon. This drop was the result of observing other types in operation and noting the points where revision was most needed. Heads up to




CONCRETE DROP FOR IRRIGATION CANALS

6 ft. and bottom widths of canal not exceeding 8 ft. are the limits considered practicable.

Many drops of older designs have failed because the erosive action of the water in passing from the discharge end of a drop into the earth section of the canal has not been overcome. Although the velocity and eddying may be sufficiently stilled by the construction of an extra long water cushion or the construction of a notched breast wall and suitable length of water cushion, it was decided that a more simple and economical design was sufficient.

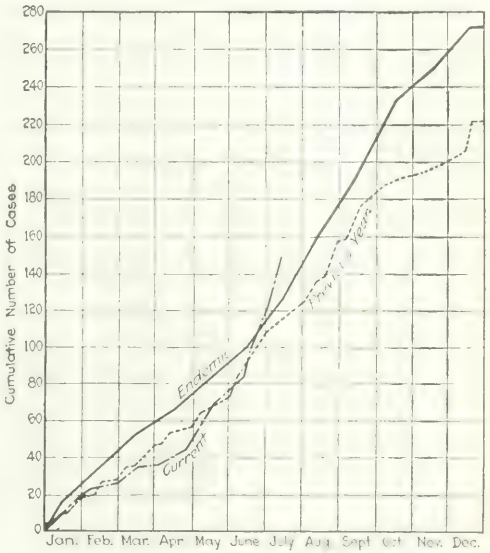
A drop having a curtain wall extended across the main body and carried to a point well below the level of the floor of the outlet apron was found to retard considerably the velocity and eddying at the end of the downstream floor. This arrangement makes the opening between the bottom of the curtain wall and the floor of the water cushion a submerged orifice. The curtain wall might be moved closer to the breast wall to act as a baffle, but it is doubtful if this would improve the operation of the drop.

The breast wall is contracted to maintain the full supply depth of water in the canal upstream when discharging at full capacity. This feature, while maintaining depth at full capacity, naturally does not function so effectively at the various stages below full supply level as would the notched breast wall. Further, the contracted sheet of falling water would obviously cause more impact than a diffused sheet. However, the curtain wall drop has shown its ability to still the turbulent water at the outlet. The crest of the breast wall is also designed to be used as a measuring weir and as a check, should the location of the drop prove advantageous for the use of either of these devices. Many drops of this type were constructed in old canals which had cut down below the original bottom owing to the high velocities. In these instances the upstream apron or floor was not built, as the existing bottom would be below the lip of the breast wall.

In view of the possibility of the orifice becoming clogged with tumble weeds, the top of the curtain wall was kept down to the elevation of, or only slightly above the lip of the breast wall, so that in case of complete stoppage of the orifice the water could pass over the curtain wall. In some of the timber drops the curtain walls were constructed of removable flashboards. These weeds get into the canals in spite of careful maintenance and supervision, but with close observance during operation the chance of clogging is remote.

## Cumulative Typhoid Case Curves

AS AN AID to the control of typhoid fever in California, three cumulative case curves are plotted by months for each county in the state, as shown by the accompanying diagram. The curve for comparative purposes is plotted from the successive totals of weekly averages of cases, excluding epidemics. The current rate curve is plotted from the cumulative totals for the




CALIFORNIA CUMULATIVE TYPHOID CASE CURVES

year. A third cumulative curve, similar to the other two, shows the weekly cumulative cases for the full year preceding the current year. In addition, index cards showing the number of cases per week for eight years in each minor registration area are filed by counties and spot case maps for the entire state are used. The same system of curves, cards and maps used to control typhoid is used for the other communicable diseases. The entire scheme is outlined by Dr. Frank L. Kelley, epidemiologist, and Ida M. Stevens, assistant epidemiologist, California State Board of Health, in *Public Health Reports* for June 3 under the title, "Making Morbidity Records Aid the Epidemiologist."

# Structural Features of Chicago Federal Reserve Bank

**Cantilever Trusses Carry Front Wall Above Fourth Floor—Columns on Cantilever Girders and Suspension Hangers—Frame Designed to Permit Conversion Into General Office Building**

CANTILEVER trusses carrying the upper wall columns above the recessed wall at the entrance colonnade, cantilever girders supporting portico columns in two fronts and structural columns in the rear wall, and second floor framing reinforced to carry the weight of interior columns by means of hangers from fifth floor girders are structural features employed to meet conditions of architectural design in the Federal Reserve Bank Building now under construction at Chicago. This building, 153 x 168 ft., is to be twenty stories high, with three basements, but it is being built now for sixteen stories.

On the Jackson Boulevard side, 153 ft., the entire wall, with the exception of the end panels, is set back from the property line from the first to the fourth floors, in order to provide room for a colonnade of stone columns which constitute a feature of the architectural treatment, but which carry practically no live load. In section these columns are only 75 per cent of a circle, the flat back being at the wall line, and the steel columns behind them, which carry the weight of the front wall, are braced at the floors with girders which provide for wind pressure. This arrangement is shown in Fig. 1.

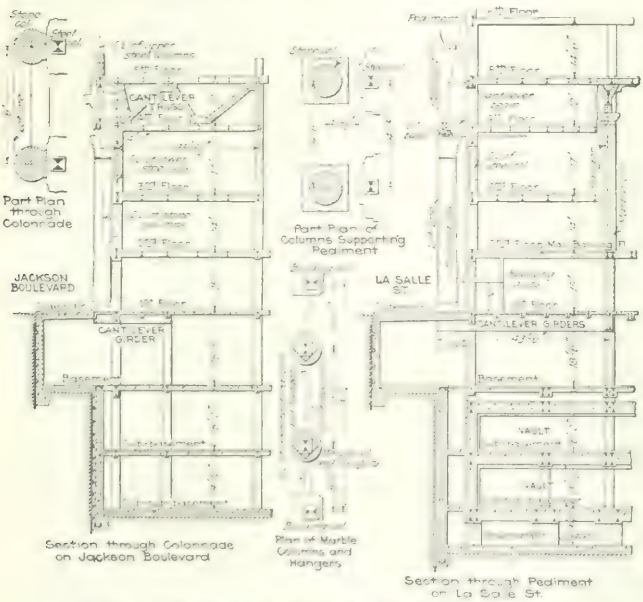



FIG. 1. CANTILEVER TRUSSES AND GIRDERS AND COLUMN HANGER IN CHICAGO BANK

Above the fourth floor the front wall on this side is set forward on the property line, the upper columns being carried by the ends of cantilever trusses having 4½-ft. cantilever arms and anchor arms extending back to the first row of interior columns, as shown in Figs. 1 and 2. Details of the truss are given in Fig. 3. The chords of these trusses form part of the fourth and fifth floor framing. Both upper and lower columns extend the full height or depth of the truss, the shear between them being taken up by heavy web plates reinforced against buckling by horizontal stiffener angles. The load on the footing at the cantilever end of the four long trusses is about 715 tons, with an upward reaction of 90½ tons at the anchor end; for the two short trusses, the figures are 521 tons and 184 tons respectively. A somewhat similar arrangement in the Peoples Gas Building, Chicago, was described in *Engineering News*, March 10, 1910, p. 294.

As the foundation piers along the Jackson Boulevard side are on the line of the columns in the lower or set-back portion of the wall, the stone columns of the colonnade are supported on cantilever girders projecting beyond these piers, in order that all masonry above the sidewalk may be carried on foundations extending to bedrock. The inner ends of the sidewalk joists are framed against an I-beam stringer along the ends of the cantilevers. On the east or La Salle St. side, 168 ft., the wall for the full height and width of the building is set back 7 ft. from the street or property line to permit the introduction of a lofty projecting portico with six stone columns (see Figs. 1 and 2). As it was impracticable to place steel columns and foundation piers under the stone columns, these latter are supported on cantilever girders, this arrangement being the same as on the Jackson Boulevard side, except that the cantilever length is 7 ft. instead of 4½ ft. These first floor cantilever girders are shown in Fig. 4.

In order to reduce as much as possible the weight carried by the La Salle St. stone portico columns and their cantilever girders, the pediment wall above them is made relatively thin. As this wall is over the outer side of the columns it would cause an eccentric loading, to prevent which it is supported on the ends of cantilever I-beams whose fulcrum bearings are cast-iron shoes over the axes of the columns and thus transmit the load centrally (see Figs. 1 and 2). Columns in the rear wall, adjacent to another building, are supported on cantilevers at the basement floor, as piers could not be sunk on the party line. The cantilever distance from center of pier to center of column is 3 ft. 4 in.

In the architectural treatment of the main banking room on the second floor (having its ceiling at the fifth floor level), marble-faced columns are located at points where there are no building columns. The height and headroom of the first story were insufficient to permit of placing in the second floor framing girders of such depth as to carry the weight of these interior

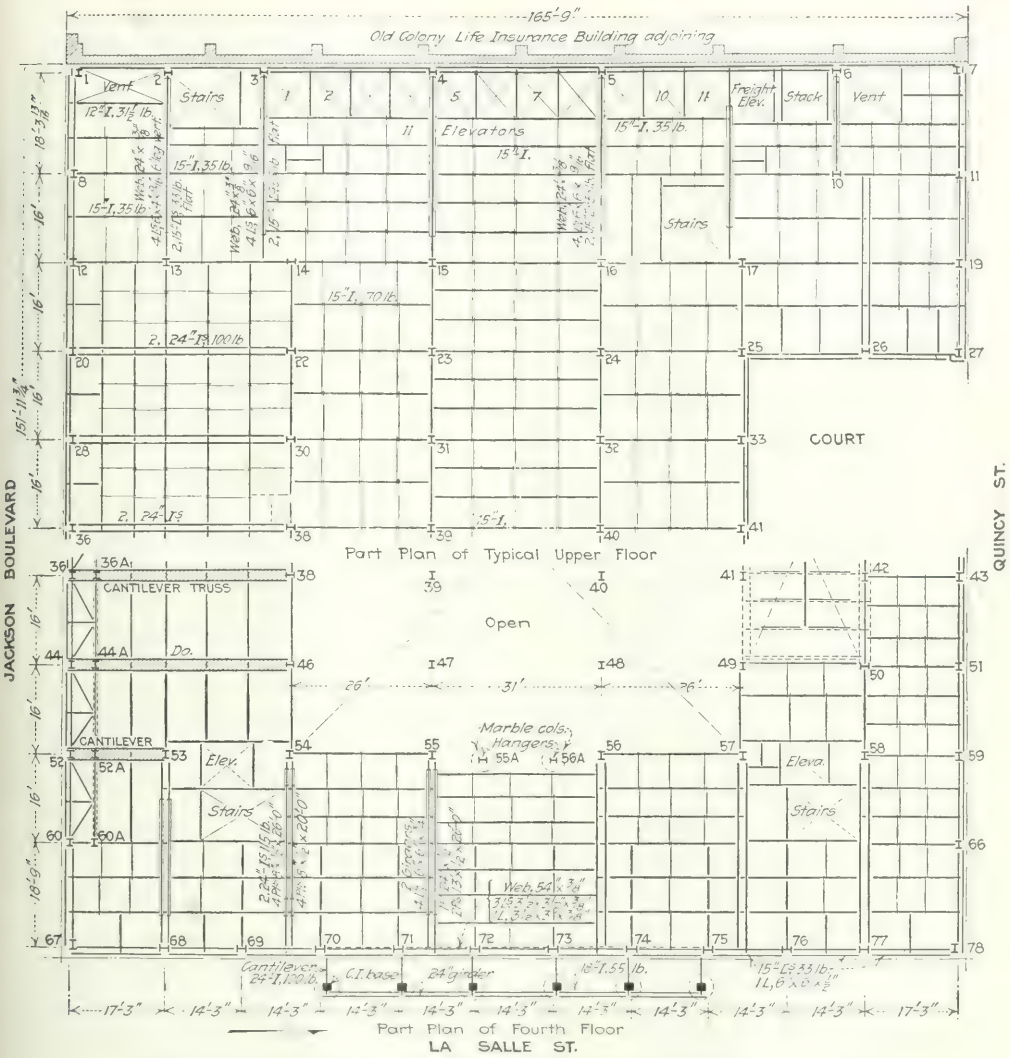



FIG. 2. FLOOR FRAMING PLANS, SHOWING CANTILEVERS, HANGERS AND COURTS

columns. Girders were introduced therefore under the fifth floor, concealed in the architectural beams above the columns, with hangers from these girders to the second floor framing. These hangers, which are inside the marble-faced columns, are I-shaped members composed of four angles and a web plate. To secure a good foundation for the marble, the points of attachment to the floor framing are encased in concrete instead of in the floor tile arches. The general arrangement of these interior columns and hangers is shown in Fig. 2, the details of the hangers being given in Fig. 5.

All main columns are seated on steel grillage on cylindrical concrete piers, none of them being carried at intermediate points by girders supported on the piers, as in some other large Chicago buildings. The piers are sunk to bedrock at 92 ft. below city datum or about 104 ft. below sidewalk level, being built in wood-lined wells or caissons in the Chicago clay. The maximum unsupported height of columns is 42 ft., and the maximum load on a column footing is 2,033 tons (for column No. 5).

The central portion, 80 x 83 ft., of the main banking room on the second floor is three stories high, with a plaster-beam ceiling under the fifth floor. Adjoining the north side of this lofty portion is a light court 22½ x 48 ft., with a skylight at the fourth floor. At the sixth floor this court is extended to the north or Quincy St. line, making an external court 39 x 48 ft., shown in Fig. 2. This court is carried up to the top of the building, thus forming two 51-ft. wings on the Quincy St. side. The steel frame is so designed that a similar light court can be introduced in the south

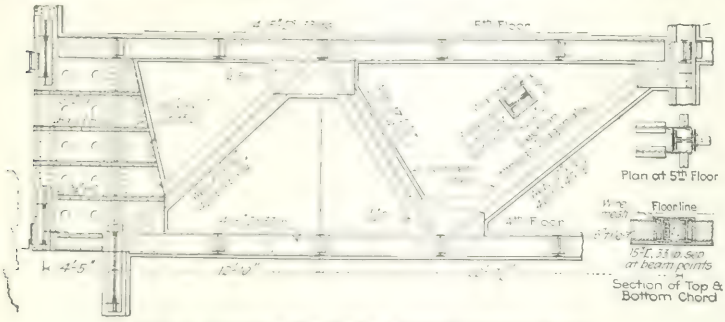



FIG. 3. CANTILEVER TRUSS CARRIES FRONT WALL

or Jackson Boulevard side, if at some time the building should be converted into a general office building.

Floor panels vary from 15 x 17 ft. to 26 x 31 ft., the framing being mainly of I-beams with tile flat arches, except that concrete is used below the second floor. The dead loads used in the design are 200 lb. per square foot for the basement and sub-basement, and 125 lb. for all the upper floors. The live loads are 100 lb. for the two basements and the first and second floors, 130 lb. for the fourth floor, and 50 lb. for the third floor and all floors above the fourth, except that special areas for a lecture hall and file rooms on the fifth, seventh and eighth floors are designed for 100 and 150 lb. live load.

Wind bracing consists mainly of gusset connections between the columns and the tops of the spandrel girders, these gussets being larger on the sides running east and west on account of the narrow wings described above. Wind girders 36 and 30 in. deep are introduced in the faces of these wings, from columns 1 to 20, 44 to 67, 7 to 27 and 51 to 78 (see Fig. 2).

Horizontal bracing in the bottom of the cantilevered framing of the Jackson Boulevard front transmits wind loads from the upper part of the wall to the columns set back in the wall below the fourth floor. Vertical diagonal bracing is used in two panels back of the elevators at the adjoining building, which is fourteen stories high.

This building was designed by Graham, Anderson, Probst & White, architects, Chicago, whose engineering department prepared the structural design. The John Griffiths & Son Co. has the general contract, the steel being furnished by the Morava Construction Co., both of Chicago.

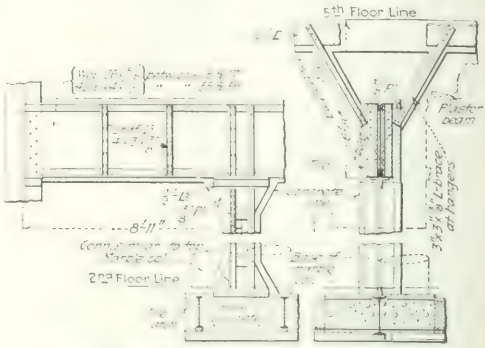
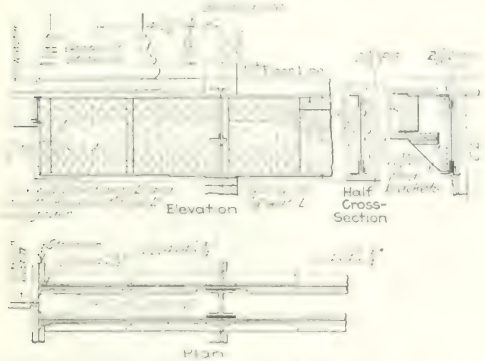



FIG. 5. HANGER SUPPORTING FLOOR UNDER INTERIOR COLUMN




1ST FLOOR CANTILEVER GIRDERS ON LA SALLE ST. FRONT

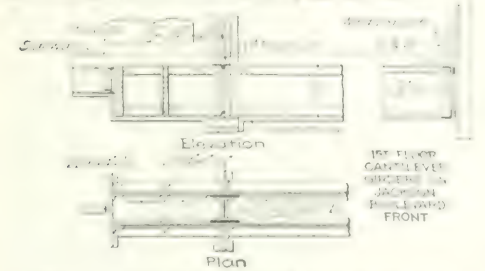



FIG. 4. CANTILEVER GIRDERS FOR [illegible] COLUMNS

## Fear Fire Danger to Great Timber Windfall

Fear of serious danger from fire in the great windfall of timber created in the forest of the Olympic Peninsula, Wash., by the cyclone of Jan. 29, 1921, has led the National Forest Service to adopt strict regulations in the danger zone including prohibition of smoking. The area swept by the 150-mile wind is 90 miles long and from 20 to 30 miles wide, in which over 6½ billion feet of timber was blown down by the storm and now lies in a tangled mass. Should fire ever gain headway in this devastated area, foresters say, the greatest conflagration ever known would result. Funds of $100,000 each have been subscribed for fire protection and suppression by the Federal government and the state. Roads, trails and telephone lines have been constructed through the blowdown, and special fire-fighting motor trucks, equipped with several thousand feet of hose and a portable pump engine are located at central points for emergency use. Guards will be stationed on all main lines of travel throughout the region, to see that no one enters except under special permit. Aerial fire patrol will also be maintained from Camp Lewis, Wash., during the danger season, through co-operation of the Air Service, U. S. Army.

# Design and Operation of Locomotive Fuel Oil Stations

**Tank Cars Discharge Into Track Troughs—Storage and Service Tanks—Gravity or Pumped Supply to Engines—Oil Columns—Fire Protection**

ON RAILWAYS operating oil burning locomotives, the installations for delivery of fuel to the engine are of a type comparable with water stations rather than with coaling stations, since the fuel is handled by pumps and piping. In general, such an installation has troughs of concrete, steel or wood for receiving the oil from tank cars, which is then delivered by pumping or gravity to storage tanks and then pumped either

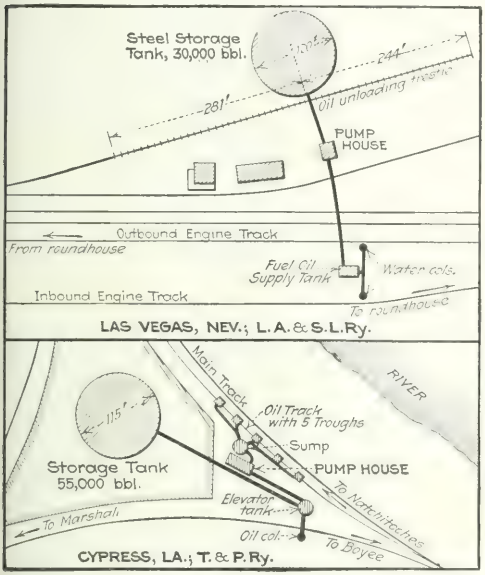



FIG. 1. LAYOUT OF TWO RAILWAY OIL STATIONS

to an elevated service tank or directly to the oil columns from which the tender tanks are filled.

*Oil Station Layouts*—A typical layout of an oil fuel station, shown in Fig. 1, is that of the Texas & Pacific Ry. at Cypress, La. Five troughs are spaced 40 ft. c. to c. on the oil track, to serve five tank cars. From each trough a 6-in. pipe is led to an 8-in. main discharging into an underground covered concrete tank or sump, except that the pipe from the middle trough leads directly into the sump, which is of 15,000 gal. capacity. The oil is pumped from this sump to a storage tank of ordinary steel plate construction and a capacity of 55,000 bbl., 115 ft. in diameter on the surface of the ground. From this tank the oil is pumped again to an elevated steel service tank of 50,000 gal. capacity, in which the oil is maintained at an average head of 12 ft. above the oil column.

Three different plant layouts on the Missouri, Kansas & Texas Ry. may be noted, as illustrating modifications to suit local conditions. At San Antonio, Tex., Fig. 2, there are three unloading troughs delivering to a sump from which the oil is pumped directly through a 10-in. line to an elevated steel tank of 100,000 gal. capacity, the usual separate storage tank being omitted. The two oil columns are served by a 10-in. gravity line from the tank and also by an 8-in. pumping main. At Houston, on the other hand, as shown in Fig. 2, no sump or elevated tank is provided, the three troughs delivering directly to a 50,000-gal. underground concrete tank, from which the two oil columns are supplied by a 10-in. pumping main. At Smithville, Tex., with five unloading troughs, the oil goes to a sump from which it is pumped to a 55,000-bbl. storage tank on the ground. From this tank or the sump the oil is pumped to an elevated service tank supplying the oil columns by gravity. In each case the oil track has separate troughs spaced 40 ft. c. to c.

An arrangement of an entirely different character, with the oil track elevated on a trestle, is used by the Los Angeles & Salt Lake Ry. at Las Vegas, Nev., as shown in Fig. 1. At this point about 25 engines are supplied daily, with an average of 2,000 gal. per engine. Cuts of three to six tank cars are pushed up a 5 per cent grade onto the unloading trestle, which has a continuous trough between the rails, and a lateral trough or covered conduit discharging through the roof of a steel storage tank of 30,000 bbl. capacity. A steam pump with a capacity of 100 gal. per minute draws oil

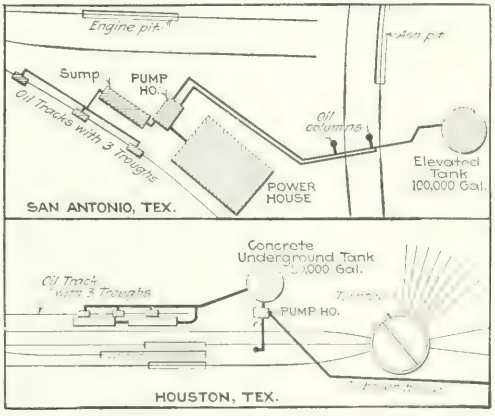



FIG. 2. OIL STATIONS ON THE MISSOURI, KANSAS & TEXAS RY.

from this tank and delivers it to a 20,000-gal. elevated supply tank, from which it flows to two standpipes serving the inbound and outbound engine tracks of the roundhouse.

*Track troughs*—Tank cars bringing the oil supply are unloaded usually by gravity from the bottom outlets standing on a side track provided with troughs between the rail. As a rule there is a series of separate short troughs or hoppers, but in some cases a long continuous trough is installed, as noted above.

Concrete is preferred on the Texas & Pacific Ry. for three principal reasons: (1) The ease with which the depth of the troughs may be varied to give the proper fall to the sump; (2) the ease with which pipe connections may be made, and (3) the non-corrosive proper-

ties. This last item is considered of special importance as the troughs are constructed frequently at points where cinders have been used for ballast and filling. On the other hand, steel plate construction is preferred on the Missouri, Kansas & Texas Ry. Although concrete troughs have been used at some of the smaller engine terminals on the M., K. & T. and have cost less than the steel troughs, the latter are considered more satisfactory, since they are less liable to be damaged and can be moved readily in case of any change in the arrangement of the terminal facilities.

Concrete troughs on the Texas & Pacific Ry., Fig. 4, are 8 x 2½ ft. with a depth of 21 in., the bottom being sloped to a 6-in. outlet. A 1:2:4 gravel concrete is

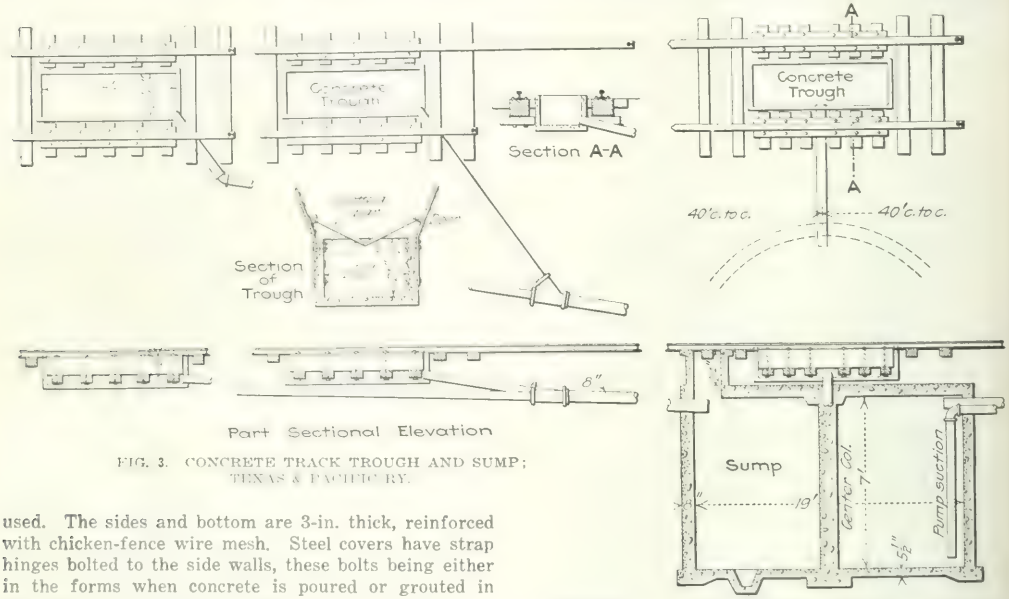



FIG. 3. CONCRETE TRACK TROUGH AND SUMP; TEXAS & PACIFIC RY.

used. The sides and bottom are 3-in. thick, reinforced with chicken-fence wire mesh. Steel covers have strap hinges bolted to the side walls, these bolts being either in the forms when concrete is poured or grouted in afterwards. Slotted bars sliding on bolts in the end walls hold the open doors nearly vertical in order to keep them from fouling the rails and to prevent splashing. Alongside the troughs, each rail is carried by a longitudinal timber resting on wood blocks. Steel troughs on the Missouri, Kansas & Texas Ry., Fig. 5, are 8 x 2 ft. and 24 in. deep, having wooden covers sheathed with galvanized iron. At the troughs, each rail is laid on short ties across a pair of stringers. From each trough a 10-in. horizontal discharge pipe leads to a 10-in. main which is laid in a trench parallel with the track and which in most cases delivers the oil to an underground sump or tank.

The continuous wood trough of the Los Angeles & Salt Lake Ry., Fig. 6, is 24 in. deep and 40 in. wide, built of 3 x 12-in. planks nailed to the caps and track stringers of a framed trestle and put together with splines or feathers in the joints. No metal lining is used. As a protection against fire the trough is covered ordinarily with loose boards or panels having cleats to hold them in place, but at the caps these top boards are nailed to the trough to hold the sides together. A wide plank walk is provided for switchmen and for the men who operate the valves of the cars. This trough is 232 ft. long, with a grade of 1 per cent. A 12 x 36-in. closed wood conduit leads from the lower end of the trough to an opening in the roof of the storage tank, the conduit having a bottom discharge. For the deck of the trestle a special construction is needed to carry the cars at the necessary height above the trough, as shown. On each cap are 12 x 12-in. blocks carrying stringers of the same size to which the track rails are spiked, rods being run through the stringers in order to hold them in position and to maintain the gage of track.

*Storage and Service Tanks*—Underground or surface tanks for storage are used according to local conditions, as noted in the description of layout of oil stations. In some cases an elevated tank combines storage and service facilities. On the Missouri, Kansas & Texas Ry. the oil from the track troughs flows usually to a sump consisting of a horizontal steel cylinder tank of 10,000 or 12,500 gal. capacity, having its top about 2 ft. above the ground to save excavation and unnecessary depth of pipes. Elevated tanks for oil service on this road are usually horizontal steel cylinders of 20,000 gal. capacity, mounted on steel trestles, with the bottom of the tank about 20 ft. above rail level, as in Fig. 6. A few large terminals have 100,000-gal. tanks of the same type and at some of the smaller terminals old 10,000-gal. tank car bodies are used, placed on timber towers.

Steam heat is provided in the tanks and mains, as the heavy Texan and Mexican oils used on this road require to be kept at a temperature of about 125 deg. F. to be sufficiently fluid for pumping and gravity flow. Pipe coils are used in the tanks and a 2-in. pipe is laid in each main, resting loose in the bottom of the main. At each trough the steam pipe in the lateral ends is an attachment for a 10-ft. length of hose to be connected to the heating coil in the tank car and thus facilitate the discharge of oil. Pumps for oil service have usually a capacity of 100 or 200 gal. per minute, increased capacity being provided by number rather than size of pumps.

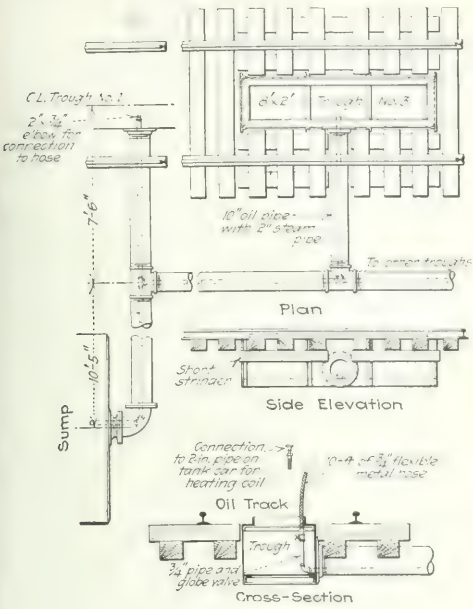



FIG. 4. STEEL TRACK TROUGH: M., K. & T. RY.

A 15,000-gal. concrete underground sump is used by the Texas & Pacific Ry. for its oil station at Cypress, La. This sump is 19 ft. inside diameter and 7 ft. deep, with 8-in. walls and a central column, steel reinforcement being used throughout. Machine-mixed concrete is specified and is given a coat of rich mortar immediately after the removal of the forms, the mortar being worked into the surface with a wood float and then lightly troweled.

Oil is pumped from this sump to a steel storage tank 115 ft. in diameter, having a capacity of 55,000 bbl. This tank is on the surface of the ground and near the outlet it is fitted with steam-pipe coils sufficient to maintain the oil at such temperature as to be

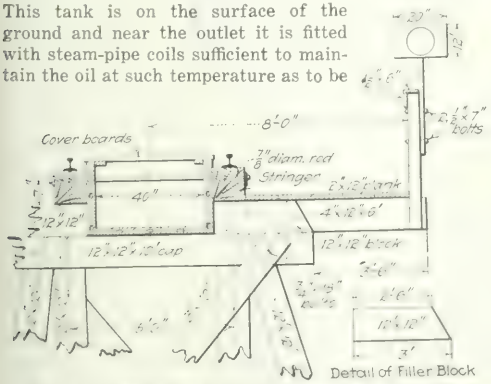



FIG. 5. CONTINUOUS WOOD TROUGH ON TRESTLE

fluid enough to be pumped. Similar coils are used also in the 50,000-gal. steel elevated service tank, which has a conical bottom with sediment drum. These coils were designed for heating the heavy Mexican oil, but have not been used as extensively as was expected. The lighter California oil requires less heat.

The storage tank of the Los Angeles & Salt Lake R.R. at Las Vegas, Nev., is of ordinary steel plate construction and is built above ground. It is 120 ft. in diameter and 14 ft. 8 in. deep, with a plank roof covered with gravel and asphalt composition roofing and having a circular monitor or raised section for ventilation at the center. Radial rafters are supported by ring girders and a shelf angle inside the shell, the girders being carried by posts which rest on plank footings on the bottom plate. A pipe radiator 20 ft. square is placed in the tank, with connections for both live and exhaust steam, in order to maintain a temperature of about 100 deg. F. This road uses California oil.

Through the side of the tank, at the bottom, stands an 8.-in. outlet, with a gate valve on the outside and a hinged length of 8-in. pipe on the inside, the open end of this pipe being held at any desired level by a chain operated from a roof manhole. An 8-in. suction main

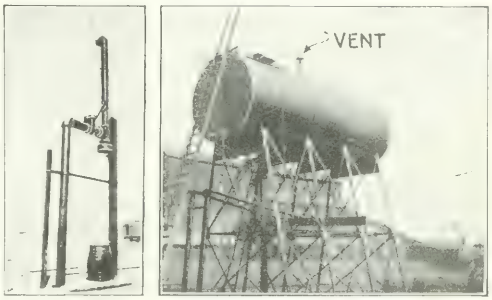



FIG. 6. SERVICE TANK AND OIL COLUMN: M., K. & T. RY.

leads from the tank outlet to the pump house and a 6-in. force main thence to the elevated supply tank, both of these being of wrought iron pipe with threaded sleeve joints. The supply tank is horizontal, 10 ft. in diameter and 35½ ft. long with flat conical ends. It is supported on a timber frame or tower, though steel and concrete bents are used at other points, the bottom of the tank being 15½ ft. above rail level. A pipe radiator is fitted inside the tank to maintain the oil at 100 deg. F. The 6-in. supply pipe is carried up and connected to a manhole on the top of the tank. At one end is a 10-in. cast iron outlet pipe attached to the bottom of the tank and carried underground to the standpipes or oil columns.

*Fire Protection*—Special provision must be made for the fire hazard incidental to the storage and handling of oil. The Missouri, Kansas & Texas Ry. equips its oil stations with small portable fire-foam engines. Surface storage tanks are fitted with pipe systems for blowing live steam across the top to quench the flames, these tanks being surrounded by low earth banks to retain the oil in case of bursting or leakage of the tank. The rails of the engine tracks at oil columns are bonded to prevent stray electric currents from flowing through the engine to the pipes and causing a spark. At the main receiving station at Galveston, where the installations were made by the Mexican Petroleum Corporation, a complete "foamite" installation has been made for smothering oil fires, but the expense for such equipment was not considered necessary at railway oil stations.

On the Texas & Pacific Ry., storage tanks are equipped with steam pipes and surrounded with earth banks. Hand chemical extinguishers are provided at the pump

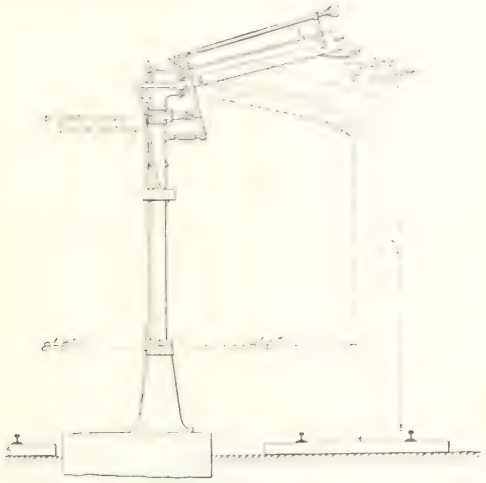
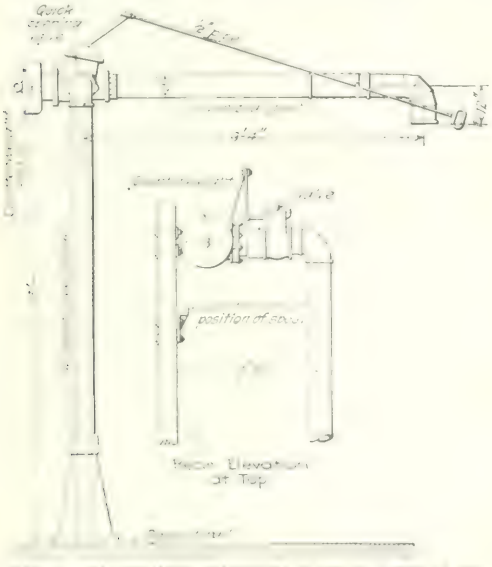


FIG. 7. OIL COLUMN: TEXAS & PACIFIC RY.

house and barrels of sand are placed at convenient points.

*Oil Columns*—To deliver the oil to the locomotive tenders, different types of oil columns are used, their design being very similar to the water columns for supplying the tenders with water. In fact, the Texas & Pacific Ry. uses a water column adapted to this purpose (Fig. 7) and supplied by an 8-in. main from the elevated tank in which the level of oil is maintained at about 12 ft. above the oil column. The horizontal spout is swung across the track when in use and can be depressed to the tender manhole, a 6-in. quick acting gate valve at the head of the column being operated by the fireman by means of a rod on the spout. To catch the oil drip after use, a small bucket is hinged to the end of the spout, this bucket being swung up (and thus emptied) when the spout is spotted over the tender. The gravity flow from the 6-in. spout is at the rate of about 250 gal. per min., varying with the temperature and the amount of oil in the elevated tank, so that the average 2,500-gal. tank of an engine tender can be filled in about ten minutes. An average of eight engines take oil at Cypress daily, with about 1,500 gal. to each engine.

In the National oil column used by the Missouri, Kansas & Texas Ry. (Figs. 6 and 8) the spout swings vertically instead of horizontally. The 8-in. column or stand-pipe, having a loop of steam pipe within, carries a horizontal arm parallel with the track and having a revolving elbow whose other end is journaled in a timber post. To the track side of the elbow is attached the 8-in. sheet iron spout, a 400-lb. counterweight on the back of the elbow returning the spout to its normal vertical position after use, so that there is little dripping of oil. A spring lock or latch holds the spout in this position, to secure it against wind pressure. A rod along the spout enables the fireman on the tender to operate a quick-acting valve in the horizontal arm. With gravity flow from an elevated service tank the 8-in. oil column discharges at the rate of 400 gal. per minute, so that a 3,000-gal. tender tank can be filled in about 7½ minutes. With the pumped supply, the discharge from the oil column is about 200 gal. per minute.



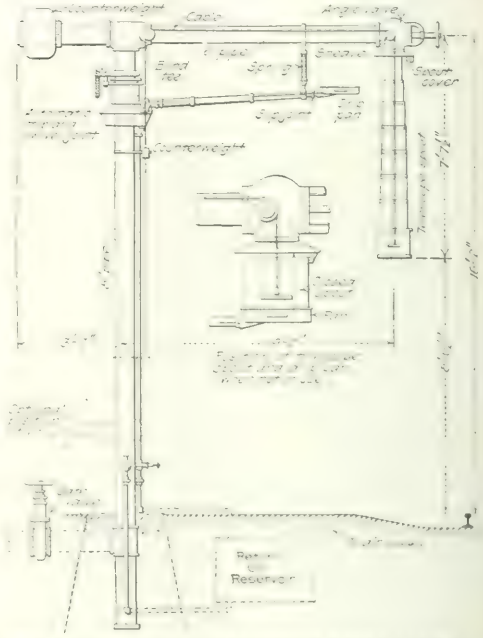




FIG. 9. OIL COLUMN: LOS ANGELES & SALT LAKE RY.

The Los Angeles & Salt Lake Ry. has used an oil column somewhat similar to that shown in Fig. 6, but it is now using the Rose design shown in Fig. 9. An 8-in. vertical pipe carries a 6-in. horizontal arm with a valve in the outer end and a 6-in. telescopic vertical drop or discharge pipe, which is closed or held up normally by a chain and counterweight, being pulled down

only to enter the tender manhole when the engine is taking oil. When the oil column is not in use, the horizontal arm is swung round parallel with the track, and a telescopic drip pipe is pulled out so as to bring a drip pan under the spout. A down pipe for the drip is carried inside the 8-in. oil pipe and may be connected to the main or to the reservoir.

Measurement of oil delivered to the engines is made usually by means of a stick graduated in inches and gallons, the height of oil in the tender tank being noted before and after filling. Each engine is supplied with a stick for this purpose. In some cases a meter is placed on the pipe line leading to the oil column.

Design and installation of oil station facilities are under the direction of the engineering department as a rule, their operation and maintenance being in the hands of the mechanical department.

## Comprehensive Water-Works Plan for Cedar Rapids

REMOVAL of the water-works plant of Cedar Rapids, Ia., to a new site across the Cedar River, new filters, pumps, power plant and an expanded distribution system are recommended in a recent report by Burns & McDonnell, consulting engineers. The present plant and equipment are inadequate for present needs and a water famine is imminent, in their opinion, unless temporary relief is provided. Two 30-ft. diameter wooden coagulation and settling tanks and four 15-ft. diameter wooden filter units are recommended as a temporory expedient. The cost is estimated at $25,000 but one half of the investment can be salvaged and utilized in the new plant.

The Cedar Rapids plant was built by a private company in 1875 and bought by the city in 1903. Emergency piecemeal construction has added new boilers, pumps and filters. This resulted in a plant inadequate for present needs, difficult to expand or remodel, and with high operating costs. The plant is surrounded by important industrial properties and natural barriers which make it impossible to secure the necessary room for settling basins, storage reservoirs or purification works. The pumps are 25 to 30 years old. The equally old wood tub filters show decay. They are expensive to operate because there is no preliminary sedimentation or coagulation of the high-turbidity river water. With no storage reservoir the pumps must respond to consumption, resulting in inefficient operation during periods of low consumption as well as at high rates when old low-duty pumps must be pressed into service. Quoting now from the report:

Four supplies were considered: (1) McLeod's spring, which is hard and insufficient in quantity; (2) Indian Creek, which carries barely enough water for present demands and is badly polluted; (3) artesian wells, which produce a hard water and an adequate quantity for the present; (4) Cedar River, which is ample in quantity, comparatively soft, but subject to surface pollution and the sewage of Vinton, 40 miles away, and Waterloo, 75 miles away. Only wells and the river were seriously considered. The uncertainty as to the quantity eventually obtainable from the wells and the larger cost over the river water for treatment to bring the well water to an equal softness with the river water, threw the decision in favor of the latter. By filtering the soft, though turbid river water the quality can easily be brought to the sanitary quality of the well water. The hardness is half that of the well water.

At the site of the present plant there is insufficient space for filters and ample settling basins. The plant is poorly arranged for expansion and more than half of the present equipment must soon be replaced. New filters would have to be located across 21 railroad tracks, increasing the low service pumping head by 30 ft. static and 5 ft. friction head, thus adding $2.50 to $3 per million gallons. At the new site proposed there is ample room for pumps, filters and basins and future extensions, accessibility of switch tracks, saving in low head pumping, and a chance to make the power plant and filter plant of fireproof construction. Remodeling the old plant would cost approximately as much as the construction of a new one.

Some of the factors assumed in the design of the proposed filter plant are as follows: A mixing chamber with a long baffled run in which the water travels ½ to 1 ft. per minute for 30 minutes will have a rated capacity of 9 m.g.d. needed for the maximum day's consumption in 1930 for an expected population of 63,000. The 1920 population was 45,566. Six hours is the retention period provided for in the settling basin for the 9-m.g.d. rate. The effluent from the six 1½-m.g.d. rapid filter units would be sterilized and then stored in a 3,000,000-gal. circular covered storage reservoir which it is proposed to locate in Bever Park, 160 ft. above the commercial district. With preliminary sedimentation it is held that the filters may be overloaded 25 per cent. The main features of improvement over the existing filter plants, one of which was built 25 years ago, and the other less than 10 years ago, are better facilities for handling coagulant, dry-feed machines, long mixing chamber which will reduce the coagulant applied by one-half, sedimentation basins to relieve the filters, to insure a better effluent and to reduce the wash water to one-fourth or one-fifth of the amount now used. A saving of $4.50 per million gallons is estimated from the reduced coagulant and wash water. A unique proposal is to utilize the flat slab roof of the storage reservoir for tennis courts, as has been done at Arkansas City, Kansas.

Of the total estimated cost of $1,248,180 the principal items are: Real estate, $75,000; 8-m.g.d. cross-compound Corliss high-duty pumping engine, $60,000; 9-m.g.d. filter equipment, $108,000; filter and head houses and basins, $152,375; intake, yard piping and sewers $30,000; pump house, $75,500; distribution extensions, $347,600; river crossing, $25,000; storage reservoir, $100,000.

## Experiments in Treating Wastes from Water Gas Plant

WATER gas wastes at Flint, Mich., have been treated experimentally with 1,500 lb. of lime per million gallons of waste as a coagulant. A satisfactory effluent was obtained from 2 hours sedimentation and filtration through a coke filter. The rate of filtration was 8 to 10 m.g.d. per acre through 24 in. of coke over which was placed 6 in. of coke breeze. The turbidity was reduced 95 per cent, color 90 per cent, oxygen consuming value 95 per cent and total solids to 100 p.p.m. There was left no visible trace of oil and only a slight taste and odor.

The normal waste contained 200 to 500 p.p.m. of turbidity, 500 to 1,500 total solids, 1,000 p.p.m. oxygen demand. Laxity in operation of the gas plant may produce an inky black waste having an oxygen consuming value of 1,800 p.p.m. and total solids of 11,000 p.p.m. Baffling was considered undesirable as the oil comes to the top best under the most quiescent sedimentation possible. After 2 to 3 hours plain sedimentation and filtering at the rate of 1½ m.g.d. per acre the coke filter became clogged in a few days with an oily, tarry material which penetrated to the bottom of the coke filter. The turbidity reduction was 75 per cent, the color none, oxygen consumed, 40 per cent and total solids 50 per cent. The effluent had a gassy odor and taste and retained some light oils. The experiments were carried out by J. R. Pollock, sanitary engineer, city engineering department, Flint, and reported by him in a paper presented recently to the Michigan section of the American Public Health Association.

# Sinking Substructure of Bascule Bridge Reconstruction

## Trunnion Piers of Dix Road Bridge at Detroit Replaced by Rectangular Frame Standing on Four 12-Ft. Square Shafts Sunk Eighty Feet Deep

IN REPLACING the foundations of the Dix St. bascule bridge at River Rouge in Detroit, safety of structure and continuity of both river and street traffic were preserved by building the new foundation around and separate from the old pier and abutment. Briefly, four deep column piers were sunk at the four corners of a rectangle embracing the old foundations. The tops of the new piers were connected by steel girders embedded in concrete onto which the bridge was lifted from the old pier and abutment. During construction, until the final change of support, the bridge operated on the original foundations.

pier carried 204,000 lb. and the counterweight trunnion pier carried 520,000 lb. Both piers were solid concrete on piles from 25 to 35 ft. long. There were 28 piles under the main trunnion pier. This gave a load per pile, including the weight of the pier of 18 tons, assuming buoyancy to be ineffective, or of 11 tons, assuming buoyancy to be fully effective on all portions of the pier below water. Under the same conditions the loads per pile for 35 piles carrying the counterweight trunnion pier were 13 tons or 12 tons.

These foundations were inadequate. They began immediately to settle and soon after construction the

FIG. 1. DIX ROAD BASCULE BRIDGE SHOWING ORIGINAL SUBSTRUCTURE

*Original Structure.*—As indicated by Fig. 1, the bridge is a Strauss bascule. It was constructed in 1912 by the Board of County Road Commissioners of Wayne County. At that time the location was in open country and the design adopted was typical of the country highway bridges of the time. Now this location is in the midst of an industrial concentration dominated by the new Ford Blast Furnaces, and River Rouge, only nominally a navigable stream in 1912, is slated by the U. S. War Department for widening and deepening to accommodate Great Lakes freighters. Ultimately, as the industrial development increases, a new bridge will be required, but for some years the old structure, with new foundations necessitated by the proposed deeper channel, will serve the traffic, and with its new substructure designed so as to form a part of the structure of the future larger bridge, its continuation in service was considered good economics.

The original bridge is 142 ft. long, with a movable arm of 112 ft. and an A-frame fixed span of 30 ft. carrying the counterweight truss and operating mechanism. It was designed for a live load of 2,000 lb. per lin.ft. with an 18-ft. roadway and two 5-ft. sidewalks outside the trusses. The substructure consists of the rest pier or abutment, a main trunnion pier and a counterweight trunnion pier or abutment. All dead load comes on by the main trunnion pier and the counterweight trunnion pier or abutment, and, neglecting wind loads, the dead load acts vertically at all times and is constant in amount for all positions of the movable leaf.

On this assumption of loading, the main trunnion bridge had to be jacked up from 6 to 9 in. and concrete added to the bridge seats. The movement was greatest at the abutment or counterweight trunnion pier. Continued settlement would have necessitated some kind of reconstruction, but, with the decision of the War Department to deepen and widen the river, immediate action was compelled, and plans were begun in November, 1919.

*Problems of Reconstruction.*—Detroit stands on a deep bed of clay. In the Rouge River section this clay presents especially difficult problems wherever heavy foundations have to be built. It is a semi-liquid blue clay. Indicative of its unreliability are the failures of sewers and that of the Ford dock wall and the settlement of buildings of the Ford plant. The clay also transmits shock. In building the Ford plant the driving of piles some distance away caused continuous settlement of the bridge foundations. These naturally difficult conditions were complicated at the Dix Bridge by the necessity of devising a method of reconstruction which would keep the old foundations safe and not interrupt greatly either street or river traffic.

Borings indicated solid rock at a depth of 90 ft. below water level and above rock a 10 to 12-ft. layer of hard material, a kind of hardpan composed of sharp stones ranging from pebbles to boulders cemented by a well-graded sand mixed with clay. Above the hardpan was the blue clay. It appeared that any stable foundation must have its bearing on the hardpan; also it appeared that any method for obtaining this bearing must be one which would not induce vibration in the

old foundation nor cause the semi-fluid clay to squeeze out or shift position. Pneumatic caisson piers to hardpan best met the requirements of no vibration and an undisturbed natural soil. Their greater cost it was considered was balanced by the fact that they could be used as sub-piers for the foundation of a future larger bridge.

For the reasons stated it was obviously impracticable to sink caissons within the area covered by the existing structures. They would have to constitute sub-piers for supporting some form of girder construction which in turn would support the old piers or the bridge itself. In view of the great weights of the old piers, and the possibility that this weight might eventually fall on the new supporting arrangement, should the pile supports continue to settle, it was decided that the plan of reconstruction must be such that there would be no connection between the original and the new substructure. Furthermore, it was essential that this plan should recognize the necessity of jacking up the superstructure to correct the existing settlement and the further settlement bound to occur during the new caisson sinking operations. Because of the light construction throughout of the superstructure and especially of the floor system, the only points at which jacking could be safely conducted were at the bridge seats.

*Method of Reconstruction.*—The plan adopted provided that four 12-ft. square caissons were to be sunk

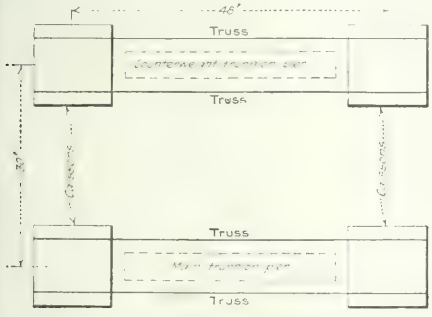



FIG. 3. DIAGRAM OF CAISSON LOCATION

80 ft. to hardpan to form sub-piers in line with and beyond the ends of the two old piers, as indicated in diagram by Fig. 3 and also by the view, Fig. 4. The plan at both piers was practically the same except in dimensions. At the river pier two steel trusses were designed one to be placed on each side of the original pier underneath the bridge, and spanning the distance transversely to the bridge between the two sub-piers. At their ends these two girders were securely braced together by heavy cross frames. The original pier being only about 4 ft. wide above water level, there was sufficient room on the top of the proposed 12-ft. square sub-piers to receive the end bearings of both girders, even allowing for a considerable variation in the final location of the sub-piers after sinking. All bracing between the top chords of the two girders was so designed as to clear the top of the original pier. This construction formed a steel frame around the old pier with the ends of the frame resting on the sub-piers. Embedded in concrete, the frames, with their connecting struts, appear as shown by Fig. 2.

During the sinking of the caissons the bridge set-

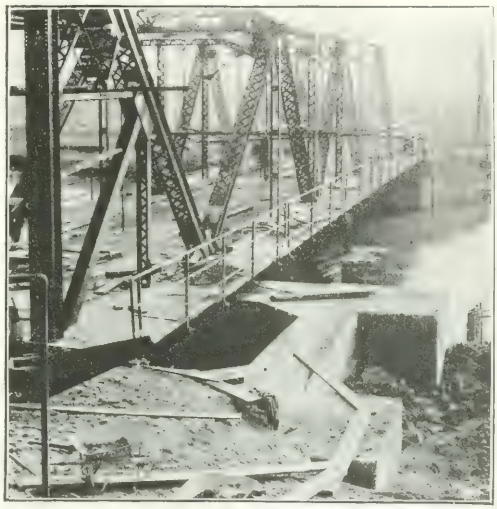


FIG. 2. RECTANGULAR FRAME ON PIERS REPLACING ORIGINAL SEPARATE PIERS

tled from side to side according to which pier was being sunk but at the completion of the four sub-piers it was found that the settlement had been consistent at each pier, resulting in a practically level condition transverse to the roadway. The bridge shoes at the counterweight trunnion pier were at this time over 17 in. below their proper elevation, 9 in. of which was due to former settlement and 8 in. due to settlement during the caisson work. The bridge shoes at the main trunnion pier were almost 6½ in. below their proper elevation, 2 in. of which was due to former settlement and 4 in. due to settlement during the work.

Caisson sinking involved no unusual methods or experiences. Some of them settled considerably out of line but not enough so to prevent the placing of the girders. It was found, however, that the weight of the 12-ft. pier was just about enough to cause settlement through the clay when all pressure was released from the working chamber. On this assumption the frictional resistance of the clay was about 450 lb. per square foot of caisson surface.

FIG. 4. SINKING CAISSONS FOR NEW SUBSTRUCTURE

When the piers were leveled up and the girder seats were placed, it was found that the settlement previously noted made it impossible to place the girders until the bridge was jacked up. Jacking was begun first at the counterweight pier. Two jacking brackets, Fig. 5, were riveted to the vertical members of the A-frames directly over the pier seats. At each of these brackets two 60-ton jacks were used. A timber frame, Fig. 5, was constructed as a jacking frame under the counterweight itself and four 50-ton jacks were placed under this frame. Jacking on all eight jacks proceeded simultaneously, and the shore end of the bridge was raised

FIG. 5. JACKING UP SUPERSTRUCTURE AND PLACING GIRDERS

to its proper elevation. This work was closely followed up with blocking and wedges on the counterweight trunnion pier. About twenty hours of continuous jacking was required. All jacking was done with the bridge in the closed position. The supporting trusses were then erected and riveted up completely before any other work was allowed, thus securing that end of the bridge and carrying its load to the sub-piers.

During the jacking just mentioned the bridge shoes on the river pier, as was to be expected, tipped up on edge and the nuts had to be released from the anchor bolts. The next operation was to jack up the bridge shoes at the river pier (the main trunnion pier). For this purpose slots were cut through the pier under the shoes to allow two jacks to be placed under each shoe and the jacking was done from these points only. In the meantime, in order to provide against any mishap, which might occur at the bridge shoes of the counterweight trunnion piers because of the tipping of the shoes during the jacking of the river pier, the 60-ton jacks under the jacking brackets were again placed and put under about half the strain. It was figured that the wood blocking between the head of the jack and the jacking bracket would so shape itself by crushing as to insure safety.

After the supporting trusses were in place and riveted up at the river pier also, the old piers were demolished to a sufficient depth to clear all new work. At this stage the bascule was supported entirely on the supporting frames between sub-piers. Forms were placed on the outside of the trusses and a massive concrete girder was poured which enveloped the entire steel frame. This, together with the pouring of heavy reinforced struts longtudinally between the sub-piers completed the foundation work.

*Cost-Plus Contract Employed.*—Bids were received on Feb. 10, 1920, and the contract was awarded to the Missouri Valley Bridge & Iron Co. On April 1 material for the work began to arrive and the contractor began setting up his plant. On June 2 the first batch of concrete was poured in the first caisson and on Aug. 28 the last of the four caissons was sealed. The work was completed in November.

When the work was advertised it was certain that it could not be let on a lump sum basis. The uncertainties in cost of materials and labor, and in the supply available, were such that no contractor capable of handling this class of work would take a chance. The work was therefore advertised under a form of cost-plus-a-sliding-scale-fee contract. Contractors bidding on the work were required to name an estimated cost which included plant rental. It was agreed that the county would pay the actual cost of the work plus a fee of $20,000, provided the actual cost did not exceed the estimated cost. If the actual cost should exceed the estimated cost, one-half of such excess was to be deducted from the fee until it became a minimum of $5,000. On the other hand, if the actual cost was less than the estimated cost the fee was to be increased by half of the saving. The contractors estimated the cost at $110,000. The actual cost was $113,450 and this, plus the resulting fee of $18,274, made a total cost to the county of $131,725.

Both the progress and the cost of the work were greatly influenced by labor difficulties, freight tie-ups and trainmen's strikes, which occurred in the interval. The average rate for laborers was 75c. and for carpenters 90c. Sand hogs were paid $1 to $1.25 per hour. Cement, fortunately, was secured by the county at the low figure of $2.02 net, f.o.b. Detroit. The fabricated steel trusses cost 8c. per pound; reinforcing steel 5c. per pound; coal $3.50 and $9 per ton, and lumber $78 per 1,000 ft.b.m. Gravel cost $1.10 f.o.b. pit with 90c. freight.

The work was carried out by the Board of County Road Commissioners, Wayne County, Edward N. Hines, chairman. Design and construction were under the direction of H. A. Shuptrine, bridge engineer for the Commission.

## Will Test Hollow Brick Walls for Crushing Strength

The "Ideal" brick wall, advocated by the Common Brick Manufacturers Association of America, a hollow wall constructed of inner and outer courses of brick tied across by headers, is to be tested for compressive strength by the Bureau of Standards at Washington. Four sections of such wall have been built and are shortly to be tested, it is announced by the Bureau.

# Normalcy Shunned in Design of Engineers' Club-House

## Fancy's Flight Reaches New Heights in Plans for Providence Society's Home

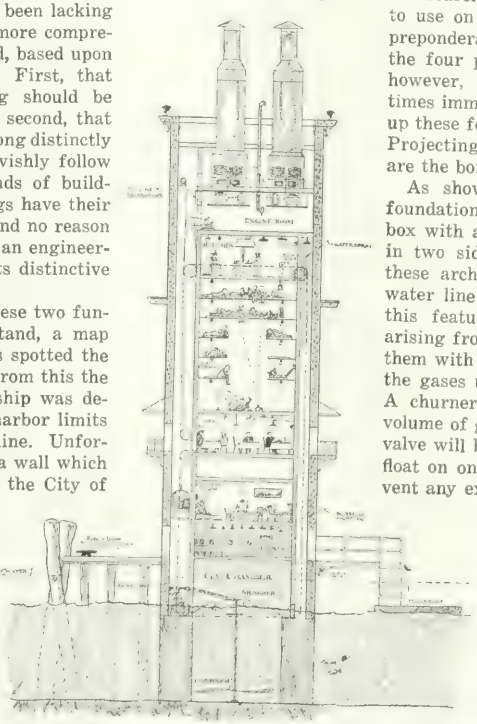
By Warren B. Lewis
Providence Engineering Society, Providence, R. I.

[*From time to time many plans for engineers' club houses have come to the attention of the editors, but the plan here described is thought unique, in the sense of Webster's definition: "Being without a like or equal; single in kind or excellence."*—Editor.]

MANY PLANS for a permanent club house which would serve not only as a gathering place for the presentation of technical papers, but also for all-around social purposes, have been considered for the Providence Engineering Society, which so far in its history has not been able to enjoy such facilities. Since the various plans presented seem to have been lacking in one respect or another, a more comprehensive plan is here presented, based upon two fundamental principles: First, that the location of the building should be mathematically correct; and, second, that its general design should be along distinctly engineering lines and not slavishly follow the architecture of other kinds of buildings. Other types of buildings have their own distinctive architecture, and no reason exists why the club house for an engineering society should not have its distinctive features as well.

Deciding, therefore, that these two fundamental principles should stand, a map was prepared upon which was spotted the location of each member and from this the center of gravity of membership was determined, falling within the harbor limits and practically on the harbor line. Unfortunately this spot is on the sea wall which was built a few years ago by the City of Providence, and a slight deviation from the first principle was decided upon by moving the site directly across the harbor where the tidal waters are free to rise and fall upon what was once the scene of the clam-digging industry.

This site is in desirable proximity to some of our more important industries; viz., the Gulf Refining Co., the Providence Gas Co., and the precipitation tanks of the sewerage system of the City of Providence. Borings were made, and it was found that the natural bottom was of a porous, plastic, impenetrable material, apparently of animal and vegetable origin, and capable of supporting any load which could possibly be placed upon it. The matter of foundation, therefore, was found to be a simple one, requiring no great expense in the matter of caissons, cofferdams, etc. It was also noted that considerable quantities of gas were continually arising, presenting certain possibilities, further mentioned.



AN ENGINEER'S "CASTLE IN SPAIN"

Without going into unnecessary detail at this point, attention is directed to the elevation of the building proposed.

The area and height of the building were carefully determined after considering the cost per sq.ft. and per cu.ft. and it was found that a building rather small in area but of considerable height was correct for this particular location. A dock is located on one side of the building, at which river steamers may tie up, and a float on the other side for canoes and row-boats. About midway of the height of the building is an automatic slide rule which can be read by mariners coming up Narragansett Bay and which will indicate the depth of water in the harbor and the locations of boats already anchored there. Around the top of the building is a frieze with figures indicating Rhode Island industries; viz., a dumb-bell, a fish, a clam, a shuttle, a caliper, a bolt of cloth and a warp beam. At the corners of the building are four searchlights which it was intended to use on election night to indicate the preponderance of votes for any one of the four political parties. As the city, however, has been Democratic from times immemorial, it was decided to wire up these four searchlights on one switch. Projecting from the top of the building are the boilers, further described.

As shown in the cross section, the foundations take the form of a square box with a flat slab on top, with arches in two sides of the box. The tops of these arches will be slightly above the water line at low tide. The purpose of this feature is to impound the gases arising from the river bed, and compress them with the rising tide, so as to force the gases up to the top of the building. A churner is provided to increase the volume of gas, if necessary, and a safety valve will be noted protruding under the float on one side of the building to prevent any excess of pressure which might be an element of danger to the stability of the building. Floating on the surface of the water within the chamber is a skimmer to collect oil on the surface and deliver it to a battery of centrifugal separators from which the oil will be taken and pumped to the boiler room which is on the top floor.

Immediately above the gas chamber is the library. The unique feature about this is that there is no doorway leading into the library, because the latter is never used anyway and it seemed an element of unnecessary expense to provide an opening. In the library will be noted the various forms of lighting units which are so extensively advertised and which, it is thought, could be very well put away where they would be of no annoyance to the membership.

Above the library is the lounge room. The distinctive feature about this is that there is plenty of natural light, but the artificial light consists of one 10-watt lamp. This was done to discourage the use of the lounge

room during the evening when technical papers are being read in the auditorium.

Above the lounge room is the café, in connection with which attention is called to the kitchen, two floors above. Food, as prepared, will be brought down on a conveyor alongside the elevator shaft and delivered into the café. The dishes, having been used, will be placed on this same conveyor which passes down into the chamber beneath the library, thence through the water to receive their first flushing, and up on the other side of the building in a hatchway down which a spray of water will be continually falling. This will thoroughly wash the dishes, which will then pass into the kitchen, through a dryer, ready for use again.

Above the café is the auditorium. This perhaps is the *most* unusual feature in the building. An auditorium sufficiently large to accommodate the membership as usually seated could not be provided in this building. Therefore it was decided to arrange a series of shelves running around the sides of the room, entrance being had to these from the elevator shaft. The members will get off at one or the other of these shelves or balconies, and will lie prone on cushions, and look over the edge toward the floor. The speaker of the evening will lie on his back, and thus will the relative positions of speaker and listeners be the same as in an auditorium arranged along more conventional lines. If the speaker is not entertaining the listener may turn around and hang his feet over the edge. When more feet than heads are visible, the speaker will know that it is time to desist.

Above the kitchen is the engine room. To conserve floor space the generators, which are directly coupled to internal-combustion engines, are suspended from the ceiling. These engines will use the gases which are accumulated in the foundation chamber. After a careful analysis it was found that the most reliable unit that could be used was the famous Ford twin-two engine.

Above the engine room is the boiler room. After due consideration it was decided that the Manning boiler was the most efficient boiler that could be used for heating and live steam uses and that it would lend itself particularly well to the floor space available. In order not to increase the height of the building unduly, it was decided to let these boilers project through the roof. It will be noted that the water gages and glasses which might seem to be in an inconvenient position are really not so by reason of the periscope which extends down into the engine room and through which the engineer can observe the water level at all times.

When the expense of running this building was figured, the designers were well satisfied with the cost of heat, light and power by reason of the free fuel available. However, they found that the café presented the usual difficulties; viz., that overhead expense is always too great and that this particular department would probably be a constant loss. You will note the space above the lounging room and immediately below the café. This space allows the overhead to be put underneath, thereby eliminating the one disconcerting element of expense.

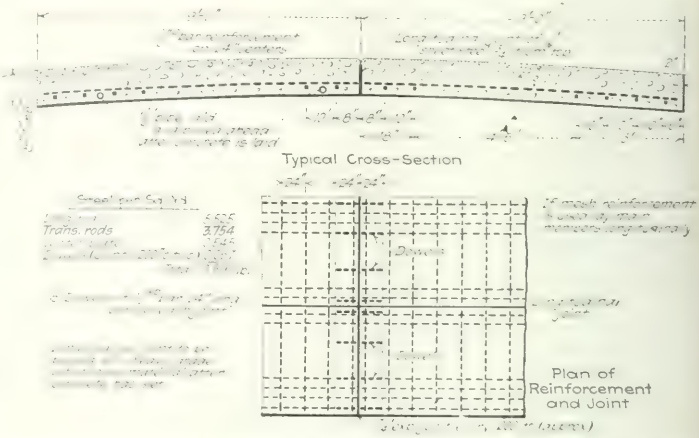
There are many minor details which have yet to be worked out, but, in the main, it is hoped that this plan, which was the result of a great deal of serious thought, will not have to be materially altered.

# Strengthen Concrete Paving Without Increasing Cost

## In New Design of Concrete Slab Steel Plate Longitudinal Joint Is Used—Thickness Uniform for Entire Width

By B. H. Wait
District Engineer, Portland Cement Association, New York

IN THE past considerably more study has been given to the mixtures, the surface and the riding qualities of the concrete road than has been given to the question of strength. The present practice with mixtures of 1:1½:3, 1:1½:3½, 1:2:3 or 1:2:4, depending upon the quality of sand and coarse aggregate, has shown us that we can obtain a lasting and satisfactory surface and excellent riding qualities if proper attention is given to the amount of water, time of mixing, manipulation, forms, etc.




DESIGN OF CONCRETE PAVING SLAB WITH LONGITUDINAL SHEET STEEL JOINT

With the above points in design and construction developed satisfactorily, the point in concrete road construction which requires attention is the strength to resist impact and bending moments caused by loads, frost action and weak subgrade. Up to date practically all concrete roads have been built monolithic for the full width of the roadway, a small amount of reinforcing metal being placed in some cases in order to hold the cracks from opening up. The roads also have been built thicker in the center with the idea that this greater thickness was needed at the center of the long beam. In such construction there has been some center cracking, some transverse or diagonal cracking, some breaking down of corners, and some wear at the joints and cracks if proper maintenance was not given.

As an improvement over former practice the design shown in the accompanying drawing and described

below has been developed. It provides for the following features:

(1) The construction of a center joint, either plain as shown in the drawing or with corrugations or keys to prevent lifting of slabs one above the other, thus dividing the slabs into 8, 9 or 10-ft. spans instead of 16, 18 or 20 ft., as are now being used, and doing away with the possibility of center cracking.

(2) The use of transverse reinforcement sufficient to eliminate longitudinal cracking in the short span sections. (In many cases it has been necessary to build concrete roads in half width in order to take care of traffic during construction and these roads have never cracked longitudinally when built of plain concrete). The reinforcement proposed should be sufficient to take care of any traffic conditions which develop in the future.

(3) Longitudinal reinforcement placed in such a way that traffic at all times will be travelling on a reinforced concrete beam of sufficient strength to carry the load without failure, to do away with transverse or diagonal cracking and to allow the elimination of joints, except expansion joints about every 200 ft.

WIRING STEEL BARS INTO MATS ON WOOD FRAME

(4) Placing of this reinforcement in the bottom of the slab where it will act to support the loads over weak places in the subgrade and so that it will allow the placing of all the concrete in one operation which should result in a better quality of concrete than can be obtained if the concrete is laid in two layers with reinforcement placed after the first layer is down.

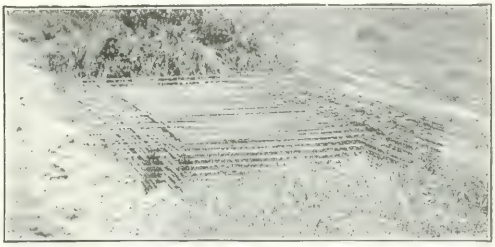
(5) Placing of steel dowels at joints in order to reinforce the corners and in order to keep one slab from riding above the other. In bad subgrades it will probably be advisable to place additional corner reinforcement on the top of the slab.

In place of a 6-8, 7-9, or 8-10-in. unreinforced or lightly reinforced pavement, as now generally laid, it is proposed to lay a uniform thickness of 6, 7 or 8 in. of concrete reinforced according to the proposed plan. By laying the center joint no point in the pavement need be stronger than the edge and the money saved (1½ in. of concrete) by making a uniform thickness of pavement will be sufficient to place the 10 lb. of steel rods per square yard as shown on the plans or a slightly smaller amount of heavy steel mesh.

### Analysis of Cost

A thickness of 1½ in. of concrete costs approximately $0.40 per square yard in plain concrete road.

A thickness of 1½ in. of concrete plus ¼ lb. per square foot of steel reinforcement, as commonly used, costs $0.55 per square yard in lightly reinforced concrete road.



STEEL REINFORCING MATS STACKED AT ROADSIDE

Steel rods can be obtained f.o.b. New York, New England, Pennsylvania, New Jersey or Delaware for about $0.0215 per pound, or the 10 lb. for $0.215 per square yard. They can be unloaded and hauled to the job for a maximum of $3 per ton or $0.0015 per pound or 1½c. per square yard for the 10 lb. A contractor laying 300 ft. of road per day will lay 6,000 lb. of steel. This can be handled by a maximum of three men at a cost of $15, or ¼c. per pound or 2½c. per square yard. Thus for 10 lb. of steel per square yard the total cost is $0.295.

It therefore appears that 10 lb. of steel rods per square yard or a smaller amount of heavy mesh per square yard can be laid with the proposed design at no increase in cost and in some cases at a material decrease in cost over present practice.

---

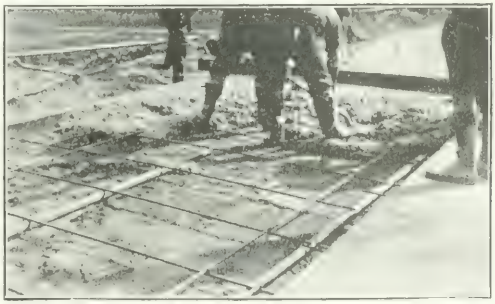
[*Reinforced-concrete highways of the same general design as that outlined above by Mr. Wait have been constructed this season by the highway division of the Massachusetts Department of Public Works. A description of the methods used by the contractor on one of these jobs is contained in the article which follows*—Editor].

---

## New Design Reinforced-Concrete Road Built in Massachusetts

By Walter S. Edge
Chief Engineer, Concrete Steel Co., New York

A CONCRETE slab of moderate thickness heavily reinforced, rather than a thicker slab of plain concrete or concrete reinforced only with a light mesh, was used this season by the Massachusetts Department of Public Works, through the division of highways, on the



IRON PIPES HOLD STEEL IN PLACE DURING POURING OF CONCRETE AND ARE THEN REMOVED

main road between Springfield and Worcester in the town of East Brookfield, included in federal-aid project No. 40. This road is slightly more than a mile in length, 20 ft. wide, is on practically a level grade and is located on a tangent. It was constructed in two halves, separated by a longitudinal construction joint down the center.

The slab is heavily reinforced with ½-in. square deformed bars. The transverse bars are spaced on 2-ft. centers, while five longitudinal bars are used in each half section of the road. Along the longitudinal center joint are placed dowels of ½-in. square deformed bars which are bent back against the face of the completed slab to facilitate the construction of the adjoining section, but which are later straightened out to bond the two halves together. The face of the joint is painted with tar before the casting of the second section. By this construction it is believed that either the edges on the center of the road may move a slight amount vertically without causing cracks in the surface of the slab and a definite longitudinal joint is formed down the center of the road which tends to separate traffic going in opposite directions.

The contractor's methods are simple and appear to be giving excellent results. The reinforcement is delivered along the grade by truck and is assembled in a wooden frame by one laborer. After wiring the intersections the mats, which are 14 ft. long and 9 ft. 10 in. wide, are piled alongside the road. When the concrete mixer has completed a section and has backed away in readiness to cast another section, a laborer adjusts three 1¼-in. pipes which rest on the subgrade and serve as a temporary support for the reinforcement. Two men pick a mat of steel off the pile and place it in position in the road resting on the three pipes, lapping the longitudinal bars about 1 ft. with those of the preceding section. The concrete is immediately deposited and worked in around the steel with shovels and the pipes are slid back under the mixer as the concrete advances. The surface of the road is screeded, rolled with a light roller, worked with a canvas belt and later roughened with a broom.

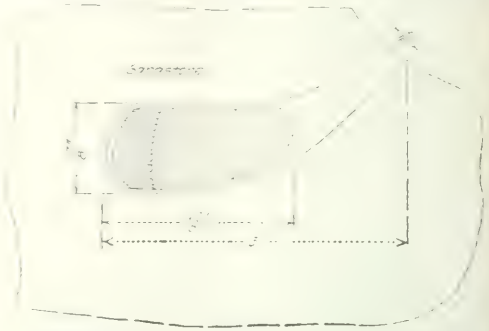
Transverse construction joints are made every 120 ft. and a ½-in. felt filler is used. These joints are dowelled across with plain bars which are painted with asphalt to destroy the bond.

The progress of the work is satisfactory, a gang of 35 men laying an average of 410 lin.ft. of 10-ft. road in 10 hr. With the type of reinforcement used it is not necessary to bring the concrete to a predetermined grade before placing the steel. One laborer is able to fabricate the steel required for this crew and while the contract price for the reinforcement in place is 5½c. a pound, the actual cost is considerably less than this. While the reinforcement used is unusually heavy, weighing about 1 lb. per square foot of surface, the slab thickness, 6 and 7½ in., is below that which is customary. The engineers of the highway division reasoned that the concrete saved by using the thinner section would partly, if not completely, offset the added cost of the steel, while the resulting roadway would unquestionably be superior to the plain concrete slab of 1 in. greater average thickness.

One feature of this road which appeals very strongly to the traveling public is the opportunity that it gives to use first one half and then the other, and in this manner either to avoid completely or at least minimize the use of detours. The work is being done by Carlo Bianchi & Co., Inc., of Framingham, Mass., under the directions of the Division of Highways of the Department of Public Works of Massachusetts, of which A. W. Dean is chief engineer.

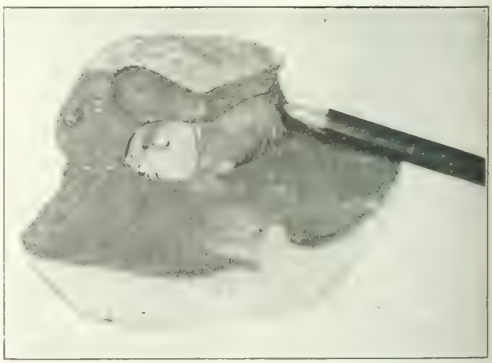
## A Marine Borer that Thrives on Sandstone

A SPECIMEN of pholas or marine borer that burrows in stone, which had grown 1⅞ in. long in a burrow 3 in. long in hard sandstone, was recently found near Punta, Cal., by W. H. Kirkbride, engineer, maintenance



SKETCH SHOWING DIMENSIONS OF ROCK BORER SPECIMEN

of way and structures, Southern Pacific Company. In boring this distance the mollusk had grown from ⅛ in. to ⅞ in. in diameter. The specimen was found near the high tide line in a rounded stone about the size of a



BROKEN SANDSTONE PEBBLE WITH EMBEDDED MOLLUSK

man's fist. The stone contained the marks of a number of borers other than the one shown in the accompanying illustration, whose dimensions were readily taken after the rock had been broken open.

### Steel Little Affected by Varied Rolling Conditions

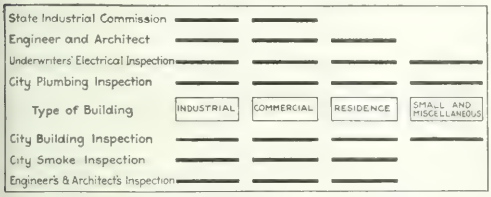
Studies of medium-carbon steels produced under a wide variety of rolling conditions at the Bureau of Standards indicate that rolling variations have little effect on the mechanical properties of the resulting rolled steel. The difference in properties between transverse and longitudinal specimens from the same plate was as great as the variations caused by rolling.

# Municipal and Private Building Inspection

## Study of Conditions in Rochester—Diverse Codes and Inspection Services—Centralization of Authority and Better Definition of Function Desirable—Utilizing Private Inspection Effectively

By Frank P. Cartwright
Assistant Engineer, Bureau of Municipal Research, Rochester, N. Y.

CO-OPERATION between public and private agencies for the control of building inspection, though desirable from the community point of view, necessarily is complicated by differences in the purposes which animate these agencies. The benefits to be secured through inspection of building construction are so real and important, however, and the facilities usually provided for city inspection so inadequate to the demands upon them, that every possible means should be taken to organize the various inspection agencies and to utilize them to the fullest extent for the protection of community and individual interests. The following discussion of conditions in Rochester, N. Y., and of the measures taken to insure good building construction, indicates some of the methods by which this may be done.




DUPLICATION AND OVERLAP OF BUILDING INSPECTION SERVICES IN ROCHESTER

There may be distinguished three general situations which occur in connection with inspection of building construction:

1. Inspection by municipal or local agencies, financed from public revenues, under governmental control, taking their authority from the police power, and enforcing set codes enacted by the local authorities.

2. Inspection by privately financed agencies, not acting under contractual relations and not backed by the police power, but securing the enforcement of a set code through control of some utility necessary to the builder.

3. Inspection by engineers or architects acting in a contractual relation for the enforcement of specifications which are purely matters of agreement between owners and builders.

The work of the second and third groups necessarily helps in great part to protect and promote the public safety and welfare, but it is essentially different from that of the first group in that the regulations enforced are not directly under public control. There is no inherent guarantee that requirements will be sufficiently strict, and, in the case of the second group, none that they will not be unnecessarily so, to insure the degree of safety and structural excellence which the community believes desirable. It also happens usually that through the duplication of agencies and the overlapping of work, building construction carries altogether unnecessary overhead charges for inspection service.

A study of the situation in Rochester shows the need of co-operation and reorganization of the three types of building inspection in order to realize the utmost benefit from the means at hand. The various organizations concerned, together with their respective fields and duties, are shown in a table on p. 196. There, of course, are still others charged with protection of health, prevention of boiler explosions, etc., but this discussion is limited to inspection of construction work. It will be noted that the inspection work carried on under city auspices is divided among three agencies, and that in addition to those of the city the governmental agencies include that of the State Industrial Commission, which regulates conditions of employment and certain features of factory construction. The insurance agencies inspect practically all electrical work which receives any inspection whatever, and a good part but not all of the elevator installations. Engineers and architects retained by the builder inspect a part but not by any means all of the more important building construction. The relative scope of the work done by each agency, and the degree to which the various fields overlap, are shown graphically by the adjoining diagram.

### Analysis of Situation

It is obvious that if each of the agencies listed is carrying out it duties faithfully within the nominal limits of its field, there are at least three and often as high as six inspection agencies whose requirements must be satisfied in connection with the building of one structure. Four of these enforce well-known codes, one is concerned only with the building contracts and specifications, and one with more or less independent and arbitrary requirements set up by the various insurance agencies. If smoke inspection is to be extended to control design and construction of fuel burning installations, as is necesasry if it is to produce anything like worthwhile results, a seventh agency will be added to those mentioned.

It is at once apparent from the diagram that the city services themselves are decentralized and should be brought together for more efficient administration. The State Industrial Commission and the engineering and architectural inspection parallel the city service in a great number of cases, though concerned with matters differing very little from those dealt with by the building code. The problems of organization, therefore, are (1) to centralize city building inspection, (2) to define the limits between the fields of the city inspection agencies and the State Industrial Commission, and (3) to utilize the private inspection agencies, so far as possible, to supplant the city work.

There also is the question, depending on factors mostly of local significance, as to whether electrical inspection should be a privately controlled service.

### Plumbing Inspection

According to a law affecting all cities in New York State, plumbing inspection is included in the duties of the local health authorities. With our present concep-

tions of public health work, such an idea seems highly fantastic, for the effects of faulty drainage in causing disease are known to be very small indeed. Whatever the original idea the plumbing codes now generally in effect have but the slightest connection with the activities of a public health unit as now carried on. The plumbing code of Rochester, like the building code, concerns only questions of materials, workmanship and type of fixtures. A plumbing inspector does not attempt to decide whether conditions are sanitary or not. He simply sees that the plumbing system is of an accepted kind, of proper materials and properly installed. This done, he goes away and forgets it until informed that it has broken down in some particular. Then he makes sure, as before, that the necessary repairs are made in a workmanlike manner. The plumbing inspector requires that a stack be of a given size; the building inspector makes sure that rooms have the floor and window area considered necessary to the health of the occupants. One is as much concerned with the public health as the other. Both are concerned with original construction only, and both should be in the Bureau of Buildings, which has the control of original construction for its object, not

### Inspection of Electrical Work

Rochester is unusual among the larger cities in that all inspection of electrical installations is delegated to the Underwriters' Association of New York State, which enforces the National Electrical Code. By agreement with the local power company no service connections are made until the underwriters' approval of the installation has been expressed. Complete inspection of electrical work in new buildings therefore is ensured.

With a disorganized and inefficient city inspection service such as apparently has obtained in the past this probably has been productive of the best results, but as a general rule it is not good policy that this service should be performed and charged for by private agencies. Electrical inspection, fully as much as building inspection, involves the exercise of the police power, and to delegate the control of electrical work to a private agency and to make the supply of power to a prospective user contingent on the approval of that agency is in effect the same as though automobile insurance companies were allowed to draft and enforce a traffic ordinance, or as though enforcement of the build-

BUILDING INSPECTION AGENCIES OPERATING IN ROCHESTER, N. Y.

| Title of Organization | Financed by | Authority to Enforce Findings Based on | Nature of Inspection Work | Object of Inspection | Field of Work |
|---|---|---|---|---|---|
| Bureau of Building—Structural Branch | City | Police power | Inspect original construction, alterations and additions | Protection of public safety and welfare, fire prevention | All building construction in city |
| Bureau of Health, Plumbing Inspectors | City | Police power | Installations and repairs of plumbing | Public Welfare | All plumbing work in city |
| Smoke Inspector | City | Police power | On complaint, subsequent to construction | Protect public welfare through smoke prevention | All plants in city |
| State Industrial Commission | State | Police power | Both of original construction and periodically thereafter | Protect health, prevent accidents and fires | Industrial and commercial structures in city and adjacent districts |
| Underwriters' Association of New York State | Insurance companies | Insurance rate regulations | Inspect electrical installations | Prevent fires and accidents | Nearly all electrical work in city and surrounding districts |
| Elevator and Casualty Insurance Inspector | Insurance companies | Insurance rate regulations | Inspect original installations and periodically thereafter | Prevent accidents | Elevator plants in city and surrounding districts |
| Architects and Engineers | Private parties | Terms of Builders' contract | Inspect original construction only | Enforcement of Builders' agreements | Construction work of all kinds |

in the Bureau of Health, which is charged with the correction of unhealthy conditions.

It furthermore is not good management to put an inspection service concerned only with materials and workmanship under the inspection of a man trained in medical matters, whose attention is almost wholly taken up with fighting disease. It has resulted, in the case under discussion, in almost complete separation and independence of the inspection service.

The municipal health bureau is an organization whose purpose is the prevention and control of disease. Its annual appropriations almost always are inadequate, and it is unfair to that body and misleading to the taxpayers to support out of these appropriations, ostensibly for protection of public health, an inspection service concerned with protection of property values far more than with the prevention of disease. This practice is quite general in American cities, and seems to be a survival of the older public policy which puts property interests above human life or health. It is a neat and successful scheme for protecting property values with money the uninformed citizen naturally believes is being spent in controlling disease.

ing code were farmed out to private organizations. The fact that the code enforced by the underwriters is one almost nationally accepted, or the possibility that privately managed inspection may often be better than that subject to political influence, does not alter the principle that police activities involving the legislative and executive branches of government should be performed by the government.

In accordance with the foregoing views a charter amendment is being drafted which is to place plumbing inspection under the supervision of the Superintendent of Building Regulation and which will add electrical inspection to the duties of the present Bureau of Buildings. Smoke inspection, once a freelance activity nominally under supervision of the commissioner of public safety, already has been made part of the work of the bureau. It is expected that the clerical work now involved in this function will be performed by the bureau's inside men and that eventually plans of power and heating plants, submitted for the smoke inspector's approval, will be handled by the same clerical procedure as are building construction plans.

It does not appear practical under present conditions

to divide inspection of building construction between the state and city agencies. The state industrial code involves some building regulation, but mostly concerns conditions of labor. The city building code goes much farther than the state law in regulating materials, workmanship, etc., but contains no safety legislation to speak of. The obvious move would be to make the city inspectors responsible for features of construction, since they must cover the ground anyway, and to leave safety regulation and working conditions to state authority. Unfortunately the two codes do not agree as to what is safe building construction under the same conditions, and at the present stage of development of building regulation there is litle hope of getting them into agreement. There seems no immediate prospect, therefore, of effective co-operation between these agencies.

### Engineers and Architects

It is customary for building application forms to specify that all work involved in the operation must comply with the requirements of the building code. Beyond this they do not usually go, and the various possibilities of obtaining control of the work through private inspection agencies are not well developed.

In Rochester, at present, and in many other cities, no code requirement or department rule exists to prevent plans for a $100,000 building from being "prepared" and submitted for approval by any carpenter who has the confidence to undertake the project. It is of course easy to dispose of extreme cases of incompetency, but there are large numbers of would-be designers and architects with a commercial bent who are very ready to attempt work beyond their capacity and who often are employed on the basis of their ability to "slip something over" on the building inspectors. Their field inspection of structures for the construction of which they are retained is also very unreliable. Even reputable architects often delegate structural design to steel companies or to other agencies, thereby dispersing still further the responsibility for dependable work.

Under these conditions there is constant friction between the city's inspection force and unreliable designers and architects. In many cases it is necessary to supervise every step of the work if the city authorities are to be certain that the structure complies with the building code.

In order to raise the professional standards obtaining in this line of work; to prevent those insufficiently trained from attempting to handle important or complicated design; and to obtain better control over those on the border line, it is believed that municipal bureaus of building inspection should accept plans and applications only from those who have received licenses to present them. This, of course, would not need to apply to minor structures, such as sheds, garages, etc., costing less than about $1,000.

### Requirements for Licenses

The requirements as to training, qualifications, etc., which should determine the issue of licenses, are a matter of some difficulty, and there is great danger that the control over these would become a political asset in the hands of the chief of building inspection. It probably will be necessary, in order to get the best results from such a system, to provide for two grades, one open to all men licensed under the laws of this or other states to practice as engineers or architects, and the other authorizing men to present plans only for minor structures. To prevent injustice this latter class should be open to all applicants reasonably qualified until such time as they show themselves unreliable either as to details of plans or construction.

The element of control is secured through the authority of the chief of building inspection to revoke a man's license upon clear evidence of such unreliability. In order to prevent arbitrary use of this authority, action should be made dependent on the approval of a board of appeal, such as are becoming customary in connection with the enforcement of building regulations.

### Field Inspection

A good percentage of the larger building operations, and practically all those involving reinforced-concrete construction, need full-time inspection by competent men. It is not reasonable for owners to depend upon municipal inspection to guarantee the safety and structural excellence of such large buildings, and it usually is not possibly for city forces, with their limited facilities, to give such work the attention which it should receive, To ensure compliance with the code and with the plans and specifications approved by the city inspectors, full-time inspectors, paid by the owner and acceptable to the chief of building inspection, should be required on all such work. The city inspectors should keep in touch with these through occasional visits, and any evidence of unreliability on the part of the full-time man should affect his standing on the list acceptable for such work.

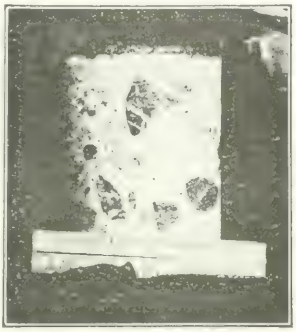
It appears that this method of controlling field work is more easily carried out, and less productive of labor troubles, than the plan, now in force in some places, of licensing contractors or contractors' superintendents. It does not provide in case of trouble for the suspension of work, which punishes the owner as well as the contractor, nor for the removal of an important figure in the work, which also disorganizes things temporarily. It unites the interests of the owner and the city inspection force, which interests really are the same. It puts on the work a full-time well qualified man who has the backing of both the city and the owner, and whose future really depends on the thoroughness of his work. In course of time it builds up a group of men which can give valuable assistance to the city forces in controlling building construction.

### Conclusion

The various methods of centralizing building inspection described in the foregoing have one general effect. They tend to increase the responsibility and authority of the city building inspectors and to further their control of private agencies of a similar nature. It will be urged that politics play too large a part in the personnel and policies of city building inspection agencies and that the measures suggested will but add to the political powers of such units without really effecting the benefits claimed. To a certain extent this probably is true, but it must also be remembered that the same things are true to a much greater extent of the uniformed police force. In spite of this there is a sound and steady tendency to add to the duties and responsibilities of the latter and to hold it accountable for performance. City building inspectors also act under the police power, and it is to the public interest not to disregard the services of which they are capable but to extend their field and increase their effectiveness, at the same time holding them to a greater accountability than at present.

## Portable Diamond Drill Cuts 4½-In. Cores from Concrete Pavement

A DIAMOND drill outfit with a bit cutting a 4½-in. core was recently mounted on a 2-ton motor truck and sent over 1,565 miles of California highway to get samples of the concrete pavement. Samples were taken three miles apart on an average, and were used in analysis of the condition of the concrete made by the United States Bureau of Public Roads. The drill, driven by a gasoline engine was mounted with the bit projecting over one side of the truck so as to be always ready for operation. The equipment complete, including a full 500-gal. water tank weighed 6,300 lb. In making a cut the bit was lowered to the pavement and guided by a wooden clamp consisting of two timbers placed on the road's surface, leveled up with shingles, and held in place by a jackscrew between the timbers and the frame of the truck. Water from the tank was forced down to the cutting edge of the bit to keep the carbons cool and free from cuttings. About 30 gal. of water per cut through a 4-in. pavement was required.



SAMPLE CORE FROM 5-IN. PAVEMENTS

Cuts were made without difficulty through both ½- and ⅜-in. reinforcing steel as well as through ¼-in. wire netting. The chief difficulty in cutting was met in working through cracks in the concrete hidden by the thin layer of asphalt on the surface. The average throughout the work was about eight cores per day. The actual number of cores taken ranged from three to thirty, although at the latter rate it was not possible to make the average distance of 3 miles between cores. When set up ready for drilling, an average of about fifteen minutes was required for cutting through 4 to 6-in. of concrete. Additional weight in the truck would have been of some advantage at times.

DRILLING RIG

The drill was made by the Diamond Drill Contracting Company of Spokane and operated under contract by the Diamond Drilling Co. of San Francisco.

## The Oklahoma City Sewage-Works Problem and Report

### City Will Inform Electorate for Fall Election—Abstract of Report of Consulting Engineers Gives Units

TWO years from Nov. 13, 1920, Oklahoma City, by order of the State Board of Health, must cease polluting the streams into which it discharges its sewage. The plant installed must produce a non-putrescible effluent free from settleable solids, equivalent to that obtained by two-story tanks, aërating beds and secondary sedimentation. To interest as many civic organizations as possible in the solution of the question a sewerage board of nine members was appointed with the personnel selected by the organizations. H. E. Musson, an engineer representing the local chapter of the American Association of Engineers, was made chairman. Dr. J. F. Martin, city health commissioner; H. J. Darcey, state sanitary engineer, and B. M. Hart, city engineer, represented the city and state. The board selected Pearse, Greeley & Hansen, Chicago, as consulting engineers. Their report has been presented (see *Engineering News-Record*, p. 877, May 19), adopted by the board, presented to and accepted by the city commissioners. It is proposed to inform the people of the plan this summer before calling for a vote on the necessary bonds this fall. Briefly, the recommended system consists of an intercepting sewer of 60-m.g.d. capacity with sewage-works of 12.5 m.g.d. discharging into the North Canadian River to handle the combined domestic sewage and industrial wastes of the main city and packing house district, and a small system for domestic sewage only, discharging into Deep Fork, dry much of the time. For both districts settling tanks and sprinkling filters are recommended. Activated sludge was considered, but largely because of the high cost of maintenance that process was not advised. Estimates for eliminating the industrial wastes from the sewage were also presented.

Some of the assumptions made in in the report follow: Ten years hence, the period for which the designs were made, the population connected with the sewers will be 128,800; 111,300 in the North Canadian District and 17,500 in the Deep Fork area. A daily per capita rate of sewage flow of 50 gal. was estimated during dry seasons and 90 gal. during wet seasons. The stockyards waste will increase these figures to 74 and 125 gal., respectively.

In the estimates for ground water infiltration, gagings indicated 110 gal. per acre daily, equivalent to 22 gal. per capita, but this figure was increased in the light of data obtained from other cities. As a result of gaging and computations the mean in Toledo, Ohio, was 777 gal. per acre daily with a maximum of 1,200 gal. during spring conditions. At Decatur, Ill., an average of 400 gal. was found during wet weather. In Cincinnati, H. P. Eddy recommended 750 gal. Gagings in Milwaukee led to a decision to use 1,620 gal. as a maximum. At Fitchburg, Mass., Metcalf & Eddy used 139 gal.

PER CAPITA WET AND DRY SEASON FLOW COMPARED

| City | Wet Season, Gal. | Dry Season, Gal. | Ratio Wet to Dry Season |
|---|---|---|---|
| Bloomington, Ill. (5) | 167 | 84 | 2.0 |
| Decatur, Ill. (3) | 150 | 97 | 1.5 |
| Toledo, Ohio (2) | 146 | 106 | 1.4 |
| Boston, Mass. (3) | 151 | 89 | 1.7 |
| Framingham, Mass. (4) | 78 | 53 | 1.5 |
| Oklahoma City (1) | 68 | 45 | 1.5 |
| Deep Fork as gaged | 68 | 45 | 1.5 |
| Deep Fork as allowed | 90 | 50 | 1.8 |
| Intercepting sewer | 150 | 90 | 1.7 |

(1) From gagings by Pearse, Greeley & Hansen.
(2) From Report on Elimination of Sewage from Toledo's Waterways.
(3) North Metropolitan Sewer District Data from Metcalf & Eddy.
(4) Massachusetts State Board of Health.
(5) Data from Folsom and Taylor.

Sizes of the treatment plant were based on the following plant loadings: Fine screens of 20-mesh are needed as a preliminary to activated-sludge tanks. Imhoff tanks for domestic sewage should have a 3-hr. settling period, a sludge

capacity of 1.75 cu.ft. per capita and gas vents covering 20 per cent of the tank surface. For the mixed domestic and industrial sewage the settling period would be 2 hr., the sludge capacity 6.5 cu.yd. per million gallons, with gas vents of 25 per cent of tank surface. For Dorr type sedimentation tanks the rating allowed was 500 gal. per square foot of tank surface. This figure is one-half that claimed by the manufacturers.

Sprinkling filters 6.5 ft. deep were recommended, but additional figures were given for 6, 8 and 10-ft. filters. The load allowed per foot of depth is 3,000 people for the Deep Fork purely domestic sewage, 2,500 people for the domestic sewage alone in the intercepting sewer and 1,500 people with Packingtown sewage added. This makes the plant sizes 0.9, 7.0 and 11.5 acres respectively.

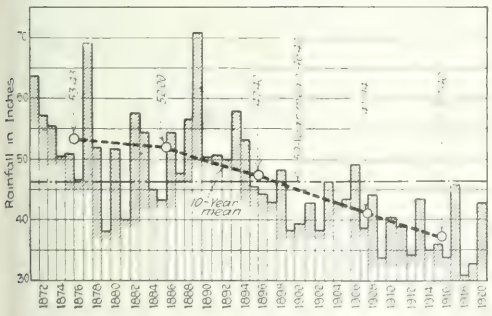
Air requirements in the activated-sludge process are 1.5 cu.ft. per gallon and 5 hr. aëration for the domestic sewage during the dry season, with half the air and 3 hr. aëration for the wet period. For the mixed sewage 3 cu.ft. of air and 8 hr. aëration are allowed, while the Packingtown sewage alone will require 4 cu.ft. of air and 12 hr. aëration.

To dispose of the sludge for the activated-sludge process lagooning was recommended only for the time being. The cost of dewatering was estimated to exceed the market value of the product based on its nitrogen content. The cost of operating dryers and presses is estimated at from $2.10 to $4.50 per unit of ammonia. Coal was taken at $6.80 per ton and power at 1¾c. per kilowatt-hour.

## Fifty-Year Rainfall Record, Norfolk, Va.

By Ellis B. Noyes
Portsmouth, Va.

THE accompanying table and diagram show the rainfall at Norfolk, Va., for 50 years, as given by the U. S. Weather Bureau. Taking ten-year means there has been a continuous decrease in the amount of rainfall for the whole period amounting to about one-third inch per year. In the last 25 years there have been only two years in which the rainfall exceeded the mean for the fifty years. I have no theory to account for this steady decrease, and it was only by accident that I discovered the facts while using the reports for an independent investigation.




RAINFALL RECORD AT NORFOLK, 1871–1920

| Year | Inches | Year | Inches | Year | Inches |
|---|---|---|---|---|---|
| 1871 | 63 25 | 1888 | 56.64 | 1905 | 43 29 |
| 1872 | 57 04 | 1889 | 70.72 | 1906 | 49 23 |
| 1873 | 55 43 | 1890 | 50 22 | 1907 | 38 72 |
| 1874 | 50 41 | 1891 | 50 63 | 1908 | 44 25 |
| 1875 | 50 96 | 1892 | 49 24 | 1909 | 33 78 |
| 1876 | 46 54 | 1893 | 57 90 | 1910 | 40 35 |
| 1877 | 69 14 | 1894 | 53 09 | 1911 | 38 95 |
| 1878 | 51 87 | 1895 | 45 41 | 1912 | 34 37 |
| 1879 | 38 08 | 1896 | 44 22 | 1913 | 43 37 |
| 1880 | 51 53 | 1897 | 42 66 | 1914 | 35 05 |
| 1881 | 40 06 | 1898 | 53 14 | 1915 | 36 12 |
| 1882 | 57 67 | 1899 | 38 41 | 1916 | 33 83 |
| 1883 | 54 30 | 1900 | 39 34 | 1917 | 45 63 |
| 1884 | 45 05 | 1901 | 42 61 | 1918 | 30 90 |
| 1885 | 43 25 | 1902 | 38 48 | 1919 | 32 89 |
| 1886 | 54 33 | 1903 | 46 10 | 1920 | 42 91 |
| 1887 | 47 74 | 1904 | 42 60 | | |

A similar diagram of the rainfall at Cape Henry corroborates the showing of that at Norfolk, while one for Richmond indicates that the causes effective at Norfolk and Cape Henry are not acting at Richmond. Cape Henry is on the shore of the Atlantic Ocean. Norfolk is about 20 miles inland from Cape Henry, and about 12 miles south of the lower end of Chesapeake Bay. Richmond is about 90 miles inland from Norfolk. The difference between the first and last ten-year mean is about 25 in. decrease at Cape Henry, 16 in. decrease at Norfolk, and at Richmond 3 in. increase.

## Wyoming and Reclamation Service Co-operative Investigations

### Joint Report of the North Platte Valley Water Resources Passed Upon by Board of Review Now Ready for Final Acceptance

WYOMING and the U. S. Reclamation Service have been making a co-operative investigation of the possibility and feasibility of future reclamation of arid lands in the North Platte valley in Wyoming. The surveys and investigations made jointly have recently been passed upon by a Board of Review and the conclusions of the latter are now before the governor of Wyoming and Secretary of the Interior for signature. The investigation grew out of the fact that Wyoming has felt aggrieved at the policies of the Reclamation Service. The State had granted the right of water to the Pathfinder dam, conditioned, it claimed, on the use of a certain amount of that water in Wyoming on certain lands mentioned in the state permit. Wyoming alleged that this privilege was used to store water, to run water through Wyoming to Nebraska lands, even preventing, through this diversion and through the control of public lands over which new canals must be built, the development of Wyoming in the North Platte Valley. The report is important in that it involves an interstate controversy and a settlement, if the conclusions of the board are accepted, is likely to be made in accordance with the peaceful plan outlined by R. I. Meeker, in *Engineering News-Record*, Jan. 27, p. 157.

The conclusions reached are as follows:

(1) The North Platte River affords a sufficient water supply for the irrigation of the arable lands in the valley that are likely to be developed, provided the available reservoir sites are utilized for storage and all the water available is used to good economic advantage.

(2) Further irrigation development in Colorado and Wyoming need not be restricted.

(3) Further development, and assured water supply for lands now under irrigation, below the North Platte project, depend upon the construction of reservoirs at the Guernsey, Keystone, Lisco or other feasible sites which will conserve an adequate portion of the water now going to waste annually on account of lack of storage and regulation.

(4) The area of land in Wyoming, not now irrigated nor having vested rights that is susceptible of reclamation from the North Platte River and its tributaries, is limited by physical and economic conditions and seems not to exceed about 300,000 acres. Development will undoubtedly proceed slowly, but the lands should be included in any general consideration of the development of the entire North Platte valley.

(5) The same is true of about 70,000 acres of land in North Park, Col. These areas are in addition to 30,000 acres having vested rights.

(6) There are several good power sites on the North Platte River, the development of which, on a large scale, must await the development of suitable markets.

In the discussion of the conclusion as to the sufficiency of the water supply many broad assumptions were made. The question of consumptive use, canal losses, return flow, river losses and the difficulty of closely controlling storage release are more or less indeterminate and the board avowedly leaned toward the side of safety. Some of the assumptions are as follows:

The diversion assumed for the 260,000 acres included in the North Platte Project is 3 acre-feet per acre made up of 1.7-ft. consumptive use and 1.3-ft. loss. This loss corresponds in percentage with the results of measurements on the Interstate Unit during the past seven years which indicate an average loss from canals and laterals of 44 per cent of the quantity diverted. The maximum quantity of water delivered to the land in any year was 2.92 ft. in 1914. With a loss of 44 per cent, this gives a diversion of 5.2 ft. The minimum quantity delivered to the land in any year was 1.38 ft. in 1915, which on a similar loss basis corresponds to a diversion of 2.5 ft. Actually the diversion in that year was 3.3 ft., the losses having been reported as 66 per cent, which is very much greater than has been reported for any other year.

### Quantity Affected by Rainfall

With a diversion duty of 3 ft. and a canal loss of 44 per cent, the quantity available for consumptive use is 1.68 ft. per acre, which is 75 per cent as much as the average past use on the Interstate Unit, 22 per cent more than the minimum past use and 57 per cent as much as the maximum past use. Such quantity appears to be entirely sufficient, especially in view of the fact that the rainfall during the irrigation season averages 12 in. and has a minimum of 6 in.

Moreover, general experience in this and other countries shows a decided tendency for a decrease with time in the amount of water required. This comes as a consequence of filling in the subsoil so that the portion thus consumed is lessened or eliminated; to the increased smoothing of the surface of the fields, so that the large amount of waste in distribution due to a rough and uneven surface is lessened; to the increased skill of irrigators and their greater familiarity with the economical ways of distributing water on their own land and to community knowledge gained from experience that less water is needed for best agricultural purposes than is usually considered necessary.

Under conditions quite similar to the North Platte valley, as the neighboring South Platte valley in Colorado, and notably in the valley of the Poudre, a tributary of the South Platte, where experience and records extend over a number of years, it has been found that the actual amount diverted from the stream has materially decreased. Where formerly 3 to 5 ft. of water were diverted, now the average is only from 1.25 to 1.5 ft. and this is found sufficient.

Further examination of the North Platte valley shows a great amount of seepage or return waters already in evidence.

The conclusion that the water supply of the North Platte River is sufficient for the development of the entire valley is based on the broad theory that the water supply will ultimately be used to the best economic advantage and for the greatest benefit of all the users; that occasional shortage in the water supply amounting to even 25 per cent or 30 per cent of the normal use are likely to prove beneficial rather than harmful in their ultimate effect and should therefore not cause concern; that the use of water must and will adjust itself to the quantity available and that less and less water will be used as time goes on and additional lands are brought under irrigation, not only because less water will be available but because it will be found that less water is needed to raise crops.

The board held that these theories could not be accepted in a case of small area on a small stream but where hundreds of thousands of acres extending along a river for a distance of 800 miles, are to be supplied by such river having an annual run-off of 2,000,000 acre-feet the dangers of disastrous shortage are so remote as to be no cause for concern, provided good engineering judgment has directed the developments.

### Future Policies

The recommendations as to future policies which the United States and Wyoming should follow according to the report are as follows:

(1) That such restrictions as have been placed on irrigation development in Colorado and Wyoming in the past on the supposition that there was an insufficient supply of water be removed. These include the refusal to grant rights of way for ditches and reservoirs on public lands; rejection of desert land entries and failure to act on Carey Act segregations.

(2) That no obstacles be placed in the way of irrigation development in any section of the North Platte valley.

(3) That development by private enterprise be permitted to proceed without artificial restrictions. The natural conditions of the valley provide such limitations that the amount of development is not apt to exceed the water supply.

(4) That no more water be sold from Pathfinder reservoir for diversion below the Whalen dam.

(5) That the proposed dam across the North Platte River near Guernsey, Wyo., be built by the United States at as early a date as possible, as a means of further conserving the water of the North Platte and as a valuable aid in the regulation, distribution and economical use of those waters. This appears to be the most logical next step in the irrigation development of the North Platte valley.

(6) That encouragement be given to development in Nebraska by construction of reservoirs in the lower valley, thus conserving the large run-off below Pathfinder that is now unused.

(7) That the Department of the Interior should expedite action on matters referring to Carey Act projects so that settlers and the state will not be discouraged by delay from carrying out the proposed development.

(8) That both the State and the Federal Governments continue to collect data in regard to stream flow, return flow and other gains and losses of the North Platte River and its tributaries.

(9) That the State and Federal Governments assist the various interests along the river, when solicited, in obtaining accurate information relative to dam and reservoir sites and other information needed for a full knowledge of the situation.

(10) That likewise, in regard to the development of power sites the State and Federal Governments give encouragement by furnishing such facts as may be available and removing obstacles that may prevent their development. The willingness of responsible parties to develop such enterprises is to a great extent an indication of their desirability

(11) The board feels strongly that it would be very unfortunate and decidedly subversive of the best interests of all concerned, if the numerous questions, admittedly vexatious and difficult of solution, could not be disposed of by amicable negotiation and co-operation. Conferences and co-operative effort should therefore be encouraged. If there can be a free exchange of views and discussion of problems by the various parties in interest, misunderstandings and serious differences will be lessened and ultimately removed.

The personnel of the Board of Review included L. G. Carpenter, consulting engineer, chairman, chosen by the other two members; Frank C. Emerson, state engineer of Wyoming, selected by the state, and E. A. Moritz, engineer, selected by the U. S. Reclamation Service. The original joint surveys and investigations were made jointly by Harold Conkling, engineer, U. S. Reclamation Service, and Ralph I. Meeker, an engineer representing the State of Wyoming.

# German Concrete Houses Poured To Full Height in One Operation

*(Berlin Correspondence)*

A NOVEL method of constructing concrete buildings has been developed in Germany. According to the claims of the patent applied for, the basic principle of the method is the molding of complete houses with lean slag concrete, poured in at the highest point of the erected forms. Forms are made in standard parts from wood, and can be used up to twelve times. They can be erected either for the whole building, or in sections of from one to two floors.

The mechanical qualities of the concrete thus obtained have been made the subject of extensive tests by the material-testing institute in Berlin—Dahlem. A section of 35 m. length has been cut out from a wall

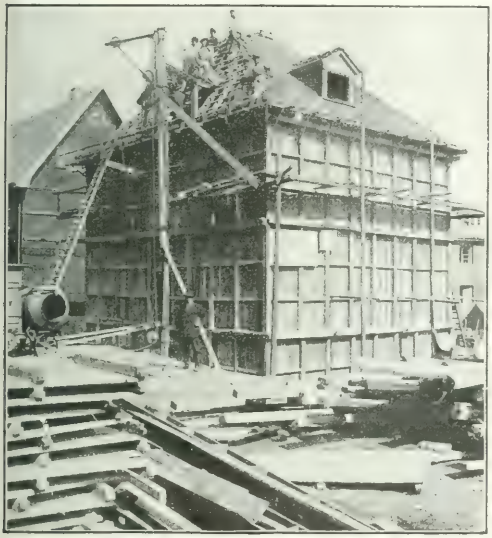


FIG. 1. FORMS PLACED FOR POURING WALLS TO FILL TWO-STORY HEIGHT

FIG. 2. COMPLETED HOUSE—SAME OPERATION AS SHOWN IN FIG. 1

made by the process, with concrete consisting of 1 part portland cement, 5 parts gravel, and 7 parts coarse boiler slag, the parts being measured by volume. After three months' hardening a compressive strength of 94 kg. per sq.cm. (2,000 lb. per sq.in.) has been developed. An even poorer mixture used in a building near Berlin, consisting of 1 part cement, 6 parts sand, and 14 parts slag, has been tested, and was found to possess sufficient compressive strength for a two-floor building.

The erection of the forms, the molding, and the removal of the forms for one four-family house of two stories has occupied twelve to thirteen days, including six days for the setting. Nineteen workmen were employed on this building for six to seven days. The walls of thickness of 35 cm. dried in a few weeks, on account of the porous structure of the concrete, after which time the walls were coated on the inside and the outside surface.

The concrete of this mixture is a bad conductor of heat, and therefore keeps the rooms warm. It is further claimed that nails can be driven in without using dowels, and that it is soft under the chisel, which facilitates plumbing work.

The costs for a building of the size mentioned are around 40 per cent below those of a brick building of corresponding size.

# Regional Surveys in Relation to Municipal Planning

## Industrial Areas, Agricultural Valleys and Mining Centers Need Survey Before Planning Can Be Undertaken

LARGE cities are overflowing their boundaries and are surrounded by satellite towns and scattered suburbs outside their areas. The regions in which these cities and their satellite communities are situated have, in addition to the local problems of each separate municipal unit within the region, a number of important problems which can only be effectively studied and dealt with as regional and not as city or town problems. That is particularly true of the location of industries, the planning of main roads and railway arteries, and the designing of park and sewer systems. Thomas Adams, city planning adviser, Ottawa, made the above statement in a paper presented at the annual meeting of the American Society for Municipal Improvements. The special problems involved he stated are as follows:

In addition to metropolitan districts surrounding large industrial centers, there are valleys, like the Boise Valley in Idaho, where a number of towns are scattered throughout a fertile farming region which need to be planned as a whole. The development of the separate communities in the Boise Valley depends largely on the development of the system of transportation by rail and road, and the utilization of water for power and irrigation for the whole valley.

In territory where there are mining operations, the need of the regional plan is perhaps most evident because the specially scattered nature of such operations results in the

growth of a series of small towns or villages around the pit-heads, with probably one or two main commercial or business centers in the neighborhood.

In all such cases the following problems need regional consideration and treatment:

1. Control of overflow of population from the main center following industrial expansion along railway and rivers, or taking the form of new residential suburbs.

2. Design and development of main arterial system of roads radiating from central districts to adjacent towns and rural areas or forming connecting highways between the radiating highways and coming under the jurisdiction of several municipal councils.

3. Planning extension of railway and other transportation facilities, with their terminals and stations, in relation to the growth of industries and population and the topographical conditions.

4. Planning and acquisition of parks and parkways so as to form a comprehensive system for the complete district.

5. Making the zoning plan to control height, use and lot occupancy effective over an area sufficiently wide to prevent bad beginnings of development in the unbuilt suburbs and to be sure that the progressive action of one municipal council will not be made ineffective by the lack of control outside its boundaries.

6. Planning of comprehensive sewage treatment, water supply and power developments where topographical or industrial conditions make united action of adjacent municipal councils desirable or even necessary for economy and efficiency.

No proper plan can be prepared as a guide for future development until a map or series of maps are prepared after a survey showing the existing development and, in the case of uneven country, the levels of the land.

The first object must be the promotion of industrial efficiency, since the city or district depends on its industries. Another main object must be the development of healthy housing conditions, since industrial success which is achieved at the expense of the health and strength of character of the people can only be temporary so far as the industries themselves are concerned, and can only lead to decay so far as the nation is concerned. Housing conditions mean not only homes but their environment, the protection of their surroundings, the development of recreation facilities near the homes, the provision of water supply, sewerage and facilities for transit.

The first need is an accurate topographical map showing the whole natural and structural characteristics of the area as well as the levels of the land. The minimum scale should be 200 ft. to 1 in. and the contour intervals 5 ft. Most cities in America are bady equipped in regard to maps. The cost of preparing them is considerable and may be estimated at from $1.50 to $2 per acre. Where practical this topographical map should be supplemented by an aerial photographic map, the probable cost of which would be $200 to $300 per square mile. Oblique photographs of important areas should also be taken from the air.

The topographical maps being prepared, accurate information should be indicated on a series of prints of these maps. For regional areas this information should comprise the following particulars: (1) Industrial development, including the arrangement and classification of all lands and the location and distribution of manufacturing plants. (2) Economic use and regulation of the subdivision of land and the character and density of structures in rural and urban areas. (3) Housing, sanitation, convenience and amenity. (4) Railways and transportation. (5) Highways. (6) Waterways. (7) Sources and distribution of power. (8) Water supplies and sewerage. (9) Civic art, including parks and boulevards.

### Public Health Department for Australia

A Department of Public Health for Australia has been created. According to *Public Health Reports*, the new department will investigate all manner of diseases, have control of laboratories, and of the Australian Institute of Tropical Medicine.

## Proposes New Rail Specification as Compromise Measure

### Robert W. Hunt Aims at Better Rails—Top or "A" Rails May Be Rolled Into Tie Plates—No High Limit for Carbon

IN AN endeavor to effect needed improvements in rail manufacture and to offset the hostility of rail makers to the specifications drafted by the rail committee of the American Railway Engineering Association (see *Engineering News-Record*, March 24, 1921, p. 515), revised specifications have been prepared by Robert W. Hunt, consulting engineer, Chicago, and submitted by him to a long list of engineers, railway officers, rail manufacturers and others interested in the rail problem.

Safety or freedom from fracture, rather than freedom from wear, is the feature chiefly desired at the present time according to Mr. Hunt, who considers that there is little if any dissatisfaction with the wear of open-hearth rails. On the other hand, the railways feel that they are not obtaining rails which will give good life under ordinary conditions and will also be free from failures. To quote Mr. Hunt's statement: "In addition to the annoyance and expense caused by defective rails which have to be removed from the track after comparatively little service, the anxiety and menace to life caused by actual broken rails is very great. Head failures in rails rolled from metal forming the tops of the ingots are apparently on the increase, and internal fissures constitute a defect most dangerous and deserving of the fullest study."

#### Tie Plates Rolled from Top Metal

*Control of "A" Rails*—That each ingot is a unit and should be tested and treated as such has been contended for several years by Mr. Hunt, who for this reason has strongly recommended the nick-and-break test for every ingot, as proposed by him in January, 1912. He states that for the past six years this test has been employed for practically all rails made in Canada, but that it has not been given a thorough trial in this country because American rail manufacturers would not permit it. As an alternative, therefore, his new specification provides for the elimination of rails made from the top of the ingot (known as A rails), if the manufacturer so elects, by rolling these rails into tie plates which will be accepted by the purchaser. The clause covering this plan is as follows:

> In case the manufacturer elects after due notice, the purchaser agrees to accept hot sheared, punched and annealed tie-plates rolled from the steel that, in the ordinary course of the manufacturer's practice, would be rolled into "A" or top rails from the ingots cast under this specification. It is understood that such tie-plates shall be in accordance with purchaser's drawings and specifications.

*Chemical Composition*—Elimination of a high point or maximum for both carbon and manganese is another feature of the new specifications, which provide only for a minimum of 0.60 per cent in each case. It is held that excess of these elements is highly improbable, as rail makers seek to avoid it. Further, it is considered that in controlling the chemical composition it will be much easier to keep the content above a specified minimum than to keep it between maximum and minimum limits. There is also a minimum limit of 0.10 per cent for silicon and a maximum limit of 0.04 for phosphorous. Rails rolled from heats containing

more than 0.75 per cent carbon, but not more than 0.9 per cent manganese and 0.03 per cent phosphorous, are to have the flanges near the ends painted yellow. These rails also would be shipped separately.

*Destruction and Drop Tests*—A destruction test, supplementary to the drop test, is included in the new specifications, as given below, but this is waived when a top discard of not less than 20 per cent is made on all ingots from which rails are offered for test and inspection. New regulations are included also for the drop tests as follows:

Drop Tests (10).—If two of the test pieces do not break at the first blow, all of the rails of the heat shall be accepted, subject to the requirements of Section 11. If two of the test pieces break at the first blow, all of the top rails of that heat shall be rejected. Second tests shall then be made from three test pieces selected by the inspector from the bottom end of the top rails of the same heat and ingots. If two of these test pieces do not break at the first blow, all of the remainder of the rails of the heat shall be accepted, subject to the requirements of Section 11. If two of these test pieces break at the first blow, all of the second rails of the heat shall be rejected.

Third tests shall then be made from three test pieces selected by the inspector from the bottom end of the second rails of the same heat and ingots. If two of these test pieces do not break at the first blow, all of the remainder of the rails of the heat shall be accepted. If two of these test pieces break at the first blow, all of the remainder of the rails of that heat shall be rejected. If two of these test pieces break at the first blow, all of the remainder of the rails of that heat shall be rejected.

PROGRESSIVE TESTING

Destruction Tests (11).—A test piece representing the top end of the top rail from each ingot of each heat rolled, which has passed the drop test requirements of Section 10, shall be nicked and broken to determine whether the interior metal is sound. If an interior defect shows on the fracture, the top rail of the ingot represented shall be rejected and a second test piece cut from its bottom end shall be nicked and broken to determine the character of the metal of the second rail. If an interior defect shows on the fracture, the second rail shall be rejected and a third piece cut from its bottom end for retesting. Thus the rails of each ingot shall be tested progressively from the top downward until the fracture shows sound metal, following which the rails of the ingot represented shall be accepted. An interior defect is interpreted to mean seams, laminations, cavities or interposed foreign matter, or a distinctly bright or fine-grained structure in the center of the section evidencing segregation, made visible by the destruction tests, the saws or the drills.

*Milling and Straightening*—Milling the rail ends is a new requirement proposed by Mr. Hunt, who also provides for reducing the amount of cold straightening. From his experience covering a number of years he believes that the cold straightening of rails can be minimized and in some cases eliminated without detriment to the track conditions, and with a saving to the manufacturers which would more than cover the cost of milling the ends square and free from burrs. After the usual requirement that "hot straightening shall be done carefully, so that gagging under the cold presses will be reduced to a minimum," there is a new clause:

All rails shall be smooth on the heads, without rough crescent-shaped marks, and the bases shall be free from guide marks and scratches. They shall be milled square on both ends, but a variation of $\frac{1}{32}$ in. in a vertical direction to make head-long rails will be permitted. All rails shall be free from twists; waves, kinks or short bends, but rails containing a uniform sweep, the middle ordinate of which does not exceed 1 in. in 33 ft., will be accepted without cold straightening.

As to fissures, Mr. Hunt believes that better attention to soaking pit practice and restriction of the cold straightening will afford relief ultimately from the development of internal fissures. In concluding his statement which accompanies the new specification he points out that the specification is not offered as the best that can be prepared, but with the thought that it "may help to compose the difference existing between the rail makers and rail users, and to afford thereby a groundwork for a common standard which will insure good safe rails at the base price."

## Concrete Blocks Mark Cross-Walks

BY JAMES S. SHEEHY
Portland, Ore.

CONCRETE BLOCKS for marking cross-walks at street intersections have proved so successful in Portland that the city may use them in future to mark safety zones throughout the downtown business district. The blocks are 2 ft. long and 6 x 6 in. in cross-section. They are precast and made of portland cement, sand and gravel. The lower part or main body of the block consists of a 1:2:4 mixture. The top half inch is made of

PORTLAND CROSSINGS MARKED WITH CONCRETE BLOCKS

Medusa or white cement in proportions of one-half cement and one-half sand.

The blocks were made for the city of Portland, by the Concrete Pipe Co. and to get smooth surface they were cast face downward. The bottom of the form is a piece of celluloid slightly curved so that when the block is inverted the top will have the proper crown.

The pavement has to be cut to a depth about $\frac{1}{2}$ in. greater than the block itself when the blocks are placed. Underneath and along the sides, with the exception of the top inch, is placed a cushion of 1:2 dry cement-sand mortar. The blocks are then set and the upper inch of the space around each block is filled with Sarco putty, an asphaltic compound.

During the past eight years the city of Portland has painted each summer traffic strips in the downtown section amounting to 15,000 lin. ft. The accumulated cost of painting and repainting has amounted to about $2 a lineal foot. The paint is readily worn away by traffic and washed off by city street cleaning flushers. Engineers of the city believe that the concrete block will outlast the pavement. Each block costs $1 to manufacture. The total cost of the block, cutting, pavement, setting, truck work and material is $4.17 per block. Figuring 56 blocks at each intersection and 288 lin. ft of line marked the cost is 80c. per linear foot of line.

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## The German Settlement

Sir—The recent editorial in *Engineering News-Record* (May 19, page 837, entitled "The German Settlement"), seems to me to lack in a couple of sentences its own term, "fair mindedness." It appears to show a lack of appreciation that it was France, not Britain nor America that suffered the wilful devastation of the Hun and that, therefore, there is no good reason why fair-minded people of France as well as those of America and Great Britain should be inclined to leniency toward the German until he has paid his debts, even if the making good in part of the mischief he has done, should be "a detriment to Germany's necessary financial and commercial relations with the rest of the world." Should it take a generation of German work to pay the reduced terms now asked by the Allies, can fair-minded people say that justice requires less, or that the principal victims of German aggression should not have at least as much after-war sympathy as the nation that deliberately planned a war of conquest, whose entire cost was to be assessed on its victims, ourselves included?

There seems everywhere plenty of the spirit of fair-mindedness for our enemies. Let us still preserve it for our friends. HENRY WELLES DURHAM.

Lima, Peru, June 27, 1921.

## Mutuality of Interest Between Owner and Contractor

Sir—The writer has read, with interest, the article appearing on page 1109 of the June 30 issue, entitled, "Ethical and Practical Considerations Regarding the Engineering Corporation," and believes that the thought expressed near the top of the second column of that page with reference to the oppositeness of interest of owner and contractor is responsible for much, if not all, of the lack of harmony and co-operation between engineers and architects and contractors.

If the engineer and architect would take the stand that the interests of the owner and contractor were identical and not opposite, and if they would write their specifications and contracts, and after they were written interpret them in a way which would give the contractor a "square deal," the architect and engineer would have enough to do in attending to and supervising their part of the work without encroaching on the field of the contractor.

For example. It is usual to order the structural steel work of a building in advance so as to insure that it will be on hand when wanted. Very often the foundations are not ready, and as the shop has no facilities for storing, it is shipped and the contractor must arrange for handling and storing the entire tonnage with the increased cost incidental thereto. The engineer or architect insists always that the contractor must absorb this cost, although if the contract were being handled by the engineer on the basis of the "larger stipulated fee" mentioned the owner would not only pay this extra cost but the "larger stipulated fee" on this cost as well.

Architects and engineers many times let the contract before the plans and specifications have been completed, and are continually making changes and additions which materially increase the cost. If the work is handled by the engineer or architect directly, the owner pays for these additional costs, plus the "larger stipulated fee," but if the contractor after indulging in the keenest of competitions for the contract, dares to open his mouth to ask for the additional compensation, to which in all fairness he should be entitled, he is told that "a contract is a contract and that was a contractor's risk" and all sorts of similar tommyrot.

When architects and engineers get out of their heads the narrow wooden idea that the owners' and the contractors' interests are opposite, and act upon the theory that they are identical, the owner will get cheaper and better construction, the architect and engineer will receive a fair and just fee (not the larger stipulated fee), and the contractor will earn the living to which a lifetime spent in a highly specialized business entitles him.

Is it not barely possible that the contractor, having been purchasing supplies and handling labor all his life, may be able to so conduct the work that he can make a profit at the *cost* of the work done under the so-called administration plan and save the owner "the larger stipulated fee?"

There are many engineers and architects who believe and act on the "live and let live" Golden-Rule principle, and these men never have the trouble spoken of in the article, but receive the co-operation and support which comes from a correct understanding of what constitutes a *mutuality*, not an opposition of interest. E. HAUPT.

Chicago, July 21, 1921.

## What Is a Profession?

Sir—I have read with interest your articles in *Engineering News-Record* of July 7, entitled "What Is a Profession?" and "the Builders' Code."

"Profession," according to the dictionary, is an occupation that involves a liberal education, and mental rather than manual labor.

A professional man is one whose stock in trade is knowledge and who has nothing to sell but that knowledge. The lawyer sells knowledge of law; the clergyman sells knowledge of religion; the doctor sells knowledge of medicine; the engineer sells knowledge of engineering science. None of these has any stock other than that which he carries around in his head.

When the doctor opens a drug store and devotes his time to selling drugs, instead of his knowledge of them, he ceases to be a professional man and becomes a merchant. When the engineer goes into the contracting game and devotes his time to selling materials and to the actual work of construction, he ceases to be a professional man and becomes a contractor.

If the contractor is a professional man, then so is any other manufacturer a professional man. As the automobile maker makes cars of materials and labor, just so does the contractor make bridges and buildings of materials and labor. They are manufacturers but are in no sense of the word professional men. The designers of the cars, the bridges and the buildings are professional men. SUBSCRIBER.

Memphis, Tenn., July 13, 1921.

## Designing Data on Japanese Wireless Tower

Sir—Your article "Concrete Wireless Tower 672 Ft. High in Japan," May 19, 1921, p. 847, is not correct in some points. The design was almost entirely in the hands of Professor Ksama, under my own general direction. Assistant Professor Nagayama contributed in the design of the top frame work and some minor details, while the Oriental Compressol Co. (a Japanese firm) assisted us in making some drawings. The specifications for the execution of work were prepared by me, but they were modified more or less by the Department of Communications. The execution of work was undertaken by the above-mentioned firm, under the superintendence of the Department of Communications. Mr. Nagayama helped this superintendence, while Mr. Ksama and I took no part.

The principal data for the design of the structure are: (1) The force due to the antennæ was taken at 25,000 lb., acting horizontally at the top of the tower in the same direction as the wind. (2) The wind pressure on a plane area was taken at 60 lb. per square foot at the ground level, and 126 lb. per square foot at the top, changing uniformly between these two extremes, while the coefficient of reduction for the projected area of the shaft was taken at two-thirds. (3) Weight of reinforced concrete 150 lb. per cubic foot; weight of earth 100 lb. per cubic foot. (4) Allowable compressive strength of concrete, 650 lb. per square inch; shear-

ing strength of concrete, 50 lb. per square inch, and tensile strength of steel, 22,000 lb. per square inch. The maximum calculated pressure on soil was 9,450 lb. per square foot. The center of pressure lies outside of the core of the base by 0.14 ft. (5) Maximum seismic horizontal acceleration 948 mm. per second.

No change of temperature was ever considered. I designed no part of the structure according to the patented system of the Weber Chimney Co. I don't know what that system of designing is. K. SHIBATA,

Professor, Tokyo Imperial University, Japan.

Tokyo, Japan, June 30.

## Freight Rates as a Deterrent to Construction

Sir—Referring to the item from the Common Brick Manufacturers in *Engineering News-Record* of June 9, p. 1013, I wish to comment on the concluding paragraph therein which starts off with the following:

"Freight rates continue to be the greatest handicap in the way of construction, . . ."

This is manifestly an erroneous statement. For instance, common brick in the city of New York come down by barge and the railroad freight rates have no effect whatever on this traffic.

Lumber from the Pacific Coast is moving into New York by water and the rail freight rates are not a consideration.

Cement is manufactured so near New York that the freight rate is only an incidental matter.

Furthermore, the carriers held an extended session with the building material men and subsequently issued a statement. I was present at the conference and I can say that nothing was presented by the building material representatives which justifies any reduction in the railroad freight rates.

Would it not be advisable for a publication of the high standing of the *Engineering News-Record* to safeguard carefully the news columns against statements which may have a very disturbing effect upon the general business of the country. T. C. POWELL,

New York, July 7. Vice-President Erie R.R. Co.

[A copy of Mr. Powell's letter was sent to the Common Brick Manufacturers Association, publisher of the digest referred to, and the secretary has replied as follows.—EDITOR.]

Sir—The common brick industry was not a party to what is called "the big freight rate case," now before the I. C. C. For this reason we were not notified of the hearing with the railway executives at Washington mentioned by Mr. Powell. I understand that the first hearing dealt largely with road-building materials and that an effort was made to hold a subsequent meeting at which all the construction interests might be represented. To prepare for this proposed meeting I sent a questionnaire to twenty-five typical plants in scattered centers throughout the Middle West, East and Southeast. The hearing was too near at hand to permit of receiving replies from the Far West. Upon information received in these questionnaires and upon our correspondence with members, contractors and architects over a period of many months, the statements in our digest are based. The report referred to by Mr. Powell is the version of the carriers only and not an official report of this hearing.

The statements in Mr. Powell's letter refer mainly to New York City, while our digest covers the whole country. New York is not the largest brick producing center, plays only a small part in the national situation, and does not enter to this controversy to any extent. It is true that most of this brick is carried on river barges.

Here are some of the questions asked and answers received:

1. "What proportion of your delivered-on-the-job price of brick today goes to pay for freight on fuel and freight on bricks?" Answers showed percentages from 15 per cent to 75 per cent; average 32 per cent.

2. "In percentage, what has been the greatest increase since 1915 in freight rate on brick from your plant to any principal market?" Answers from 60 per cent to 504 per cent! average 193 per cent.

3. "Would lower freight rates on brick and other building materials (say a reduction of 25 per cent), stimulate building in your market?" Two answered no; one of these stated he delivers entirely by truck; the other was so situated that his increase in rates was only 60 per cent. All others emphatically state that reduction of freight rates would stimulate building. Several reported their plants closed because the price of brick plus freight was prohibitive in their principal markets. Many expressed the opinion that 25 per cent was not a sufficient reduction.

General Order 28, imposed during the war, placed an arbitrary freight increase of 2c. per 100 lb. on brick. It was explained that this was frankly intended to discourage brick manufacture and shipment to favor direct war needs. This increase has never been taken off. When the I. C. C. granted the increase of rates from 25 per cent to 40 per cent, this was on top of General Order 28. Here are some of the specific results of these increases:

North Haven, Conn., is one of the largest brick producing centers in New England. The rate to Boston in 1915 was 91½c. a ton; and to New York 70½c. a ton. The rates today are: to Boston, $2.24 a ton; to New York, $1.96 a ton. The principal manufacturers in that section state that these two markets are entirely eliminated by these rates. It now costs $5.60 to ship a thousand brick from North Haven to Boston and $4.90 to New York. Add delivery from railroad to job and elimination of these markets is explained.

All Norfolk, Va., brick plants are located a few miles out of the city. In 1915 the rate per thousand brick, plant to city, was 50c. Today it is $1.87½ plus 175 per cent increase in switching charges.

Cincinnati manufacturers report that an average increase of 247 per cent on rates have entirely shut them out of Middletown, Hamilton, Miamisburg, West Carrolton, Tippecanoe, Piqua, Troy, Dayton and Springfield.

In Columbus, Ohio, the rate from plant to city in 1915 was 37c. a ton; today it is $1.12—a tax of $2.80 a thousand brick from the nearest plant to a city railroad siding.

Placing a thousand brick on a siding in Trenton from Fieldsboro, seven miles distant, now costs $4.44, as against $1.26 in 1915. Fieldsboro delivers to Trenton now exclusively by truck.

In the Baltimore territory an increase from 65 cents in 1915 to $1.40 per thousand brick has closed all plants except those that make truck deliveries. Buffalo is supplied from plants 11 to 14 miles away. It costs $5 a thousand brick to ship from plant to city. Many manufacturers now make deliveries by truck.

I can state without fear of contradiction that the yard price of common brick today throughout the United States is based upon the actual cost of manufacture, plus a profit yielding only a small return upon investment down to no profit at all. Due to competition, brick is being sold in many parts of the country at less than cost to manufacturers. An average price of common brick at the yard, taking all the principal producing centers into consideration, is $15 today.

The great majority of brick plants dependent upon rail transportation are closed or operating at a fraction of capacity; while plants able to reach their principal market by truck are operating at from 50 to 100 per cent capacity.

Brick men cannot understand why a penalty imposed during the war frankly for the purpose of stopping operation should be allowed to remain when the country needs construction as badly as it needed munitions in 1917 and 1918. RALPH P. STODDARD,

Cleveland, July 15. Secretary-Manager, Common Brick Manufacturers Association of America.

## Partly Shut Valves Reduce London Water Use

By partly closing all main valves on the water distribution system of London, England, between 6 p.m. and 6 a.m. the total water consumption was recently reduced by 44 m.g.d. (U. S.) over the rate a year ago or to a total of 307,000,000 U. S. gallons a day.

# HINTS FOR THE CONTRACTOR

## Homemade Device Gives Hot Water for Washing in Camp

AN EFFECTIVE means of providing hot water for construction camps where there is a piped water system but where a tank or boiler is not available, is shown in the accompanying illustration. The only material required is a few lengths of pipe, preferably about 1 in. in diameter, and some scrapped sheet metal. The pipe is roughly coiled so as to form a hollow cylinder about 30-in. in diameter and is connected to the water supply line near the tap where hot water is desired.

PIPE COIL FOR HEATING WATER IN OPEN FIRE

Around the coil the metal sheets are set up to form a wind shield and the equipment is complete. A fire built inside the pipe coil heats the water quickly and by keeping the fire up and drawing the water slowly a continuous supply of hot water can be maintained.

The arrangement shown in the accompanying illustration was used by the Southern Pacific Co. to supply water for washing in a temporary camp where the men lived in cars on a siding on the Tehachapi Pass.

## Locomotive Turbines for Flood Lighting Night Construction

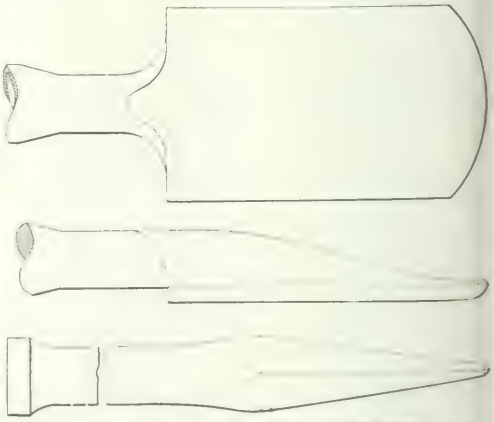
APPLICATION of locomotive headlight turbines for generating current to operate flood and headlights on steam shovels and construction locomotives engaged in night work has recently been tried with success by the Mandle Clay Mining Co., Whitlock, Tenn. The equipment of the company for mining operations consists of two steam shovels and three shifting locomotives, on all of which are mounted floodlight projectors and 500-watt headlight turbines of the same type as used for locomotive headlights, having a pressure range suitable for construction equipment.

The larger of the two shovels has the floodlights mounted to illuminate directly the point at which the bucket is operating, the headlight on the shifting engine serving to aid in unloading into the car. The floodlights on the smaller shovel which is of the revolving type are so placed that they not only illuminate the bucket's field of operation, but, when the shovel is swinging around for unloading, they light up the car.

The turbines on both shovels and locomotives are of the standard type built by the General Electric Co. for locomotive headlights. They are equipped with low pressure valves and nozzles carrying rated voltage and capacity between 70 and 170 lb. boiler pressure with a water rate of approximately 110 lb. per hour.

## Tools for Tunneling with Pneumatic Hammers

A BULL POINT and "shovel" blade successfully used with a rivet hammer in tunneling indurated clay, with pebbles, are illustrated by the sketches. These tools were 18 to 20 in. long and were used in a regular Thor long-stroke riveting hammer with the regulation one-piece safety retainer. Men with hand picks and shovels were making slow progress; the speed was quadrupled by the pneumatic tools. The tunnel, 1,500 ft. long, with two 10-ft. shafts, 76 ft. deep, was completed in 10 days with three 8-hour shifts of eight men operating at each end. The Nash Construction Co., Chicago, Ill., was the contractor.



BULL POINT AND SHOVEL BLADE FOR PNEUMATIC HAMMER

# NEWS OF THE WEEK

New York, August 4, 1921

## Duties of State Engineer of New York Increased

### ansfers from Health and Conservation Departments—To Do Engineering Work on Water Power

A start has been made in the direc-on of carrying out the policy out-ied by the Governor of New York in s first annual message to the legisla-re of combining, under the state en-neer, all the engineering work of the ate. On July 1 laws passed by the 21 legislature went into effect trans-rring engineering work heretofore rformed by the State Department of alth and the State Conservation mmission to the Department of State gineer and Surveyor, thus bringing is work under the jurisdiction of ank M. Williams, state engineer. her legislation created the New York ater Power Commission, which is nposed of the conservation commis-ner, the attorney general, the state gineer, the president pro tempore of Senate and the speaker of the As-nbly. The engineering work for this v water power commission is now ng performed by the state engineer.

PUBLIC HEALTH AMENDMENTS

The amendments of the public health abolish the division of sanitary gineering under the State Health mmission and create the division of itation. Prior to this amendment, ns for sewerage and sewage dis-al submitted to the State Depart-nt of Health went to the division of itary engineering for examination report. Previously this division made investigations and reports on sting water supply and sewage ks, public reservoirs, stream pollu-n, violation of rules and regulations the protection of watersheds, milk teurization plants and suppression mosquitoes. Under the new legisla-n the bureau of sanitary engineer-of the state engineer's office will form, according to Mr. Williams, the ctly engineering work, leaving other ters to the health department.

y amendments to the Conservation v all engineering work heretofore formed by the Conservation Depart-nt will be handled by the state en-eer. This affects matters dealing h plans for public water supplies for water storage together with inspection and approval of plans the construction of docks and dams. hree-headed commission, composed the conservation commissioner, at-ney general and state engineer, is ned and has jurisdiction over land nage for agricultural purposes,

*(Continued on p. 208)*

## Introduce Bill for Harding Railroad Financing Plan

A bill has been introduced in Congress by Representative Winslow, of Massachusetts, chairman of the interstate commerce committee of the House, to carry out President Harding's recommendations for immediate legislation to afford financial relief to the railroads. It is the purpose of the bill to release to the railroads amounts due them by the Government from the period of federal control, now being held up to offset the indebtedness of the carriers to the Government for capital expenditures under the Railroad Administration. The bill authorizes the funding of the carriers' debt to the Government, estimated at over half a billion dollars, through the War Finance Corporation.

## New York Port Authority Meets with Rail Executives

A meeting between the presidents of railroads entering the Port of New York and the Port of New York Authority to consider plans for improving the freight situation of the port was held in New York City July 26. It was announced that the conference took up the subject of belt lines to connect terminals, and it was stated that they would be of advantage in releasing water-front property and bringing rail connections directly to ships.

The Port Authority is continuously holding meetings with representatives of civic and business organizations of cities and communities within the Port District to assist in formulating a plan for recommendation to the legislatures of the two states before Jan. 1, 1922.

## Movement Begun for Road Bond Issue in South Carolina

A good roads association has just been organized in South Carolina and some of the officers have expressed an intention of proposing a $50,000,000 bond issue to the next session of the General Assembly. In order to issue state bonds in South Carolina, according to information received from Charles H. Moorefield, state highway engineer, the issue must first be approved by the General Assembly, next voted by the people, and, third, confirmed at the subsequent meeting of the General Assembly, all of which would involve about two years' time.

There is a strong probability that some scheme for financing road improvement by means of a bond issue will be pressed before the next General Assembly, but no definite policy has been announced by those who are agitating the matter.

## Pontoon Bridge Across Hudson Proposed

### Senate Bill Would Authorize Structure Supported by 50 Shipping Board Wood Vessels

Preliminary steps in a project for facilitating interstate vehicular and pedestrian traffic between New York and New Jersey were taken last week when Senator Frelinghuysen, of New Jersey, introduced in the Senate a bill authorizing the construction of a pontoon bridge across the Hudson River between Yonkers, N. Y. and Alpine, N. J. While detailed engineering plans for such a structure have not, as yet, been made, the general scheme is based on the use of about 50 of the wooden vessels which the U. S. Shipping Board is trying to dispose of. The plan is sponsored by George A. Post, president of the Hudson River Bridge Corp., who has been advised by Gustav Lindenthal, consulting engineer, that there are no engineering difficulties serious enough to make the project impracticable. The structure planned is a temporary one and would probably not be in service more than ten years. Its advocates feel that, once built, it would serve as an object lesson in relieving interstate traffic congestion and would be a convincing argument in winning public support for the proposed permanent steel bridge across the Hudson, described in *Engineering News-Record* of May 26, p. 901.

CONSTRUCTION BY PRIVATE CAPITAL

Senator Frelinghuysen's bill would create a bridge building corporation the personnel of which would include, in addition to Mr. Post, Thomas A. Gillespie, of the contracting firm of that name, R. A. C. Smith, former New York dock commissioner, and a number of others. No appropriation by Congress is asked, as the bridge would be built by private capital and paid for by toll receipts. The bill further specifies that work must be begun within one year after its passage and completed within two years.

Pending the preparation of more detailed plans the War Department, which will be charged with approval of the site, type of structure, and toll charges, is understood to have put no obstacle in the way of the project, although Col. Edward H. Burr, Corps of Engineers, U. S. A., in charge of the New York District Engineer Office, has not as yet been called upon officially to report upon the plan for the proposed pontoon bridge.

Major W. A. Welch, general manager and chief engineer of the Palisades Interstate Park Commission, is credited

with the conception of the Hudson River pontoon bridge. Some time ago the U. S. Shipping Board sought anchorage along the Palisades water front for a fleet of its wooden vessels, agreeing to pay a rental charge for such mooring privileges. When this proposal reached Major Welch he suggested that these ships be put to some useful purpose and recommended that the feasibility of their employment as supports for a pontoon bridge across the Hudson be looked into. This proposal was taken to the Hudson River Bridge Corp., and after its chief engineer, Mr. Lindenthal, had endorsed the feasibility of the general scheme, authorization for the structure was sought by Mr. Post through the medium of such a bill as Senator Frelinghuysen has introduced.

### To Cost $2,000,000

According to present estimates the pontoon bridge can be built for $2,000,000 or less and will require 50 of the Shipping Board's vessels. These are wooden boats of the Ferris type, each with a length of 268 ft. and a beam of 45 ft. In order to provide clearance for river traffic it will probably be necessary to construct some sort of tower support on each vessel so that the main bridge structure may be carried at a height of about 40 ft. above the surface of the water. It is planned to have a lift span for larger vessels, such as the Hudson River Day Line boats, near the center of the bridge.

At the tentative point of crossing the Hudson River is about 5,000 ft. wide, with a maximum depth of 40 ft. The normal tidal current is from 3 to 4 miles an hour and the rise and fall of tide about 4 ft. It has been suggested that screw piles be employed as a means of anchoring the vessels for the pontoon structure. Originally the bridge would be constructed to carry two lanes of traffic, one in each direction, additional width to be provided if the volume of traffic developed warrants such expansion. In the event of approval by the War Department and the passage by Congress of the bills now before it, it is understood that no additional legislation by the States of New York and New Jersey would be necessary to enable construction work to begin.

## Commend Highway Council

A resolution by the directors of the Mississippi Valley Association commends the Federal Highway Council in undertaking a survey of every agency of transportation for the purpose of determining in the public interest the respective sphere in which the different form of transportation are most economic, efficient and practical. The resolution states that the Mississippi Valley Association agrees with the Secretary of Agriculture in his statement that "unquestionably it is desirable to bring about a greater correlation of the different means of transportation so that each may be more useful in its field."

## Tacoma to Protect Pipe Line from Flood Damage

The city of Tacoma, Wash., and Pierce County will immediately take steps to construct protection works at McMillin, where the Puyallup River threatens to destroy the city's gravity water pipe line. The river has cut its way to within 100 ft. of the pipe, and another flood, it is feared, would probably mean the complete destruction of the city of McMillin. W. A. Kunigk, of the Tacoma water department, and County Engineer E. A. White have made investigations and favor the condemnation of land for a new river channel. An estimate of $30,000 has been set for the entire protective work, which will include rebuilding the drift barrier piers which sank last year due to undercutting by floods, and the placing of brush mattresses to protect the banks and check currents. The cost will be divided equally between the city and county.

## Montclair Water Co. Declines Offer

The Montclair (N. J.) Water Co. has declined the town's offer of $700,000 for its distribution system, noted on p. 167 of our issue of July 28. The valuation report of Clyde Potts and related matters have been referred to John Milton, corporation attorney of Jersey City, and special counsel for Montclair, to institute condemnation proceedings.

## N. Y. State Engineer Reorganization

(Continued from p. 207)

stream flow, river regulation and municipal water supply.

The New York Water Power Commission has jurisdiction over the issuance of licenses for the development of water power projects in which the State has proprietary right or interest. The act creating this commission is similar to the federal water power act. This commission, through the state engineer, investigates the water power possibilities of the State.

As regards personnel, the amendments have resulted in the following transfers of heads of bureaus to the State Engineer's Office: Theodore Horton, formerly chief engineer of the engineering division of the State Department of Health becomes chief sanitary engineer of the Bureau of sanitary engineering. A. H. Perkins, formerly division engineer of the division of waters in the Conservation Commission is division engineer in charge of the bureau of drainage and stream regulation. E. H. Sargent becomes senior assistant engineer in charge of the bureau of water supply. A. R. McKim, inspector of docks and dams under the Conservation Commission, is in charge of the bureau having supervision over docks and dams. F. P. Williams, formerly special deputy state engineer, in charge of the construction of the Barge Canal and Barge Canal terminals, is secretary of the New York Water Power Commission.

## Action Against Harbor and Beach Pollution by Oil Wastes

Oil, tar and asphalt wastes from tankers and other water craft and from industrial plants on shore have led to the formation of the Interstate Committee of One Hundred on Pollution of Coast Water and Beaches (New York and New Jersey), which has petitioned Congress for relief. Exisiting federal statutes, it is said, apply to New York Harbor only. It is also said that the nuisance has increased greatly in the last three years with the growth of the oil trade and in the use of oil for fuel by vessels. That this kind of nuisance is not confined to the New York and New Jersey shores is shown by the fact that the Rhode Island legislature of 1920 created a board of purification to control water pollution other than that affecting the public health. The Rhode Island board has specific jurisdiction over the discharge from water craft of petroleum and allied wastes (see *Engineering News-Record*, Nov. 4, 1919, p. 914).

## Philadelphia Sewage-Works Contract to Be Completed

The resumption of construction work on the contract for the Northeast sewage-works for the city of Philadelphia is to be resumed under the original plans and specifications as soon as an agreement between the city and the National Surety Co. of New York already authorized by city ordinance has been executed. The contract was abandoned by the Philadelphia Subway Construction Co. on June 28, 1920. The original contract, dated Aug. 7, 1917 was for $1,025,000. The new contract with the bonding company authorizes the payment of $275,000 additional. Frank H. Caven is director, and Joseph C. Wagner assistant director of Public Works.

## Princeton Enlarges Scope of Engineering School

Princeton has given an undergraduate course in civil engineering and a graduate course in electrical engineering for many years. Next fall under graduate courses in mechanical, electrical, mining and chemical engineering will be added to the curriculum. A four year course will lead to the degree of B. S. in engineering and is designed to meet the needs of the student who does not expect to practice the profession of engineering but wishes the engineering training to fit him for business or manufacturing. For those who decide to follow engineering as a profession an additional year of special work in the chosen branch will bring the engineer's degree. The establishment of the new courses has been largely due to the efforts of certain of Princeton's engineering alumni through the graduate body known as the Princeton Engineering Association.

Prof. Arthur M. Greene will become head of the Princeton Engineering School in 1922, as already announced

## Chicago Plans Calumet Harbor

An ordinance passed by the City Council of Chicago provides for developing Lake Calumet as an inland harbor in the southern section of the city. In this shallow lake a deep channel is to be dredged, with slips for vessels, the material excavated being used to form the piers and to fill in a large area of made land for terminal facilities and industrial development. This project was noted in *Engineering News-Record* of April 21, p. 673.

## Seattle Chapter of A.A.E. Favors Skagit Project

On July 15 the members of the Seattle chapter of the American Association of Engineers passed a resolution which was forwarded to the city authorities urging them to complete at the earliest possible date the development of the Gorge Creek unit of the Skagit power project which is in prospect of being held up for lack of funds. A committee was appointed to confer with the municipality or other committees from civic associations for the purpose of spreading information regarding the details and desirability of the project.

## $2,000,000 for N. Y. Street and Other Refuse Disposal

An appropriation of $2,000,000 serial bonds has been made by the Board of Estimate of New York City for the purchase by the street cleaning department of motor trailers, floating equipment, the acquisition of sites for and the construction of water-front and inland refuse reclamation stations and reduction works for dead animals. John A. Leo, commissioner of street cleaning, informs *Engineering News-Record* that, according to present indications, "the amount will be devoted almost entirely to the establishment of reclamation plants." The conclusions of a report on this and related subjects by a committee, of which Commissioner Leo was a member, were given in *Engineering News-Record*, June 30, p. 1135.

## Discuss Plans for Wholesaling Hetch Hetchy Power

Rapid progress in the Hetch Hetchy tunnels for the water supply of San Francisco, Cal., has led to the conclusion that the first block of Hetch Hetchy power, about 66,000 hp., to be developed in the Mocasin Creek plant, will be available in two and a half years. There has been discussion of late between officials of the city and the power company regarding the sale of this block of power in its entirety to the Pacific Gas & Electric Co. John A. Britton, vice-president and general manager of that company, recently made an inspection trip over the project with M. M. O'Shaughnessy, city engineer.

If the company can be assured of this power certain of their development work could be deferred. If the city does not dispose of it wholesale and desires to bring it to San Francisco approximately 150 miles of transmission line would have to be built, after which there would still be the question of a distribution system if the power were to be used for street lighting and industrial service generally.

## Engineers Professional Men in New Railway Classification

A new set of rules, providing for classification of steam railway employees, was put into effect July 1 by the order of the Interstate Commerce Commission to provide statistics intended to meet the needs of both the U. S. Labor Board and the Interstate Commerce Commission. The need of such classification of professional positions was developed at the hearing of the request for increases of salaries for professional engineers conducted by the American Association of Engineers before the Board of Wages and Working Conditions of the U. S. Railroad Administration on April 2, 1919. C. E. Drayer, secretary of A. A. E., makes the following comment on the new classification:

"It is significant that occupational classification has now been made on railroads after careful and scientific study. So far as we know it is the first time in history, not only of this country, but the world over, where anything like two million employees have been classified on an absolutely scientific basis.

"Engineers in railroad employ are definitely put in the professional group. It is a distinct step in advance for the engineer in his striving for recognition to be classed officially on railroads as a professional man.

"It is important that the actual distribution of employees into the official classification now in progress by the railroads be done accurately. The engineer group includes the following distinctive classes of positions:

| GRADE 1 | Symbol |
|---|---|
| Engineering computer | PER-11 |
| Engineering draftsman | PER-12 |
| Instrument man | PER-13 |
| Junior engineer (civil) | PER-14 |
| Junior engineer (electrical) | PER-15 |
| Junior engineer (mechanical) | PER-16 |
| Leading draftsman | PER-17 |
| GRADE 2 | |
| Assistant engineer (accounting) | PER-21 |
| Assistant engineer (civil) | PER-22 |
| Assistant engineer (electrical or signal) | PER-23 |
| Assistant engineer (mechanical) | PER-24 |
| Assistant engineer (valuation) | PER-25 |
| Chief draftsman | PER-26 |
| Inspector and detailer | PER-27 |
| Division engineer (not maintenance of way) | PER-28 |
| Resident engineer | PER-29 |

"Such position as district engineer, engineer of bridges, engineer of signals, engineers of tests, electrical engineer, valuation engineer, engineer of motive power, division engineer and office engineer, in which the preponderant duties are to perform or assist in executive or supervisory work, are included in executive, officials and staff assistant service.

"The classification work was done by J. L. Jacobs and his associates of Chicago, with the co-operation of members of the staff of the U. S. Railway Labor Board."

## Federal Motor Vehicle Tax Proposed in House Bill

### Rate of 40 Cents per Horsepower for Pneumatic-Tired Cars and Scaled Fees for Trucks

Federal licenses and registration fees for both passenger and commercial motor vehicles, in addition to existing state licenses and fees, are provided for in a bill introduced in the House of Representatives, July 28 by Congressman T. Frank Appleby of New Jersey. The bill (H.R.7991) fixes a rate of 40c. per horsepower for vehicles with pneumatic tires and a graduated fee for motor trucks based on carrying capacity.

By the terms of the bill all persons operating automobiles or self-propelled vehicles of any character on the public highways in interstate travel are required to take out a special federal license, which carries with it a federal registration tag forming a part of the state license tag. The federal tag is to be recognized by the authorities of all states as permitting the owner of the automobile to whom the license was issued to operate his machine within the confines of any state without any additional registration or the securing of any other license or the payment of any additional tax. The federal licenses, the bill states, will be issued through the motor commissioners of the various states, and of the fee charged 90 per cent will go to the United States Government, and 10 per cent to the state through which the license is issued.

The bill, its proponents state, is intended to not only simplify and promote interstate travel and commerce by motor vehicles, but also to produce revenue. Congressman Appleby feels that while it will probably bring in an annual revenue of approximately $10,000,000 the law will nevertheless, be welcome to the class upon whom the tax will fall, as they will be glad to pay the small registration fee required in order to escape the petty annoyances with which they are now forced to contend through the conflicting and burdensome motor provisions and regulations of the various states.

Secretary of the Treasury Mellon, appearing before the House ways and means committee this week, advocated a flat federal tax of $10 on every motor vehicle.

## Louisiana to Draft Vehicle Law Changes This Fall

The burden of drafting Louisiana's new motor vehicle law, the basis of which was fixed by the recent constitutional convention, as outlined in last week's issue, will fall upon the State Legislature which will convene in special session Sept. 6. While the constitution does not stipulate what the restrictions shall be as to gross weight of vehicle, weight per inch, width of tire, etc., it is understood that 20,000 lb. for gross weight and 500 lb. per inch width of tire are contemplated.

## Crane of 300 Tons Weight Set in Place by Larger Crane

By W. Mack Angas, Lieut. C.E.C. U. S. N., and E. M. Bredin
Public Works Dept., U. S. N.

A traveling hammerhead crane weighing 300 tons was lifted and swung over to place recently by the 350-ton revolving crane on the fitting-out pier of the Philadelphia Navy Yard. It was the heaviest load yet handled in the course of actual work by the big crane.

The 350-ton crane, described in *Engineering News-Record*, Jan. 22, 1920, p. 172, is located 600 ft. from the shore end of the new 1,000-ft. fitting out pier; and the traveling crane which was the load in the somewhat spectacular lift mentioned is intended for use on the part of the pier lying between the shore and the big crane. Tracks for

LIFTING NAVY YARD CRANE WEIGHING 300 TONS

the traveling crane have been laid, however, on both the outboard and inboard parts of the pier and arrangements provided for the big machine to lift its "assistant" round from one part of the pier to the other when necessary. The traveling crane is of the revolving hammerhead pintle type.

It was necessary to erect the traveling crane on the tracks lying out beyond the big crane so as not to block the railroad approaches to that machine and interfere with the fitting out of the hospital ship "Relief." After completion of the traveling crane by the contractor and a preliminary test, the upper part of the fixed (i.e., nonrotating) tower was strengthened so that the entire crane could be safely suspended from the four upper corners of the tower. Forged steel links were connected to the structure at these points by bridge pins and to them were shackled pendants consisting of double 2¼-in. steel cables slung from the equalizer hook on the two main hoists of the 350-ton crane. All rigging was arranged so that the load would automatically equalize itself on the eight cables that supported it and all lifting tackle was tested with a 50 per cent overload before being used.

The transfer of the traveling crane from the outboard to the inboard tracks was accomplished in 2 hr.

## Hoover Urges Fall Letting of Highway Contracts

In a letter to the Governors of various states, dated July 26, Herbert Hoover, Secretary of Commerce, suggests that greater economy and more evenly balanced employment would result from fall instead of spring awards of highway construction contracts. The text of Secretary Hoover's communication follows:

"In making a systematic study as to what we can all do to promote employment and to thus assist in tiding over the very severe situation that we are now in, this department has had its attention called to the bearing of the period at which contracts are currently let for the building of public roads upon this problem. In order that there should be no question as to the correctness of the conclusions that had been reached, I summoned a committee comprising representatives of the great engineering societies who have prepared for me the enclosed opinion.

"The conclusions of this inquiry are, in a word, that there would be additional economy in construction if the contracts for the roads were let in the fall instead of in the winter and spring; that contracts let at this time would enable considerable employment over the winter in the manufacture of material and equipment and in the placing of material ready for construction early in the spring. It would enable contractors to give employment to some of their staffs through the winter instead of imposing it at a higher rate upon the short summer construction season. It would relieve pressure on labor during the period of larger demand for agricultural help and would, indeed, expedite the completion of road building.

"The criticism that we are in a period of falling prices and possibly of railroad rates, and that contracts let this fall might be at higher figures than would prove necessary later in the season may be answered by making provisional contracts so that any such difference would accrue to the state. This method has been partially adopted in a few states and you will, of course, understand that my only desire is to offer a suggestion that co-operative action might lead to some reduction of unemployment."

## Tentative Valuations Issued

Additional tentative valuations announced by the Interstate Commerce Commission include the properties of the Toledo, St. Louis & Western R.R., the Western Pacific Ry., and the Ann Arbor R.R. In each case, as in the "supplemental tentative valuations," the reports include a single sum as "final value" and a separate statement of additional cost of acquiring carrier lands due to condemnation and damages.

The final value of the properties owned and used by the Toledo, St. Louis & Western R.R. for purposes of transportation is given as $17,282,977; cost of reproduction new, $16,742,614, and cost of reproduction less depreciation, $12,980,050. Outstanding capitalization as of valuation date was $48,412,413 and the investment account, $39,339,257.

Final value of the Western Pacific Ry. (properties wholly owned and used for transportation) is reported as $66,061,208; cost of reproduction new, $61,577,074. The investment account up until valuation date was $156,318,136.

Final value of properties wholly owned and used for purposes of transportation by the Ann Arbor R.R. is given as $11,046,455. Capitalization outstanding as of date of valuation was $17,271,538.

Tentative valuations have also been issued on the following properties with final values of properties wholly owned and used for purposes of transportation as indicated:

| | |
|---|---|
| Grand Trunk R.R. of Canada | $106,8[illegible] |
| Minneapolis, St. Paul Ry. | [illegible] |
| Grand Canyon Ry. | 1,[illegible] |
| [illegible] & Eastern R.R. | 1,[illegible] |
| [illegible] Southern Ry. | [illegible] |
| Southern Ry. | 1,361,298 |
| [illegible] & Northern Ry. | [illegible] |
| Chicago, Milwaukee & Gary Ry. | [illegible] |
| [illegible] R.R. | [illegible] |
| Trinity & Brazos Valley Ry. | 9,064,0[illegible] |
| Minneapolis, Western Ry. | [illegible] |
| White River R.R. | [illegible] |
| Gulf, Texas & Western Ry. | 1,667,771 |
| South Manchester R.R. | 171,[illegible] |
| Peoria Ry. Terminal Co. | 1,122,3[illegible] |
| Mount Hood R.R. | 507,0[illegible] |
| Gideon & North Island R.R. | 108,600 |
| Garden City Western Ry. | 192,05[illegible] |
| St. Louis-South Western Ry. | 23,831,[illegible] |
| Stephenville, North & South Texas Ry. | 2,150,000 |
| Washington & Choctaw Ry. | 117,8[illegible] |
| Sardis & Delta R.R. | 116,000 |
| Tennessee & Henderson Ry. | [illegible] |

## ommittee Studies Highway Bills

(Washington Correspondence)

After a general discussion of the two ighway bills by the full committee on ost offices and post roads, it was de- ded to allow a few days for the in- ividual members of the committee to udy the two measures. It was de- ded to report out the bill which al- eady has passed the House with such nendments as may be agreed upon. was hoped that such an agreement ould be reached early in August. enator Townsend, the chairman of the ommittee, declared that everything ould be done to expedite the considera- on of the amended bill by the Senate, egardless of the fact that it may be npossible to secure the appropriation hich the bill would authorize.

## Doty Heads Licensing Board

Paul Doty, of St. Paul, has been ected chairman of the Minnesota oard of registration for architects, ngineers and land surveyors. H. T. owns, of Minneapolis, is secretary- reasurer and N. Y. Taylor, Litchfield, ice-chairman. The other members of e board are F. W. McKellip, Fair- ult; F. G. Gorman, Duluth; A. F. nuger, St. Paul, and Dwight E. Wood- idge, Duluth.

# PERSONAL NOTES

ARTHUR E. MORGAN has re- med as chief engineer of the Miami nservancy District, effective Sept. 1 d will be succeeded by Charles H. ul, who is at present assistant chief gineer. Mr. Morgan will divide his ne between his engineering practice th the Dayton Morgan Engineering ., Dayton, Ohio, and the work he has dertaken, as president, in the re- ranization of Antioch College at Yel- w Springs, Ohio.

E. A. VAN DUSEN, for the past o years with the Fargo Engineering ., Jackson, Mich., as structural and draulic engineer on design and re- rts for hydro-electric developments, s resigned to accept a similar posi- n with the Power Construction Co. ew England Power Co.), Worcester, ss.

. A. GRANT, formerly chief of field gineering on the construction of the lson dam, Muscle Shoals, Ala., is w engaged in hydraulic design work the reconstruction of works in eblo, Col.

JEREMIAH C. FINCH, recently sistant to First Deputy Fred W. Sarr d chief of the bureau of plans and rveys, has been appointed secretary the New York State Highway Com- sion.

. P. KEMON, construction superin- dent for Terry & Tench Co., Inc., has n transferred to Washington, D. C., the work of underpinning the Lin- n Memorial.

THE WYCKOFF ENGINEERING CORP., New York City, has been organized by M. M. Wyckoff, formerly engineer, construction superintendent and general purchasing agent for the T. A. Gillespie Co., to engage in the general practice of engineering and contracting.

CHARLES N. MONSARRAT, who resigned about two months ago as consulting engineer to the Department of Railways and Canals of the Canadian Government to enter private engineering practice with P. L. Pratley, with offices in Montreal, has been appointed consulting engineer of bridges, Canadian National Rys. and the Grand Trunk Pacific Ry. He will continue his private practice and devote a portion of his time to the railway consulting work.

NORMAN J. HOWARD, bacteriologist in charge of the filtration plant laboratories, Toronto, Ont., has sailed for England and Ireland where he will visit Birmingham, Manchester and other cities to observe what progress has been made in the activated sludge method of sewage disposal.

O. MINER LELAND, for many years a member of the engineering faculty of Cornell University, is now dean of the engineering department of the University of Minnesota.

MORTIMER W. SMITH, JR., twice engineer of Broad Oaks, W. Va., now a part of the city of Clarksburg, and at one time deputy county surveyor of Harrison County, has been appointed assistant city engineer of Clarksburg.

CEDRIC A. MARTIN has been appointed construction engineer for the City of Puyallup, Wash., on contemplated sewer and paving work. He served several years on construction and valuation for the Northern Pacific Ry., on railway valuation with the Interstate Commerce Commission, as county engineer of Franklin County, Wash., and as surveyor in Idaho for the U. S. Forest Service.

BENJAMIN BEAN, an employee of the California Highway Commission for seven years and for the past eight months computor with the Bureau of Valuation of the Interstate Commerce Commission, Kansas City, Mo., has been appointed field engineer with the State of Missouri on project No. 99, Clay County, on federal-aid highway construction.

CHARLES E. JONES, formerly superintendent of construction, U. S. Engineer Department, on Lock 4, Allegheny River, has been transferred as superintendent of construction to Lock 6, Monongahela River.

MURRAY & FLOOD is a firm recently organized, with offices in New York, by William S. Murray, formerly chairman of the Super-power Survey and Henry Flood, Jr., formerly engineer-secretary of the Super-power Survey.

FLOYD E. RICHEY has been appointed checker of materials at the U. S. Public Health Service Hospital, Whipple Barracks, Prescott, Ariz., now under construction.

DR. MILLER R. HUTCHISON, who served as chief engineer and personal representative to Thomas A. Edison, has been elected president of an organization to investigate and develop inventions, with offices in New York City. Among those associated with him are Hudson Maxim and Sir Edgar Rees Jones.

CARL R. GRAY, president of the Union Pacific Co., has been elected president of the Los Angeles and Salt Lake R.R.

# OBITUARY

DR. W. E. STONE, president of Purdue University, Lafayette, Ind., was killed in a fall on Mount Eon, Alberta, Canada, July 27, in an effort to rescue his wife, who had fallen to a narrow ledge on the face of a deep crevice. Dr. and Mrs. Stone were experienced mountain climbers and had left Banff, Alberta, on July 15 to attempt the ascent of Mount Eon. Dr. Stone was born in Chesterfield, N. H., in 1862, and received the degree of B.S. from Massachusetts Agricultural College, 1882; B.S., Boston University, 1886; Ph.D., Göttingen, 1888, and LL.D., Michigan State Agricultural College, 1907. He was assistant chemist at the Massachusetts State Agricultural Experiment Station for about two years and later became chemist of the Tennessee Agricultural Experiment Station. In 1889 he joined the faculty of Purdue University as professor of chemistry. He later became vice-president and in 1900 president of the university. He was a member of the Indiana State Board of Education.

MAJOR L. A. FISCHER, chief of the division of weights and measures, U. S. Bureau of Standards, died July 20 in Washington, D. C. He was born in Washington in 1864 and was a lifelong resident of that city. He was graduated from George Washington University with the degree of B.S. in 1864. He was a leader of the movement to promote a uniform system of weights and measures in the United States and was author of a history of weights and measures (1905). In 1904 he compiled the laws relating to weights and measures in the United States.

W. L. LOGAN, bridge department, Illinois Central R.R., Council Bluffs, Iowa, was accidentally drowned in the Missouri River July 1, 1921, according to all available evidence. He was a graduate in civil engineering, Purdue University, 1915, and had been in the bridge department of the Illinois Central for the past six years. At the time of his death he was supervising the construction of retards in the Missouri River, about three miles north of Council Bluffs.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Building Survey Made by Philadelphia Housing Association

New York and Los Angeles are two cities of over 500,000 population that are nearly providing for the normal increase in their populations, according to a survey recently made by the Philadelphia Housing Association. Examination of the building permits issued in principal cities of the United States shows that during the first six months of 1921 New York provided for 90 per cent of the normal yearly increase in population, and Los Angeles 92 per cent. Other cities provided the following percentages of normal yearly increases: Cleveland, 40 per cent; Pittsburgh, 34 per cent; Chicago and San Francisco, 32 per cent; Detroit, 27 per cent, and Philadelphia, 13 per cent.

Information was also gathered upon the amount of construction undertaken for the first six months of 1921, as compared to the corresponding period of 1920. Boston shows a gain in permits for the first half year of 120 per cent, Chicago, 107 per cent, St. Louis 116 per cent, Los Angeles 92 per cent, San Francisco 70 per cent, and Cleveland 30 per cent. For a four months' period New York shows an increase in permits of 33 per cent and a gain in provisions for families of 182 per cent. In Philadelphia there was a loss of 41 per cent in permits and 47 per cent in families provided for.

### New Construction Funds

Of the large cities four show a decrease in funds going into new construction in 1921 over 1920. In six cities there is an increase. Pittsburgh reported a decline of 32 per cent in funds going into new dwellings, Baltimore 26 per cent, Detroit 25 per cent, Philadelphia 64 per cent. A gain in funds devoted to new dwellings in the first part of 1921 over the same period of 1920 was 31 per cent in Boston, 39 per cent in Cleveland, 42 per cent in Los Angeles, 111 per cent in San Francisco, 143 per cent in New York, and 167 per cent in St. Louis.

Increases in the amount of money going into construction of all kinds during the first half year of 1921 over 1920 were reported as follows: Los Angeles, 41 per cent; Chicago, 4 per cent, and New York, 10 per cent. Other cities decreased their total value in buildings of all kinds—factories, garages, theaters, public buildings, etc.—decreases being: For Baltimore, 9 per cent; Pittsburgh, 17 per cent; San Francisco, 24 per cent; Boston, 32 per cent; Cleveland, 34 per cent; St. Louis, 40 per cent; Detroit, 40 per cent.; Philadelphia, 55 per cent.

Thus the housing association finds that Philadelphia is at the bottom of the list of cities of over 500,000 population as regards housing.

## New Labor Body Announced

Believing that the extremely militant attitude of a great many labor leaders is harmful to the cause of labor, that old-time methods must be discarded as having outlived their usefulness and that an entire new system of handling disputes between wage earners and employees must be practiced, several officers of various organizations within the American Federation of Labor have announced the formation of the Loyal Labor Legion of New York City. F. P. A. Vacarelli, former vice-president of the International Longshoremen's Association, is the head of the new organization, which, according to a statement issued by Mr. Vacarelli, grew out of a meeting of the Loyal Labor Legion last Friday night when a new constitution embodying the latest ideas on labor was adopted. It is said that 90 per cent of the organization's membership is composed of elected officials of American Federation of Labor trade unions.

Four clauses which carry distinctly new notes in the attitude of labor toward capital and the public provide that the Loyal Labor Legion recognizes: (1) The right of men and women to work regardless of membership or nonmembership in trade unions; (2) the rights of the general public as a party at interest in labor controversies; (3) the necessity for laws establishing courts of arbitration with powers to enforce obedience to their decisions; (4) the settling of differences between employers and wage earners without intervention by persons not personally affected by the matter in controversy.

In his statement Mr. Vacarelli asserts that a great deal of the present unemployment may be laid "to the unwise leadership of men who ran amuck and called hundreds of strikes immediately following the war. When the greatest need was increased production, reckless labor leaders encouraged their followers to make impossible demands compelling hundreds of plants to close."

"Organized labor," continues the statement, "needs a new birth. The doctrine of peace and prosperity must displace that of rule or ruin. New membership and new vision must enter the A. F. of L. from top to bottom and principles and methods accepted that will bring peaceful agreements and reasonable bases rather than destructive warfare for unobtainable demands."

## Pennsylvania Highway Work

So far during 1921 the Pennsylvania State Highway Department has completed the construction of 281 miles of durable roadway into which concrete enters in some form. The maintenance forces of the department during 1921 have entirely resurfaced 104 miles of waterbound macadam and have put down 207 miles of unbound macadam.

## Contracts Let During July Total $106,011,049

### Miscellaneous Building and Street and Road Work 75 Per Cent of Total—Public Works Building Active

The total value of contracts let during July as reported in *Engineering News-Record* was $106,011,049, or close to 80 per cent of the total amount of money involved in contracts let during the corresponding period of 1920. Miscellaneous building construction leads for July with street and road work a close second, the total value of these two types of construction being in the neighborhood of $79,000,000 or 75 per cent of the total for the month. *Engineering News-Record* does not report on contracts let for residential building.

Both miscellaneous building and street and road work were considerably more active during July of 1921 than during July of 1920. Other classifications of construction also exceeded last year, the only wide disparity between 1921 and 1920 in favor of the

VALUE OF CONTRACTS LET DURING JULY, 1920 AND 1921

| | July, 1920 | July, 1921 |
|---|---|---|
| Waterworks | $3,793,237 | $3,105,9[illegible] |
| Sewers | 3,162,632 | 3,985,99[illegible] |
| [illegible] | 5,637,615 | 5,053,3[illegible] |
| [illegible] | 21,752,756 | 33,942,9[illegible] |
| [illegible] | 1,941,897 | 609,2[illegible] |
| [illegible] | 30,968,000 | 6,781,0[illegible] |
| [illegible] | 38,947,190 | 45,452,0[illegible] |
| [illegible] | 4,431,976 | 3,182,9[illegible] |
| Miscellaneous | 13,028,267 | 3,696,95[illegible] |
| Total | $129,284,470 | $106,011,04[illegible] |

latter being in industrial work. Th industrial contracts let during July 1920, totaled approximately $31,000,00 whereas during July, 1921, they wer little in excess of $6,500,000.

Though the total value of contract let during July of this year is als about 80 per cent of that of July, 192 when actual dollars are compared, th two figures are found to correspon almost exactly when the decrease i the cost of construction during the pa year is taken into account. *Engineering News-Record's* construction co index figure published in the issue July 21, p. 127, shows this reductio to be in the neighborhood of 18 pe cent. Applying this differential th respective figures representing the tot contract value for the two years ar 1920, $129,284,470; and 1921, $128 727,702.

Again, taking the construction co index number into account, it is fou that the value of a construction doll during 1920 was 42c., whereas for Jul 1921, it is 51c. Reducing these tw figures to a 1913 base, the figures re resenting the total contract values b come, approximately: 1920, $54,00 000; 1921, $53,000,000.

The total value of contracts let f

the first seven months of 1921 is therefore approximately $685,000,000. This figure compares with $1,097,970,327 for the first seven months of 1920. Applying the 18 per cent difference in construction costs for the two years the 1921 figure is raised to more than $800,000,000 for the first seven months, when compared to 1920.

## Ohio Lets Highway Work Worth $1,847,907

During the past week the Ohio State Highway Department let road contracts worth $1,847,907. Of this amount $1,775,008 is for the construction of highways of various types and the remainder is for the construction of bridges. The total mileage involved in the thirty contracts which were awarded for highway construction is in excess of 61 miles, divided among the following types: Brick, 16 miles, bituminous macadam, 16 miles; concrete, 9 miles; waterbound macadam, 10 miles. The mileage involved in contracts for only grading and installation of drainage structures was in excess of 13 miles.

## Gompers Urges Plan to Decrease Seasonal Employment

Samuel Gompers, president of the American Federation of Labor, recently urged upon President Harding the advisability of the government taking into consideration all the conditions of the labor market before initiating any public construction. Mr. Gompers asserted that much inconvenience and actual loss could be avoided if construction of public works were undertaken at times when private construction did not furnish sufficient employment for wage-earning classes. The suggestion, he said, was particularly applicable to the seasonal occupations.

## West Coast Lumber Production

In the week ending July 23, 105 mills in western Oregon and western Washington reported a lumber production of 50,584,143 ft. b.m., which is 34 per cent below normal production. New business totaled in excess of 43,000,000 ft. b.m. and shipments approximately 49,000,000 ft. b.m. The local business totaled 3,623,267 ft. b.m.

## June Employment Conditions

Fewer engineers by 304 made application of the American Association of Engineers for positions in June than in May, although the number was still nearly twice as many as in 1920. Comparative statistics follow:

| | May 1921 | June 1921 | June 1920 |
|---|---|---|---|
| Applicants | 2,264 | 1,960 | 1,062 |
| Positions received | 401 | 551 | 499 |
| Men referred | 2,788 | 1,419 | 2,632 |
| Men placed | 214 | 195 | 283 |

The average monthly salary for positions filled in June was $185, $5 more than in May. Nine positions paying more than $5,000 per year were filled.

## Southern Pine Production 73 Per Cent of Normal

Southern pine production, according to a report made to the Southern Pine Association by 139 mills was 73 per cent of normal production for the week ended July 22. The total production of these mills was almost 69,000,000 ft. b.m., or an average of 494,000 ft. b.m. per mill. The normal production of

# Labor Rates and Conditions Throughout the Country

Actual changes in schedule are reported by three of the nineteen cities which keep us informed monthly as to labor rates and conditions. In Birmingham carpenters now receive 75c. per hour, as against the former rate of 87½c., while common labor is paid as low as 15c. an hour. Hod-carriers, formerly receiving 25 to 40c., are now paid the lower rate. Certain adjustments have been made in New Orleans; as a result of arbitration the rate for carpenters is now 88c., as against $1. The hoisting engineers waived arbitration and by negotiation have accepted a 10 per cent reduction, to 90c. per hour. By a voluntary offer by the pile-drivers 80c. is now paid for that class of labor, as against $1. Common labor is receiving 30c. and less, as against the former rate of 50c. In Los Angeles common labor is paid $4.50 per day, whereas the former rate was 75c. per hour. Despite this reduction there is a large surplus of common labor. In the case of the skilled crafts, work is fairly plentiful, with residence building particularly brisk. There is a good demand for pile-drivers, but hoisting engineers find difficulty in obtaining employment in their trade.

Detroit reports no change in labor rates, although on some jobs men are accepting less than the established scale. Few new construction jobs are going forward, and the volume in prospect appears to be decreasing. All classes of labor are plentiful. Minneapolis reports labor plentiful, as elsewhere, with noticeable unemployment continuing in the building trades. The schedule is the same as last month, and the bricklayers' union has notified the city building inspector that effective July 15 it will recognize the current rate of $1 per hour. This rate was announced by the employers' association and made effective May 1.

S means scarce; E, enough; P, plentiful—Higher rates indicated by +, decreases by-

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | $0.90P | $0.70P | $1.00P | $0.54P | | $0.74P | $20@.25P |
| Baltimore | 1.25P | .80P | .87½P | .54P | $0.74P | 1.00P | .35P |
| Birmingham | 1.00P | .75P | | .25 | | 1.00P | .15@.25 |
| Boston | .90P | .90P | .90P | .60P | .90P | .90P | .55P |
| Cincinnati | 1.25P | 1.00P | .70E | .85P | 1.00E | 1.25P | .35@.40 |
| Chicago | 1.25 | 1.25 | | | | 1.25 | 1.00 |
| Cleveland | 1.25P | 1.25P | 1.25P | .87½P | 1.10P | 1.25P | .87½P |
| Dallas | 1.00P | 1.00P | 1.00E | .60E | 1.00E | 1.00E | .50@.75P |
| Denver | 1.37½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | .37½@.50P |
| Detroit | 1.00P | .80P | .80@.90P | .50@.60P | 1.00P | .80P | .50P |
| Kansas City | 1.07½ | 1.00 | 1.00 | .80 | 1.07½ | 1.07½ | .70 |
| Los Angeles | 1.25P | 1.00P | 1.00P | 1.12½P | 1.00P | 1.00P | —.56¼P |
| Minneapolis | 1.00P | .80P | .80P | .60P | | .80P | .50P |
| Montreal | .90P | .65P | .60P | 40P | .50P | .65P | .30P |
| New Orleans | 1.00P | —.88P | —.90P | .40P | —.80P | 1.00P | .30P |
| New York | 1.25 | 1.12½ | 1.25 | .87½ | 1.12½ | 1.12½ | .75@.80 |
| Pittsburgh | 1.12½P | 1.00P | 1.00P | .80P | | 1.00P | Open |
| St. Louis | 1.25P | 1.25P | 1.25P | .85P | 1.25P | 1.25P | .67½P |
| San Francisco | 1.25P | 1.12½P | 1.12½P | 1.00P | 1.12½P | 1.12½P | 81¼P |
| Seattle | 1.00P | 80P | 80P | 70P | 1.00P | .87½P | 50P |

these mills is 93,837,246 ft. b.m., or an average per mill of 675,000 ft. b.m. The orders on hand at the beginning of the week ended July 22 amounted to 196,000,000 ft. b.m., and the orders received during the week were 67,000,000 ft. b.m., or a total of 263,000,000 ft. b.m. The shipments during the week amounted to a little more than 69,000,000 ft. b.m., or 2,000,000 ft. b.m. more than the orders received during the week.

## Committee on Waste Elimination Reports on Metal Trades

About $1,000,000,000 is the annual waste in the metal trades industry attributable to idle men and machinery, according to the report of the Committee on Elimination of Waste in Industry of the Engineering Council. This loss is for labor only and takes no account of the value of material produced were productivity increased.

Instability of labor and incompetent management, says the report, are the chief factors contributing to the loss. The average waste due to avoidable labor turnover is estimated at $100,000,000 annually. The report urges that modern employment methods, with particular attention paid to why men quit work, be studied.

The report is part of the general report made by the committee in its national survey of industrial waste, directed by L. W. Wallace, of Washington. The metal trades investigation was in charge of Fred. J. Miller, of New York, former president of the American Society of Mechanical Engineers, and by William B. Ferguson, of Philadelphia.

**Engineering News-Record Construction Cost Index Number**

*(See Issue of July 21, p. 127)*

| | |
|---|---|
| [illegible] | 193.47 |
| [illegible] | 202.82 |
| [illegible] | 251.40 |
| [illegible] | 100.00 |

## Building Material Prices in Britain

*(London Correspondence)*

There has been a considerable decrease in the selling price of a number of building materials from the peak reached during the spring of 1920, though some materials were higher in May of this year than during the general high point reached last year, such materials including cement and brick. The following table indicates the comparative prices of several materials:

The prices herein quoted have been made on the basis of a normal exchange, the real quotations being given, in pounds sterling, shillings and pence.

| Commodity | Prices— July, 1914 | Feb., 1920 | May, 1921 |
|---|---|---|---|
| Sand, per cubic yard | $0 98 | $5 70 | $5 54 |
| Brick, per thousand | 8 22 | 15 19 | 18 67 |
| Portland cement, per ton | 8 94 | 18 91 | 21 24 |
| Timber, baltic, per cubic yd. | 1 40 | 4 74 | 4 20 |
| Rail, steel, per ton | 0 52 | 2 51 | 0 74 |
| Railroad, per ton | 138 48 | 338 94 | 208 32 |

## Conditions in the Brick Industry

Over-competition prevails quite generally in the brick industry according to the monthly digest issued by the common Brick Manufacturers' Association of America. The composite price as revealed by reports of nearly 100 manufacturers representing every important brick producing center was $14.49 on July 1 as against $15.14 on June 1. The composite price means little except that it indicates the general trend. Brick is selling from $9 per thousand in the Southeastern States and in Texas to $25 per thousand. The low price is not general even in those sections, but is the extreme result of competition which the digest characterizes as "thoughtless and unbusinesslike." The number of brick plants closed is about the same as was reported during June. There is plenty of material, quotes the digest, and labor is plentiful and fairly efficient.

"Practically all the plants closed," says the digest, "are railroad yards dependent upon rail for shipment to market and the prohibitive freight rates eliminate them. More brick than ever before is being delivered from plant to job by truck. The railroads will permanently lose much of this tonnage."

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Railway Material**—The month's quotations show light rails at $45 per ton for all weights. Ties are down 5 to 10c. each in St. Louis. Standard spikes can be bought at $3 per 100 lb., Pittsburgh mill, and are down also in St. Louis.

**Pipe**—The July 7 basing card for wrought pipe shows the steel discounts 2 per cent greater than last month, while the discounts on wrought-iron pipe are 6 per cent higher. Discounts in New York warehouse are 6 per cent higher on 1@3 in. butt-welded steel pipe, and 2 per cent higher on 3½@6 in. lap-welded. There are several adjustments in cast-iron quotations. St. Louis reports a heavy increase on clay drain tile, and submits no explanation at this time. Sewer pipe has advanced in St. Louis, but is down in Los Angeles, Cincinnati and Atlanta. Contracts let for cast-iron pipe in July, according to the Construction News section of *Engineering News-Record*, amounted to $1,168,000.

**Paving Material**—Road oils have declined about 1c. per gal. in New York; with asphalt in packages $4 lower than last month and in bulk $1 lower per ton. Asphalt is down also in Minneapolis, Atlanta and Cincinnati. Cincinnati reports [illegible] per sq.yd., as against $4.25 last month. The demand for curbing in the New York district is greater than present production capacity, with the result that bluestone has advanced 10 per cent over last month's quotations. Wood-block paving is down in New Orleans up in St. Louis.

**Sand, Gravel and Crushed Stone**—Gravel is 25c. per cu.yd. cheaper in New York than a month ago. Reductions are reported also in Cincinnati and St. Louis.

**Lime**—Hydrated finishing down in New York, St. Louis, Boston, Montreal and New Orleans, hydrated common down in Boston and Atlanta and advanced 50c. per ton in New Orleans. Lump finishing 20c. higher in Minneapolis and 40c. in Atlanta (180 lb.bbl.). Common lump down in Cincinnati. Minneapolis and New Orleans report rise.

**Cement**—The situation in New York remains as reported last week, with the price $2.60 to $2.70 net, delivered, while the price at the mill supplying New York is $2.10, and $2.80 alongside dock, including four bags at 10c. each. Down in St. Louis, New Orleans and Los Angeles. Rosendale cement reported lower in Boston.

**Common Brick and Hollow Tile**—Common brick down in Boston and Atlanta, and slightly firmer in Cincinnati. Hollow tile slightly lower in Boston, Cincinnati and Atlanta, while a slight advance is reported in New Orleans.

**Roofing Materials**—Market continues steady on roofing materials.

**Structural Material**—Reduction in steel continues with present mill base for structural shapes $1.85. Warehouses are reflecting the decrease, the New York base price being $2.88 delivered; for St. Louis $3.12½, for San Francisco $4.15. Rivets are now $2.65 Pittsburgh mill, and $4.40 New York, delivered.

**Steel Sheetpiling**—Current price $2 Francisco and New York.

**White and Red Lead**—First change since March occurred last week when price was reduced ¾c. per lb.

**Lumber**—Decrease of $1 to $3 in St. Louis. Sharp decline in New Orleans, Cincinnati and Montreal.

**Steel Sheetpiling**—Current price $2 per 100 lb., Pittsburgh.

**Wire Rope**—Fairly general decrease of 5 per cent.

**Manila Rope**—Tendency downward.

**Wood Piles**—Larger sizes $2 to $4, cheaper, New York.

Price advances this week are indicated by **heavy type**; declines by *italics*

**PIG IRON**—Quotations compiled by The Matthew Addy Co.:

| | Current | One Year Ago |
|---|---|---|
| CINCINNATI | | |
| No. 2 Southern (silicon 2.25 @ 2.75) | $ [illegible] | $45.60 |
| Northern Basic | [illegible] | 42.80 |
| Southern Ohio No. 2 (silicon 1.75 @ 2.25) | [illegible] | 46.80 |
| NEW YORK, tidewater delivery | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | 30.26 | 49.70 |
| BIRMINGHAM | | |
| No. 2 Foundry (silicon 2.25 @ 2.75) | 20.00 | 42.00@44.00 |
| PHILADELPHIA | | |
| Eastern Pa., No. 2X, 2.25@2.75 sil.) | [illegible] | 46.00@48.25* |
| Virginia No. 2 (silicon 2.25 @ 2.75) | 29.74* | 45.00* |
| Basic | 31.50† | 44.50† |
| Grey Forge | 21.50 | 43.50* |
| CHICAGO | | |
| No. 2 Foundry Local (silicon 1.75 @ 2.25) | 20.00 | 45.00 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | 26.00 | 48.70 |
| PITTSBURGH, including freight charge from the Valley | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | 22.00 | 45.65 |
| Basic | 20.50 | 44.40 |
| Bessemer | 23.50 | 44.90 |

*F.o.b. furnace. † Delivered

## RAILWAY SUPPLIES

**STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb is charged extra:

| | Pittsburgh | | | Chicago |
|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | |
| Standard bessemer rails | $45.00 | $45.00@60.00 | | $45.00 |
| Standard openhearth rails | 47.00 | 47.00@62.00 | $47.50 | 47.00 |
| Light rails, 8 to 10 lb. | 45.00 | 50.00@55.00 | [illegible] | 2.45@3.00* |
| Light rails, 12 to 14 lb. | 45.00 | 50.00@55.00 | 2.20* | 2.41@2.95* |
| Light rails, 25 to 45 lb. | 40.00 | 50.00@55.00 | 2.20* | 2.32@2.85* |

*Per 100 lb.

**RAILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8½ Ft. | 7 In. x 9 In. by 8½ Ft. |
|---|---|---|
| Chicago, White Oak | $1.85@$1.40 | $1.45@$1.50 |
| Chicago, Hardwood and Red Oak | 1.25@1.30 | 1.40@1.45 |
| Chicago, Empty Cell Creosoted (Douglas Fir) | .45 | .50 |
| San Francisco, Green Douglas Fir | .80 | 1.12 |
| San Francisco, Empty Cell Creosoted Douglas Fir | 1.76 | 2.48 |

Prices on standard "untreated railroad ties" specification, f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pine and Cypress |
|---|---|---|---|
| Grade 3 | $1.25 | $1.00 | $.90 |
| Grade 2 | 1.15 | 1.00 | .80 |
| Grade 1 | 1.10 | .95 | .70 |

**TRACK SUPPLIES**—The following prices are per 100 lb. f.o.b. Pittsburgh for carload lots, together with those shown in the other columns:

| | Pittsburgh | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Current | One Year Ago | Chicago | St. Louis | [illegible] | [illegible] | [illegible] | [illegible] |
| Standard spikes, ⅝-in. and larger | $3.00 | $4.00@4.25 | $3.40 | $3.40 | [illegible] | [illegible] | [illegible] | 4.00 |
| Track bolts | 4.00 | [illegible] | 4.00 | 4.00 | [illegible] | [illegible] | [illegible] | 4.00 |
| Standard section angle bars | 2.75 | 3.00@4.25 | 2.75 | 3.25 | [illegible] | [illegible] | [illegible] | 4.00 |

## PIPE

**WROUGHT PIPE**—The following discounts are to jobbers on steel, on the Pittsburgh, Chicago and Coast bases, July 7, 1921:

BUTT WELD

| Inches | Steel Black | Galv. | Inches | Iron Black | Galv. |
|---|---|---|---|---|---|
| ⅛ to ¼ | 64½ | 57½ | ⅛ to 1½ | 39½ | 27½ |
| ⅜ to ½ | 66½ | 61½ | 15 | 42½ | 32½ |
| ¾ to 1 | 69½ | 63½ | 2 | 44½ | 34½ |
| 1¼ to 1½ | 67½ | 61½ | 2½ to 6 | 45½ | 35½ |
| 2 and 2½ | 65½ | 57½ | 7 to 12 | 43½ | 33½ |

LAP WELD

BUTT WELD, EXTRA STRONG, PLAIN ENDS

| | | | | |
|---|---|---|---|---|
| ⅛ to ¼ | 57½ | 51½ | ⅛ to 1½ | 39½ | 27½ |
| ⅜ to ½ | 60½ | 54½ | 15 | 42½ | 32½ |
| ¾ to 1 | 63½ | 57½ | 2 | 44½ | 34½ |
| 1¼ to 1½ | 61½ | 55½ | 2½ to 4 | 45½ | 35½ |
| 2 | 59½ | 53½ | 4½ to 6 | 43½ | 33½ |
| 2½ to 3 | 63½ | 57½ | 7 to 8 | 41½ | 31½ |
| 3½ to 6 | 61½ | 55½ | 9 to 12 | 39½ | 29½ |
| 7 to 8 | 59½ | 53½ | | | |
| 9 to 12 | 57½ | 51½ | | | |

LAP WELD, EXTRA STRONG, PLAIN ENDS

| | | | | |
|---|---|---|---|---|
| 2 | 54½ | 44½ | 2 | 42½ | 32½ |
| 2½ to 3 | 60½ | 50½ | 2½ to 4 | 44½ | 34½ |
| 3½ to 6 | 58½ | 48½ | 4½ to 6 | 42½ | 32½ |
| 7 to 8 | 56½ | 46½ | 7 to 8 | 40½ | 30½ |
| 9 to 12 | 54½ | 44½ | 9 to 12 | 38½ | 28½ |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | [illegible] | 62½% | [illegible] |
| 3½ to 6 in. lap welded | 51% | 48½% | 48½% |

| | Galvanized | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | [illegible] | 50% | 38½% |
| 3½ to 6 in. lap welded | [illegible] | 46% | 34½% |

Malleable fittings, Class B and C, from New York stock sell at net list prices. Cast iron, standard sizes, 20—5% off

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York | | | | | |
|---|---|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
| 4 in. | $53.30 | $79.30 | $58.00 | $61.10 | $49.70 | $71.00 |
| 6 in. and over | 48.30 | 76.30 | 51.00 | 58.10 | 46.70 | 70.00 |

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin.ft.:

| | New York | | | | | |
|---|---|---|---|---|---|---|
| Size, In. | Current | One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
| 3 | $50.00 | $42.50 | $85.00 | $50.00 | [illegible] | $55.00 |
| 4 | 60.00 | 60.00 | 85.00 | 60.00 | $90.00 | 65.00 |
| 5 | 90.00 | 85.00 | 140.00 | 80.00 | 115.00 | 84.00 |
| 6 | 115.00 | 110.00 | 140.00 | 100.00 | 150.00 | 110.00 |
| 8 | 185.00 | 175.00 | 200.00 | 150.00 | 250.00 | 181.00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots:

| Size, In. | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | $0.13 | $0.132 | | 125 | $0.135 | $0.13 | |
| 4 | 13 | 132 | $0.11 | 125 | 135 | 1625 | $0.18 |
| 5 | 25 | 198 | | 175 | 2025 | 195 | 165 |
| 6 | 25 | 198 | 165 | 175 | 2025 | 2275 | 25 |
| 8 | 41 | 308 | 275 | 250 | 315 | 325 | .35 |
| 10 | 61 | 462 | 385 | 350 | .4725 | 455 | |
| 12 | 78 | 594 | .4675 | 450 | .6075 | 585 | 80 |
| 15 | 1.01 | 792 | .6875 | 780 | 81 | 975 | |
| 18 | 1.90 | 1.10 | 935 | 1.09 | 1.125 | 1.365 | |
| 20 | 2.28 | 1.32 | 1.2475 | 1.15 | 1.35 | | |
| 22 | 3.04 | 1.98 | | | 1.80 | | |
| 24 | 3.42 | | 1.7875 | 1.87 | 2.025 | 2.34 | 2.40 |
| 27 | | | | 3.30 | 3.75 | 3.25 | |
| 30 | | | 4.00 | 3.80 | 4.75 | 3.90 | |
| 33 | | | | 4.60 | 5.50 | | |
| 36 | | | | 5.00 | 6.00 | | |
| | 3 | 5 | 8 | 12 | 24 | 36 | |
| Boston | $0.125 | $0.185 | $0.25* | $0.[illegible] | $1.85 | $2.40 | |
| Minneapolis | | | 40 | 77 | 2.55 | 5.66 | |
| Denver | | 15 | 50 | 50 | 1.95 | | |
| Seattle | 145 | | 56 | 72 | 2.00 | | |
| Los Angeles | 115 | 165 | 275 | 280 | 1.60 | | |
| Newark | | 108 | | 90 | 1.60 | | |
| Cincinnati | 115 | 171 | | 90 | 1.10 | 1.41 | |
| Atlanta | 095* | 135 | | 90 | 1.60 | | |
| Minneapolis, rural | 30* | 45 | 85 | 1.55 | 4.50 | 6.50 | |
| | 123 | 1845 | 297 | 2.75 | 2.34 | 5.8425 | |
| Baltimore | 15 | 198 | 51 | 99 | 2.00 | | |
| Baltimore, delivered | | 28 | 44 | 86 | 2.84 | | |

*4-in., 6-in., 9-in., 30-in. respectively.

## ROAD AND PAVING MATERIALS

**ROAD OILS**—The following are prices per gallon in tanks, over 8,000 gal. minimum f.o.b. place named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45% asphalt (at terminal) | $0.05½ | $0.13 |
| New York, 65% asphalt (at terminal) | [illegible] | 13 |
| New York, binder (at terminal) | [illegible] | 14 |
| New York, flux (at terminal) | [illegible] | 14 |
| New York, liquid asphalt (at terminal) | [illegible] | 13 |
| St. Louis, 40-50% asphalt | [illegible] | 10 |
| Chicago, 40-50% asphalt | 06 | 08 |
| Chicago, 65% asphalt | 06½ | 08 |
| Dallas, 4-in. penetration | 10 | 07 |
| Dallas, 6-in. penetration | 13 | 08 |
| Dallas, 75-90% asphalt | 15 | 10 |
| San Francisco, binder, per ton | 15.00 | [illegible] |

* Freight $21.75 per ton to Whiting, Ind.

**ASPHALT**—Price per ton in packages (350-lb bbl. or 42 gal. drum) and in bulk in carload lots:

| | Package | Bulk |
|---|---|---|
| New York (Bayonne, N. J.) | $ | $/ |
| Boston | N | |
| Chicago | 28 50 | 21 00 |
| San Francisco | 21 | 15 |
| Dallas | 35 00 | 27 00 |
| Seattle | 27 | |
| Denver | | 7 |
| Minneapolis | | |
| St. [illegible] | 1 | 1921 |
| Buffalo | 40 00 | |
| Los Angeles, [illegible] | | 15 00 |
| Memphis | 25 | 21 00 |
| Atlanta | | |
| Detroit, refinery, [illegible] | 24 | 2 00 |
| Cincinnati | 2 | |
| Montreal, N. J. [illegible] | 27 | |
| Montreal, N. J. asphalt cement | 29 50 | 25@ 31 |

Trinidad, crude, Pacific ports, 80c per ton.

N. Tex. crude or fuel oil in tank cars, f.o.b. refinery, Mexia, 60c per bbl.; in tank wagons 4 to 5 deliveries, Dallas, $1 per bbl.; in barrels, 3 times.

**PAVING STONE**—

| | | |
|---|---|---|
| New York | 5-in. granite [illegible] | $13 [illegible] M |
| Chicago | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 65 [illegible] per M |
| Boston | 5-in. granite | 4 25 sq.yd. |
| Atlanta | Granite | 2 [illegible] yd. |
| Detroit | Granite, 26" blocks | per sq.yd. 107 00 per M |
| Baltimore | Granite | 2 25 sq.yd. |
| Montreal | Granite | 130.00 per M |
| [illegible] | Granite, 4 x 8 x 4 | 3.25 sq.yd. |
| Cincinnati | Granite | 4 50 sq.yd |
| St. Louis | 4x8x4 dressed<br>4x8x4 common | 3.35 sq.yd.<br>3 00 sq.yd. |
| Kansas City | No. 1 Granite | 3.90@3.95 sq.yd. |

**FLAGGING**—

| | | |
|---|---|---|
| New York | Bronx | $0.25 sq.ft. |
| | Manhattan, 4 ft. | .26 sq.ft. |
| | Queens, 5 ft. | .26 sq.ft. |
| | [illegible] | [illegible] lin.ft. |
| Chicago | [illegible] | 70 lin.ft. |

**CURBING**—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

**WOOD BLOCK PAVING**—

| | Treatment | Per Sq.Yd. |
|---|---|---|
| New York | 1c | $2 27 |
| New York | 1c | 2 [illegible] |
| New York | 16 | 2 75 |
| [illegible] | 16 | 3 45 |
| Chicago | 1c | 3 75@ 4 00 |
| Chicago | 16 | 3 25@ 3 50 |
| St. Louis | 16 | 3 25 |
| [illegible] | 16 | 3 75 |
| Seattle | 1c | Cedar [illegible] |
| Minneapolis | 1c | 2 [illegible] |
| [illegible] | 16 | 2 [illegible] |
| [illegible] | 1c | [illegible] |
| [illegible] | 1c | [illegible] |
| [illegible] | 1c | [illegible] |
| Denver | 16 | 3 [illegible] |
| Baltimore | 1c | 3 75 |
| [illegible] | 1c | 4 [illegible] |
| Detroit | 1c | 2 84 |
| [illegible] | 1c | [illegible] |
| Cincinnati | 1c | 3 30 |
| Kansas City | 1c | 2 35 |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots [illegible] per cu.yd.

| | 1½ In. — Current | 1½ In. — One Year Ago | Screened — Current | Screened — One Year Ago |
|---|---|---|---|---|
| New York | $ [illegible] | $3 00 | $1 25 | $1 50 |
| Boston | 2 [illegible] | [illegible] | [illegible] | 1 00 |
| Chicago | [illegible] | 2 13 | [illegible] | 2 15 |
| St. Louis, [illegible] | [illegible] | 1 55 | 1 60* | 1 55 |
| Seattle | [illegible] | 1 25 | 1 50 | 1 25 |
| Detroit, [illegible] | [illegible] | 2 50 | 3 00 | 2 00 |
| Minneapolis, [illegible] | [illegible] | 1 35 | 1 00 | 1 25 |
| Cincinnati | [illegible] | 1 50 | 1 60 | 1 45 |
| San [illegible] | [illegible] | 1 50 | 1 50 | 1 50 |
| [illegible] | [illegible] | 3 00 | 2 00 | 2 75 |
| New Orleans | 2 85 | 3 00 | 1 35 | 1 40 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Atlanta, per ton | 2 35 | 2 25 | 2 25 | 2 25 |
| Detroit | 2 25 | 2 50 | 2 25 | 2 50 |
| [illegible] | 1 40 | 1 40 | [illegible] | 60 |
| Montreal, per ton | 1 56 | 1 45 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | 1 60 |

Pea gravel and Pearl [illegible] in Ottawa, $[illegible] per ton; screened, to [illegible] 80c. per ton.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. — Current | 1½ In. — One Year Ago | ¾ In. — Current | ¾ In. — One Year Ago |
|---|---|---|---|---|
| New York | $1 90@ 2 00 | $1.90 | $1 90@ 2 00 | $2.15 |
| Chicago | 2.50 | 2.35 | 2.50 | 2 50 |
| St. Louis, delivered | 1.60* | 1.90 | 1.60* | 1 90 |
| Dallas | 2 80 | 3 50 | 2 80 | 3 50 |
| San Francisco | 2.25 | 1 50 | 2 50 | 1 50 |
| Boston | 3 00 | 3 00 | 3 00 | 3 00 |
| Minneapolis, [illegible] | 2 00 | 2.25 | 2 25 | 2 50 |
| Kansas City† | 1 25 | 2 35 | 1 40 | 2 35 |
| Denver | [illegible] | 3 75 | | 3 75 |
| Seattle, delivered | 3.00 | 3 00 | 3 50 | 3 50 |
| Atlanta | 2.25* | 3 10 | | |
| Cincinnati, delivered | 2.06 | | 2.06 | 1.65 |
| [illegible] | 1.60* | 1 60 | 1.60 | 1 70 |
| Detroit | 2 00* | 2 00 | 2 00* | 2 00 |
| Baltimore | 1.75* | 1 60 | 1 75* | 2 00 |
| Montreal | 2 00* | 2 30 | 2 10* | 2 55 |
| [illegible] | 3 20 | | 3 10 | |

*Per ton. †F.o.b. Joplin, Mo.

**CRUSHED SLAG**—Price of crushed slag, [illegible] per 100 lb. at plants:

| | 1½-In. | ¾ In. | Roofing | Sand |
|---|---|---|---|---|
| Lehigh or Bethlehem, Pa. | $1 00 | $1 00 | $2 50 | $0 90 |
| [illegible] Catasauqua, Pa. | 1 00 | 1 00 | 2 00 | 90 |
| Buffalo, N. Y. and Lime Pt., Pa. | 1 25 | 1.25 | 2.25 | 1 25 |
| Emaus, Pa. | 1 25 | 1 25 | | 1 25 |
| East Canaan, Conn. | 1 25 | 1 35 | 4.00 | 1 10 |
| Birmingham, Ala. | 1.00 | 1 10 | 2 05 | 90 |
| Toledo, Ohio | 1 50 | 1 50 | 2 35 | |
| Atlanta, Ga. | | 1 10 | | |
| Easton, Pa. and New Jersey | 1 20 | 1 20 | 2 50 | 90 |
| Western Pennsylvania and New Jersey | 1 25 | 1 25 | 2 50 | 1 25 |

Birmingham, f.o.b. pier, $1.15 (or $2.75 per cu.yd. erected)

**LIME**—Warehouse prices:

| | Hydrated, per 180-Lb. Barrel — Finishing | Hydrated, per 180-Lb. Barrel — Common | Lump, per 180-Lb Barrel (net) — Finishing | Lump, per 180-Lb Barrel (net) — Common |
|---|---|---|---|---|
| New York | $1.[illegible] | $.. | $.. | $3 79* |
| Chicago | 20 00 | | | 1 75 |
| St. Louis | [illegible] | 20 00 | | 2 50* |
| [illegible] | [illegible] | | 3 50† | 3 25 |
| Dallas | 27 50 | 25 00 | | 3 00† |
| Cincinnati | 16 70 | 14 [illegible] | | 1.[illegible] |
| San Francisco | 25.40 | 22.00 | | 2 25 |
| Minneapolis | 29.00 | 22.00 (white) | 2.00 | 1 80 |
| Denver | [illegible] | 3.20 (bbl.) | 1.00 (bu.) | |
| Detroit | 22.00 | 19.00 | 2.00† | 1 80* |
| Seattle | 27.00 | | 3 50 | |
| Los Angeles | | 30.00 | 3.00* | 3 00* |
| Baltimore | 22 25 | 17.50 | | 12 75 |
| Montreal | 28.00 | [illegible] | 15.00‡ | |
| Atlanta | 1.[illegible] | [illegible] | 2 00 | 1 30 |
| New Orleans | [illegible] | 37 50 | [illegible] | 2 25 |

*280-lb barrels. †Per 180-lb. barrel. ‡Per ton.

NOTE—Refund of 10c per barrel.

**NATURAL CEMENT**—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bag:

| | Current | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2.80 | $1.50 |
| [illegible] | 1 60 | 1 60 |
| New [illegible] | 3 [illegible] | 3 [illegible] |
| [illegible] | 11 00 ton | 1 [illegible] |
| [illegible] | 1 87 | 2 85 |
| Boston (Rosendale) | 1.05@1.95 | 2.35 |

**PORTLAND CEMENT**—Current prices are for [illegible] carload lots, [illegible] bags, to contractors:

| | Current — Without Bags | One Month Ago — Without Bags | One Year Ago — Without Bags |
|---|---|---|---|
| New York, delivered | $ [illegible] | $2 86 | $4 [illegible] |
| New York, alongside dock to [illegible] | [illegible] | 1 40 | 2 [illegible] |
| [illegible] | 1 80 | 1 80 | 2 [illegible] |
| Boston | 2.86 | 2.86 | 3 32 |
| Chicago | 2.17 | 2.17 | 2.15 |
| Pittsburgh | 2 17 | 2.17 | 2 20 |
| Cincinnati | 2 43 | 2 43 | 2 42 |
| Detroit | 2.43 | 2.43 | 3 00 |
| Indianapolis | 2.43 | 2.43 | 2 42 |
| Toledo | 2 49 | 2 49 | 2 28 |
| [illegible] | [illegible] | 2 [illegible] | 2 [illegible] |
| [illegible] | [illegible] | 2 [illegible] | 2 [illegible] |
| Duluth | 2.10 | 2 10 | 2 20 |
| Peoria | 2.45 | 2.45 | 2 32 |
| [illegible] | 2 [illegible] | 2 51 | 2 4[illegible] |
| Davenport | 2 47 | 2.47 | 2 36 |
| St. Louis | 2.90 | 3 00 | 2.85 |
| [illegible] | 3 00 | 3 00 | 2 85 |
| [illegible] | [illegible] | 3 36 | 3 24 |
| Minneapolis | 2.41 | 2.41 | 2 42 |
| Dallas | 3 10 | 3 10 | 3 80 |
| [illegible] | 3 16 | 3 10 | 3 03 |
| Cincinnati | 2 60 | 2 60 | 2 15 |
| [illegible] | [illegible] | 3 60 | 2 70 |
| Atlanta | 2.62 | 2 62 | 2 85 |
| Cincinnati | [illegible] | 3 51 | 3 10 |
| Los Angeles | [illegible] | 3 51 | 3 28 |
| Baltimore, delivered | 3 58 | 2 58 | 4 00 |
| Dayton | 2 43 | 2 43 | |
| Birmingham | 3 05 | 3 05 | |
| Ivanhoe | [illegible] | [illegible] | 2 76 |
| Montreal | [illegible] | 2 [illegible] | 2 [illegible] |

[illegible] bbl., 10c. each; 40c per 100 lb.; 80c per 100 lb. Montreal

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH by 4-INCH MESH

| Style Number | Weight in Pounds | Pittsburgh, Mill | New York (Warehouse) | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|---|
| 032 | 0.022 | $0.74 | 1.16 | .... | $1.15 | $1.24 |
| 049 | 0.028 | 0.94 | 1.45 | .... | 1.46 | 1.56 |
| 068 | 0.035 | 1.14 | 1.74 | .... | 1.80 | 1.92 |
| 093 | 0.045 | 1.46 | 2.20 | .... | 2.30 | 2.46 |
| 126 | 0.057 | 1.80 | 2.69 | .... | 2.86 | 3.07 |
| 153 | 0.068 | 2.14 | 3.18 | .... | 3.40 | .... |
| 180 | 0.078 | 2.46 | 3.63 | .... | 3.93 | .... |
| 245 | 0.103 | 3.24 | 4.74 | .... | 5.15 | .... |
| 287 | 0.119 | 3.75 | 5.46 | .... | 5.96 | 6.41 |
| 336 | 0.138 | 4.35 | 6.33 | .... | 7.32 | .... |
| 395 | 0.160 | 5.04 | 7.30 | .... | 8.00 | .... |

PAVING

| | | | | | | |
|---|---|---|---|---|---|---|
| 036P | 0.017 | $0.56 | .... | .... | $0.88 | .... |
| 053P | 0.024 | 0.79 | .... | .... | 1.24 | .... |
| 072P | 0.031 | 0.99 | .... | .... | 1.57 | .... |
| 097P | 0.040 | 1.28 | .... | .... | 2.02 | .... |
| 049R | 0.024 | 0.79 | .... | .... | 1.24 | .... |
| 067R | 0.031 | 0.99 | .... | .... | 1.57 | .... |
| 089R | 0.040 | 1.28 | .... | .... | 2.02 | .... |

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in width in rolls 150-, 200- and 300-ft lengths. Galvanized is about 15% higher.

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted area as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | $23.25 | $27 50 | $26.70 | $34 20 | $31 55 |
| 26 | 250 | 24.65 | 28 90 | 28.90 | 28.75 | 33.30 |
| 25 | 300 | 27.80 | 31 15 | 31.15 | | 36.00 |
| 24 | 340 | 29.10 | 33 10 | 33.10 | 33.00 | 37.45 |
| 22 | 433 | 33.80 | .... | .... | .... | 43.30 |

*Material shipped from mill, freight allowed, or at warehouse. Delivery charge 1c. per sq. yd.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.

ROLLED FROM BILLETS

| | Pittsburgh Mill | New York (Warehouse, Uncut) | Birmingham Mill | Chicago | St. Louis | Dallas | San Francisco |
|---|---|---|---|---|---|---|---|
| Inches | | | | | | | |
| and larger | $2.10 | $2.90 | **$2.75** | $3.13 | $3.02 | $3.75 | $2.35 |
| and larger | 2.15 | 2.98 | **3.10** | 3.17 | 3.07 | 3.80 | 2.40 |
| and larger | 2.20 | 3.03 | **3.10** | 3.23 | 3.12 | 3.85 | 2.45 |
| and larger | 2.35 | 3.08 | **3.10** | 3.38 | 3.27 | 4.00 | 2.60 |
| and larger | 2.60 | 3.13 | **3.10** | 3.83 | 3.52 | 4.45 | 2.85 |

*Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St Louis | Dallas | | Chicago | St Louis | Dallas |
|---|---|---|---|---|---|---|---|
| in and larger | $2.00 | $2.00 | $4.25 | | $2.40 | $2.55 | $3.40 |
| | 2.05 | 2.05 | 4.30 | | 2.40 | 2.40 | 3.45 |
| | 2.15 | 2.20 | .... | | .... | .... | 3.50 |

**BRICK**—Contractors price per 1,000 in cargo or carload lots as follows:

| | Common— Current | One Month Ago | One Year Ago | —Paving Block— 3-inch* | 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $18.40 | $18.40 | $33.00 | $47.00 | $47.00 |
| New York (at dock) | 15@15.50 | 15.50 | 25.00 | .... | .... |
| Chicago | 12.00 | 12.00 | 16.00 | 34.00 | .... |
| St. Louis, salmon | 17.00 | 17.00 | 16.00 | .... | .... |
| Denver, salmon | 14.00 | 14.00 | 17.00 | .... | .... |
| Dallas | 12.50 | 12.50 | 24.00 | 44.00 | .... |
| San Francisco | 18.00 | 18.00 | 18.00 | .... | 44.38 |
| Los Angeles | 15.50 | 15.50 | 13.50 | .... | (not used) |
| Boston (del.) | 15.00 | 70.00 | 32.00 | 42.00 | 50.00 |
| Minneapolis (del.) | 17.00 | 17.00 | 24@26 | 37.00 | 43.00 |
| Kansas City | 15.50 | 15.50 | 22.00 | .... | .... |
| Seattle | 17.00 | 14.00 | 15.00 | 48.00 | 53.50 |
| Cincinnati | 19.00 | 18@20 | 24.00 | 37.00 | .... |
| Montreal (del.) | 18.00 | 18.00 | 16.00 | 100.00 | 120.00 |
| Detroit (del.) | 16.25@18 | 16.25@18 | 23.00 | 41.30 | 44.00 |
| Baltimore (del.) | 25.00 | 25.00 | 20@25 | 40.00‡ | 44.00‡ |
| Atlanta | 14.00 | 11.00 | .... | 40.00 | .... |
| New Orleans | 14.50 | 14.50 | 25.00 | .... | .... |
| Birmingham | 12.00 | .... | .... | .... | .... |

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

**HOLLOW TILE**—Price per block in carload lots for hollow building tile:

| | New York— Current on Trucks* | One Year Ago | Chicago | St. Louis building partition | San Francisco | Perth Amboy N. J. Factory |
|---|---|---|---|---|---|---|
| 4x12x12 | $0.12320 | ..... | $0.09475 | $0.090 | $0.145 | ‡ |
| 6x12x12 | 16420 | | 13740 | 121 | 21 | |
| 8x12x12 | 219 | | 16105 | 165 | 29 | 2084 |
| 10x12x12 | | | 19700 | 218 | | 2605 |
| 12x12x12 | | ..... | 23750 | 250 | | 3126 |

*5% per off for cash.

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Boston | $0.165 | $0.198 | $.227 |
| Minneapolis | .084 | 161 | .230 |
| Minneapolis (delivered) | 092 | 175 | .250 |
| Cincinnati | .07425 | 1364 | 1418 |
| Kansas City | 115 | 207 | |
| Denver | .09 | 16 | 23 |
| Seattle | .10 | 175 | 30 |
| Los Angeles factory | 11 | 192 | 23* |
| New Orleans | 14 | 25 | 42 |
| Detroit (delivered) | .107 | 250 | 2776 |
| Montreal | 20 | 30 | 35 |
| Baltimore | 16 | 27 | 45 |
| Atlanta | .0765 | 146 | .... |
| Dallas | 13 | .... | .... |
| Birmingham | 11 | 18 | .... |

**STRUCTURAL MATERIAL**—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

| | Pittsburgh, Mill | New York (del.) | Birmingham | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | 1.85 | $2.88 | $2.76 | $4.50 | $3.12½ | $2.88 | $4.16 |
| Channel, 3 to 15 in. | 1.85 | 2.88 | 2.76 | 4.50 | 3.12½ | 2.88 | 4.16 |
| Angles, 3 to 6 in., ¼ in. thick | 1.86 | 2.88 | 2.76 | 4.50 | 3.12½ | 2.88 | 4.26 |
| Tees, 3 in. and larger | 1.85 | 2.88 | 2.76 | 4.50 | 3.12½ | 2.88 | 4.26 |
| Plates | 1.85 | 2.88 | 2.76 | 4.50 | 3.32½ | 2.88 | 4.26 |

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Pittsburgh, Mill | New York— Current | One Yr. Ago | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| | | Warehouse | | | | | |
| ½ in. and larger | $2.65 | $4.50 | $6.00 | $4.53 | $4.12½ | $5.50 | $5.75 |

CONE HEAD BOILER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | 4.25 | 4.50 | 7.10 | 4.63 | 4.23½ | 6.10 | 5.30 |
| ⅝ and ¾ | 4.90 | 4.65 | 7.25 | 4.78 | 4.23½ | 6.35 | 6.05 |
| ⅞ and 1 | 4.15 | 4.90 | 7.50 | 5.03 | 4.23½ | 6.60 | 6.30 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2.75@$3.00 | $3.78 | $5.00 | $5.00 | $4.48 | $4.95 |
| Cut | 3.00@3.25 | 6.85 | 6.28 | 7.75 | 4.98 | 5.00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

| | New York 1-Ply | New York 2-Ply | New York 3-Ply | Philadelphia 1-Ply | Philadelphia 2-Ply | Philadelphia 3-Ply |
|---|---|---|---|---|---|---|
| | 1 c.l. | 1 c.l. | 1 c.l. | 1 c.l. | 1 c.l. | 1 c.l. |
| No. 1 grade | $2.07 | $2.43 | $2.85 | $1.97 | $2.33 | $2.75 |
| No. 2 grade | 1.77 | 2.08 | 2.45 | 1.67 | 1.93 | 2.35 |

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.80 per roll in carload lots and $3.05 for smaller quantities f.o.b. Philadelphia.
Shingles, red and green slate finish, cost $7.95 per square in carloads; $8.20 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices per ton f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq. ft.) per roll of 432 sq. ft. | $2.60 |
| Tar pitch (in 400-lb. bbl.) per 100 lb. | 1.95 |
| Asphalt pitch (in barrels) per ton | 47.50 |
| Asphalt felt (light) per ton | 80.50 |
| Asphalt felt (heavy) per ton | 84.50 |

**SHEETS**—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

| Blue Annealed | Pittsburgh, Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $3.10 | $3.25 | $3.88 | $4.25 | $3.60 |
| No. 12 | 3.15 | 3.30 | 3.98 | 4.35 | 3.70 |
| No. 14 | 3.20 | 3.35 | 4.08 | 4.45 | 3.78 |
| No. 16 | 3.30 | 3.45 | 4.18 | 4.55 | 3.90 |
| Black | | | | | |
| *Nos. 18 and 20 | 3.85 | 4.00 | 4.95 | 5.30 | 4.40 |
| *Nos. 22 and 24 | 3.90 | 4.05 | 5.00 | 5.35 | 4.50 |
| *No. 26 | 3.95 | 4.10 | 5.05 | 5.40 | 4.55 |
| *No. 28 | 4.00 | 5.00 | 5.15 | 6.50 | 4.60 |
| Galvanized | | | | | |
| No. 10 | 4.00 | 4.15 | 5.45 | .... | 4.50 |
| No. 12 | 4.10 | 5.10 | 5.55 | 6.60 | 4.20 |
| No. 14 | 4.25 | 4.40 | 5.55 | 6.60 | 4.36 |
| Nos. 17 to 21 | 4.40 | 4.55 | 5.85 | 6.90 | 4.66 |
| Nos. 22 and 24 | 4.55 | 4.70 | 6.00 | 7.00 | 4.80 |
| *Nos. 25 and 26 | 4.70 | 4.85 | 6.30 | 7.30 | 4.96 |
| *No. 28 | 5.00 | 6.00 | 6.40 | 7.50 | 5.10 |

* For painted corrugated sheets add 30c. per 1000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

**LINSEED OIL**—These prices are per gallon:

| | New York— Current | New York— One Year Ago | Chicago— Current | Chicago— One Year Ago |
|---|---|---|---|---|
| Raw in barrel (5 bbl.) | $0.80 | $1.53 | $0.75 | $1.95 |

WHITE AND RED LEAD—Prices per [illegible]

| | White Lead | | | | | |
|---|---|---|---|---|---|---|
| | In Oil | | | | In Oil | |
| | Dry | In Oil | Dry | In Oil | | |
| 1000-lb. keg | 13 00 | 14 50 | 13 50 | 17 | 15 50 | |
| 100-lb. kegs | 13 25 | 14 75 | 15 75 | 2 | 13 25 | 15 75 |
| 25-lb. pail | 1 | 15 00 | 16 00 | 7 | 13 50 | 16 00 |
| 12½-lb. pail | 1 | 17 50 | 18 | | 16 00 | 8 |
| 1-lb. can | 1 | 5 | 20 50 | | 18 | |

## LUMBER

San Francisco—Prices for carload lots:

| | Log Run | | | Rough Edge | | Dressed | |
|---|---|---|---|---|---|---|---|
| | 12 Ft. | 14 to 24 Ft. | 25 to 32 Ft. | 12 Ft. | 14 to 24 Ft. | 25 to 32 Ft. | |
| 3x4 to 4x4 | $24 50 | $25 50 | $ | | | $ | |
| 3x10 and 4x10 | 2 | | | | | | |
| 3x12 and 4x12 | 2 | | | | | | |
| 4x4 to 8x8 | 2 | | | | | | |
| 6x10 and 12 | 2 | | | | | | |
| 3x14 | 26 50 | 27 50 | 28 50 | | | 30 50 | |
| 4x14 and 12 | 2 | | | | | | |
| 4x14 | 27 00 | 28 00 | 29 00 | | | 31 00 | |

| | 24 Ft. and Under | 25 to 32 Ft. | 33 to 40 Ft. |
|---|---|---|---|
| 10 | $25 50 | $27 50 | $28 50 |
| 14 | 2 | | |
| 16 | 2 | | |
| 14 | 27 00 | 29 00 | 29 50 |

New York, Chicago and St Louis

| | Southern Pine | | | | Douglas Fir | |
|---|---|---|---|---|---|---|
| | 20 Ft. | 22–24 | 20 Ft. and Under | 22–24 Ft | | |
| 3x4 to 8x8 | $31 | $34 | $ | $ | | |
| 3x10 to 10x10 | | | | | | |
| 3x12 to 12x12 | 43 00 | 44 00 | 54 00 | 55 00 | | |
| 3x14 to 14x14 | 48 00 | 49 00 | 59 00 | 60 00 | | |
| 3x16 to 16x16 | 55 00 | 56 00 | 64 00 | 65 00 | | |
| 3x18 to 18x18 | | | | | | |
| 4x20 to 20x20 | | | | | | |

*Wholesale price on dressed or long-leaf pine. Short-leaf runs up to 14 x 14 costs $5 per M. less.

Price to contractors, on lighters or cars, New York, about $5 additional.

St. Louis: Yellow pine, 22–24 ft. long, 3 x 4 to 4 x 4, $ ; 3 x 6 to 8 x 8, $33; 3 x 12 to 5 x 12, $ ; 3 x 14 to 4 x 14, $ ; 3 x 16 to 4 x 16, $ ; 3 x 18 to 5 x 18, $58.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2 for merchantable and $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes

Other Cities

| | 8 x 8-In. x 20-Ft. and Under | | | | 12 x 12-In. 20 Ft. and Under | |
|---|---|---|---|---|---|---|
| | P. | Fir | Hemlock | Spruce | P. | Fir |
| Boston | $45 00 | $52 00 | $55 00 | $45 00 | $55 00 | $52 00 |
| Seattle | | | | | | |
| New Orleans | 26 00 | 25 00 | | | 31 00 | 27 00 |
| Baltimore | 58 00 | | | | 68 00 | |
| Cincinnati | | 50 00 | | | | 64 00 |
| Montreal | | 85 00 | 68 00 | 78 00 | 78 00 | 100 00 |
| Los Angeles | | 83 00 | 82 00 | | | 88 00 |
| Detroit | | Quotations for bills as may | | | | |
| Denver | | | | | | |
| Minneapolis | 42 00 | | | | 49 00 | |
| Atlanta | 27 50 | | | | 39 00 | |
| Dallas | 35 00 | | | | 46 00 | |
| Kansas City | 34 00 | 35 00 | | | 39 00 | 37 00 |
| Birmingham | 30 00 | | | | 38 00 | |

| | 1-In. Rough, 10 In. x 16 Ft. and Under | | | 2-In. T. and Gr. 10 In. x 16 Ft | |
|---|---|---|---|---|---|
| | P. | Fir | Hemlock | P. | Fir |
| Boston | $45 00 | $48 00 | $37 00 | $43 00 | $48 00 |
| Seattle | | 20 00 | | | 20 00 |
| New Orleans, at mill | | 22 00 | | | |
| Baltimore | 42 50 | | | 40 00 | |
| Cincinnati | | | | | |
| Montreal | 120 00 | | 60 00 | 80 00 | 80 00 |
| Los Angeles | | 41 00 | 40 00 | | 28 |
| Denver | | 29 75 | | | 27 75 |
| Minneapolis | 38 00 | | 31 25 | 36 00 | |
| Atlanta | 15 00 | | | 18 00 | |
| Dallas | | 33 00 | | 35 00 | |
| Kansas City | 36 00 | 30 00 | | | 31 00 |
| Detroit | 48 00 | | | | |

*Mixed carloads up to 12 ft. long, $1 per M. extra; up to 30 ft.

Birmingham—Dimension and form lumber delivered on building site, $26@$28. For 8x8x20 and smaller, 85 per cent heart, $33; 12x12x20 and smaller, 85 per cent heart, $42; 1x10x16 and smaller, rough, $16; 2x10x16 t. and g., $22; f.o.b. mill.

Detroit—General quotations not available. Rough fir, 2 x 12 and 2 x 4, by 16 ft., $44. 3 x 12 x 16 ft., $48. 2 x 4 x 16, $42.

## FREIGHT RATES

[illegible] freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

| | | | |
|---|---|---|---|
| [illegible] | $ 33 | [illegible] | $ 33 |
| Birmingham | 76½ | Kansas City | 81½ |
| Baltimore | 41 | Fir | 51 |
| Buffalo | 29½ | New York | 38 |
| Chicago | 38 | Pacific Coast (all rail) | 1.66† |
| [illegible] | 44 | [illegible] | 42 |
| [illegible] | 1.15* | [illegible] | 33 |

Note—All 3% tax [illegible]

Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel [illegible]

## CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $ | $2 55 | $2 55@$3 65 |

WIRE ROPE—Discounts from list prices [illegible] grades of bright and galvanized are as follows:

| | New Year |
|---|---|
| [illegible] | |
| [illegible] | |
| [illegible] | |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| [illegible] | |
| [illegible] | |

Special [illegible] for logging and mine use, 12½% off.

[illegible] steel round strand 30% off; flattened strand 15% cast steel [illegible] 17½.

[illegible] plow steel 12½% galvanized iron rigging and guy rope.

[illegible] plow steel 17½% galvanized iron rigging and guy rope.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0.18 | New Orleans | 1 |
| New York | .16½ | Los Angeles | 1 |
| Chicago | .18 | Seattle | .16 |
| Minneapolis | 17 | St. Louis | 1 |
| San Francisco | .15 | Montreal | .30 |
| Atlanta | .1950 | Detroit | 18 |
| Denver | .19 | Baltimore | 25 |
| Cincinnati | .17 | Kansas City | 16½ |
| Dallas | .29 | Birmingham | 20½ |

*780-ft. coils.

EXPLOSIVES—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | $0.31 | $0.345 |
| Boston | .24 | .275 |
| Kansas City | .2425 | .2925 |
| Seattle | .20 | .235 |
| Chicago | .2425 | .2675 |
| Minneapolis | .2299 | .2555 |
| St. Louis | .28 | .315 |
| Denver | .2375 | .2725 |
| Dallas | .29 | .375 |
| Los Angeles | .25 | .29 |
| Atlanta | .27 | .305 |
| Baltimore | .2875 | .3175 |
| Cincinnati | .265 | .2765 |
| Montreal | .2150 | .2550 |
| Birmingham, delivered | .1925 | .2275 |
| New Orleans | .2725 | .3075 |

PILES—For spruce and plain pine piles, delivered New York, the price is as follows.

| | |
|---|---|
| Spruce 10-in. butts, 5-in. tops, length 20-30 ft | $11 50 |
| Spruce 12-in. butts, 6-in. tops, length 30-40 ft | 10.50 |
| Pine 12-in. butts, 6-in. tops, length 41-50 ft | 12.00 |
| Pine 14-in. butts, 6-in. tops, length 51-60 ft | 16.50 |
| Pine 14-in. butts, 6-in. tops, length 61-71 ft | 21.00 |

| | Dallas | St. Louis |
|---|---|---|
| 6-in. x 20-ft | $4 60 | $7 90 |
| | 7-in. x 30-ft | 10 10 |
| 6-in. x 30-ft | 7 10 | 15 55 |
| | 8-in. x 35-ft | 16 55 |
| 8-in. x 30-ft | 8 45 | 16 05 |
| | 7-in. x 40-ft | 16 05 |
| | 8-in. x 45-ft | 27 05 |
| 8-in. x 35-ft | 10 38 | 28 05 |

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 heavy melting steel | $16 50 | $11 00 | $11 00 |
| Steel rails | | 14 00 | 11 50 |
| No. 1 railroad wrought | 17 50 | 15 00 | 14 |
| No. 1 machinery cast | 5 00 | 4 00 | 5 00 |
| Cast iron car wheels | 5 75 | 6 00 | 7 00 |
| Heavy cast scrap | 8 50 | 14 00 | 12 50 |
| Heavy melting steel axles | 9 00 | 13 00 | 12 00 |
| Locomotive tires | 14 00 | 30 00 | 27 00 |

SHIP SPIKES—Current prices per 100 lb.

| In | San Francisco—Galv | San Francisco—Black | Spikes |
|---|---|---|---|
| [illegible] | $9 10 | $8 40 | $8 55 |
| [illegible] | 8 65 | 6 65 | 8 25 |
| [illegible] | 8 50 | 6 50 | 8 30 |

Pittsburgh base, $[illegible] to $3 40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 87 — NEW YORK, AUGUST 11, 1921 — Number 6

## Better Times for the Railroads

CURRENT returns of railway operating income and earnings are showing consistent improvement. There is some increase in traffic but, more important, there is successful effort to reduce operating expenses. The returns to date are by no means conclusive but they are decidedly encouraging. In fact, only the unsettled labor and wage situations becloud an otherwise hopeful railroad outlook. The government's indebtedness to the carriers is being paid under recent congressional authorization. The sum spent for capital expenditures during federal control will probably be funded. Deficits are being reduced and in some cases are being turned into profits. Even the labor situation has more hopeful aspects than it did six months ago. This is a hopeful situation. It promises some relief to a much distressed industry, and one whose satisfactory condition is necessary to general prosperity.

## Proved by the Ages

SENATOR FRANCE in his views on leaving Russia, cabled to the United States by the *New York Times*, merely reinforces what we have heard from time to time for over two years—that the communistic state in Russia is a failure and that those in control have gradually adopted the methods, if not the theories, of a capitalistic régime. However, the senator's statements are rather broader than previous reports and indicate that the powers that be in Russia are fully aware of the completeness of the breakdown of the Marxian experiment and appreciate the necessity of basing their society on private ownership. The peasants are now land-owners, even though the land was secured by confiscation, and form the basis of a society that will demand that rights of private ownership be respected. The Russian lesson has been expensive. It has ended in accordance with prediction—in failure; but the fact of the ending and the reversion to the only theory that, with weak human nature as the predominant factor, the ages have proved workable as the basis of society are worth emphatic and repeated recording.

## Experiment and Theory

APT demonstration of the true value of approximate theoretical analysis may be found in the subject of eyebar-head stresses. Rigidly precise analysis of these stresses is impossible, and it might therefore be concluded that construction depends on empirical data, since approximate analysis involves errors of unknown amount. The design of heads has, in fact, been wholly an empirical matter. Now, however, application of approximate analysis to the case shows that very high stresses exist in eyebar heads. These stresses are so high that their existence should be verified or disproved by test. Further, physical test—by strain-gage measurement of eyebars in the testing machine—must be depended upon for the actual determination of the stresses and for improvement of head design. The theoretical investigation is limited to reconnaissance service: it suggests certain probabilities, and marks out a line for experimental research. This is the true service of approximate analysis and, if used accordingly and combined properly with physical experiment, theoretical study will always remain the primary instrument of engineering progress.

## Eyebar Stress and Safety

WITH respect to the relation between bridge safety and the high stresses just referred to, it is pertinent to recall that back of the reputation of the eyebar as the most dependable element of bridge construction is a remarkable record of safe performance. Some years ago a bridge in the West fell under circumstances that threw suspicion on one of its bottom-chord eyebars, which was found broken; the incident aroused widespread question because of the very fact that it was unprecedented. Though the case was never investigated, an omission that is still felt as a distinct loss to engineering knowledge, it had value in emphasizing the high degree of safety of eyebars shown by their past record. Because of this excellent record it was quite a shock when Theodore Cooper came before the American Society of Civil Engineers in 1906 with a paper on the great distortion which the head of an eyebar undergoes under even moderate stressing, and it is almost equally disconcerting to read the present results with their high stress figures. But the important thing to remember is that (with normal, ductile steel, at least) this distortion affects the safety of bars in the ordinary sense very little. With special steels and in structures of special type, head distortion is of more direct importance, as in suspension-bridge eyebar chains. The article in the present issue originated directly in connection with such eyebar chains, and the facts as well as the approximate analysis it presents make a strong claim for careful study in this connection. At the same time their application to the design of eyebars for use in ordinary truss bridges is obvious, since no engineer will be willing to tolerate the possibility of his bridge being crippled at loads hardly exceeding his design loads. It may be hoped that the subject will be explored by a thorough test investigation. But the question at issue does not primarily concern safety, as the excellent record of eyebars conclusively proves.

## The Engineer in Building Control

IN THE LAST analysis municipal building inspection is a means of waste prevention, furthering both public and private economy. Guarding public safety through prevention of accident, perhaps the most important single objective of building control, is itself an indirect waste prevention, while the other purposes

of building code administration, such as the elimination of slipshod and low-grade construction, are obviously of direct waste-preventive effect. In the light of this fact the statement that "city inspection is inadequate to the demands upon it" made in this journal last week by F. P. Cartwright, is a serious charge, though one that will be admitted by men conversant with building work. The condition referred to is not temporary, or restricted to one city, but will be found everywhere and is permanent in its very nature. It constitutes a problem that is always before us. To make city building inspection thorough enough to guarantee the excellence of construction is quite impracticable. Various interests are at work—for example the Building Officials Conference, whose annual meeting was recently reported in these columns—to make the control of building operations more effective, but a full solution of the problem is not to be hoped for. The sketch of the single case of Rochester as outlined by Mr. Cartwright is typical. Extremely incomplete functioning, scattering of responsibility, and confusion of authority are common defects, which in combination tend to discourage and burden sound building construction. The remedies Mr. Cartwright indicates may be summed up in the term "better co-ordination." What this will accomplish, the author's exposition makes plain. But however efficiently co-ordinated, building control by governmental and insurance authorities can at best furnish only a general check on results. For ultimate assurance of competent building construction the engineer and the architect are the only reliance. To maintain these important agencies in full authority is one of the objects for which we require not only the maintenance of high professional ideals, but as well the establishment of definite relations between public and profession.

## Figuring from a False Base

WEEK before last comment was made on the remarkable fact that the shipments of cement in the first six months of this year were 98 per cent of those for the same period of 1920, while shipments of stone, sand and gravel were 87 per cent. These figures, manifestly, are not a correct index of the conditions in the construction field. A more correct picture is shown by a comparison of the contracts let in the respective periods. For example, for the first six months of this year the contracts let aggregated 60 per cent of those let during the same period last year, the figures being based upon *Engineering News-Record* compilations. In other words, the industry is operating at 60 per cent of last year's capacity.

This comparison more truly reflects the feeling of depression that obtains in the industry; but, on broad consideration, is a view based on these figures justified? In other words, is comparison with 1920 the correct way to gage the activity of the construction industry? Bearing in mind that during the first half of 1920 we witnessed the greatest peace-time activity that American business has ever known, we believe that the 1920 base is not a proper one for comparison. If we could, in a year or two, hope to see again the activity of the early part of 1920 we would be justified in accepting that base. There is a general belief, however, that such abnormal activity will not recur for some years. Is it not wise, therefore, temporarily to accept a lower base?

For present thinking, the year 1915 would be better, and 1913 has some features to recommend it, for it was entirely free from war influence. However, 1913 might not be a proper base for we should rightly look for a gradual increase in business, proportionate to the growth of population, between 1913 and the present date.

If 1915 be taken as the base for judging of construction activity it will be generally agreed, we believe, that 1921 is a fairly good year. In saying that we are fully cognizant of the present extent of unemployment and of the back-breaking carrying charges due to expanded organizations and plants. The thinking may not lighten these burdens, but will put us in a sounder frame of mind and prepare us for judging more justly of the business activities of the next few years. Eventually, of course, business will "come back" to the fullness of 1920's activity, when, with full employment for all our workers and improved efficiency, production will exceed that of 1920, even though the value in dollars be less.

Bearing in mind, then, the warrant for comparison of 1915 or 1913, and that the contracts let in the first half of this year, within the limits of *Engineering News-Record's* tabulations, amounted to $579,000,000, there is reason for optimism and faith rather than discouragement. The contemplation of these figures, we freely admit, may give little satisfaction to the builders of industrial plants, whose specialized field is at the foot of the list, with only 17½ per cent of last year's activity, but the showing made by figuring from an earlier base is decidedly encouraging to the industry as a whole.

## Because We Lack Faith

POINTING in the same direction as the preceding editorial is an article which appeared in the July 7 issue of *American Machinist*, by Theodore H. Price, editor of *Commerce & Finance*, of New York. He contends that the world is as rich today as it was before the war and that there is no sound reason for discouragement at the tremendous size of the world's debts. He agrees that serious problems are involved in their payment, but contends that an ample margin of values exists to offset those debts, even if not in the liquid form that would be represented by gold bullion. Summing up he says:

"If we had an inventory of all the property of the world as of June 1, 1914, and could compare it with another made June 1, 1921, it would probably be found that the value of humanity's assets had increased sufficiently to offset the debt incurred during the last seven years and that the world is just as rich now as it was before the war. This statement will doubtless be challenged by some who will ask how the losses caused by what is called 'the waste of war' have been met. The answer is that these losses were met by intensive production and effort while the war was being fought."

His closing paragraph sums up the situation with reference to America in admirable fashion:

"Our resources are undiminished, our opportunities are numberless, and the obstacles in the way of their development are chiefly the creatures of our imagination. Faith and industry are qualities that will triumph over all the obstacles that the economist can conjure up."

The same thought is expressed in President Harding's Pilgrim address: "Solvent financially, sound economically, unrivaled in genius, unexcelled in industry, reso-

lute in determination and unwavering in faith, these United States will carry on."

One can come to the optimistic point of view expressed by Mr. Price and President Harding from various angles—and the variety of avenues to the single conclusion is all the more warrant for believing that the conclusion is correct. Faith and confidence are the solvents of the present difficulty. The world is not bankrupt, even though a receiver is needed to insure proper and orderly re-division of assets.

## Barring Foreign Port Equipment

LAST WEEK the New York City Board of Estimate and Apportionment, in approving of the calling for bids for the crane equipment of two of the Staten Island piers, added the condition that the equipment must be of American manufacture. This was done because of representations that foreign manufacturers, chiefly German, were expected to seek the business and, if price alone were considered, would capture the contracts. It was contended that the foreign cranes were not as good as American equipment of the same type and that an American city should favor domestic manufacturers in order to give employment to American workmen. The specifications, it is stated, favor the German manufacturers due to the influence of the foreign lessees of the pier, who, under the curious theory of port development held by the present city administration, have almost complete control of pier design and equipment.

What proportionate weight these arguments had with the board cannot be ascertained, nor has an engineer's report to the board on the subject been made public. The decision, however, is one of exceptional interest in connection with our present export and import trade situation and involves principles of importance to American engineers and manufacturers.

Of the statements made, the more important is the contention that the foreign cranes are inferior to those of American make. This is a broad statement, susceptible of proof only by the most painstaking inquiry into the service records of both foreign and American equipment. Lacking such an inquiry it is not a sufficient argument for excluding the foreign equipment.

Allied, however, to this contention are the long-time performance, maintenance and repair factors, to which much weight must be attached in reaching a decision. The German manufacturer, under present necessity, is looking for any market into which he can break. Obviously he cannot look here for a permanent market in dock cranes and similar port equipment; his present opportunity is a temporary one, due to the war unsettlement. His interest in long-time performance would be less, therefore, than that of an American firm which is looking for repeat orders, and whose reputation would be very much jeopardized by failure of its equipment in so important a location as the Staten Island piers. Moreover, American firms would be interested in the maintenance, and could more readily take care of repairs.

In the future, too, when European, and particularly German, costs rise, repair bills might mount to high figures. New York is buying cranes not for a three or a five-year, but for a twenty-year use. Consequently, it is justified in looking pretty well into the future and of taking into consideration, not present-day conditions but those that will obtain when we are some four or five years further removed from the abnormal conditions created by the war.

To the argument that an American city should be willing to spend about $100,000 more for cranes that can be bought abroad for probably $400,000, on the plea that it would help feed unemployed American workmen, relatively little consideration need be given here. Everyone desires to see our unemployed put to work. However, *all other conditions being equal* we question whether New York City, whose tax rate is already very high and under protest by the taxpayers should saddle its people with the additional expense. No stockholder would approve his board of directors spending $100,000 extra in a $400,000 deal on philanthropical grounds.

We are fully aware, of course, of the outcry that would be raised against public officials who, under present conditions, would let contracts to foreign, and particularly German, firms. In fact, a majority of the public itself might take the ground that American workmen should be favored even at higher cost, but economically the contention cannot be maintained.

Aside from these factors is another point that requires consideration, namely, that of adaptability to American workmen and to the other items of dock equipment. There can be little doubt that the American workman works best with American tools. He is familiar with American systems of control. He knows how to gage his operations to a nicety due to long practice with American equipment. Moreover, he maintains best the type of equipment with which he is familiar. Further than that, however, the equipment must fit in with everything else of a mechanical nature involved in dock operations, with our types of freight cars, and our locomotive clearances, with our motor trucks and other mobile equipment.

It may be contended that all of these matters can be covered by specifications. Theoretically, that is true—true in the same sense that a manufacturer of heavy machinery having seen a new type of equipment built by a competitor can quickly produce a similar design. Yet we know from long and disastrous experience that this manufacturer will require months and possibly years to work the "bugs" out of the design. Similarly, there are many intangibles in fitting in a system of cranes to all manner of American equipment.

On the whole, therefore, on the grounds of maintenance, repairs and adaptability there is reason to believe that the decision of the New York board to eliminate foreign equipment may be sound. The engineer's report, not now available, would shed light on the situation. It is well to emphasize, however, that a decision of this sort is essentially an engineering matter. The better method of procedure would have been to allow the foreign bids to be received—on specifications, however, untainted with foreign practice—and then, with the differential in first cost available, to weigh against the saving in price the various considerations that have here been set down.

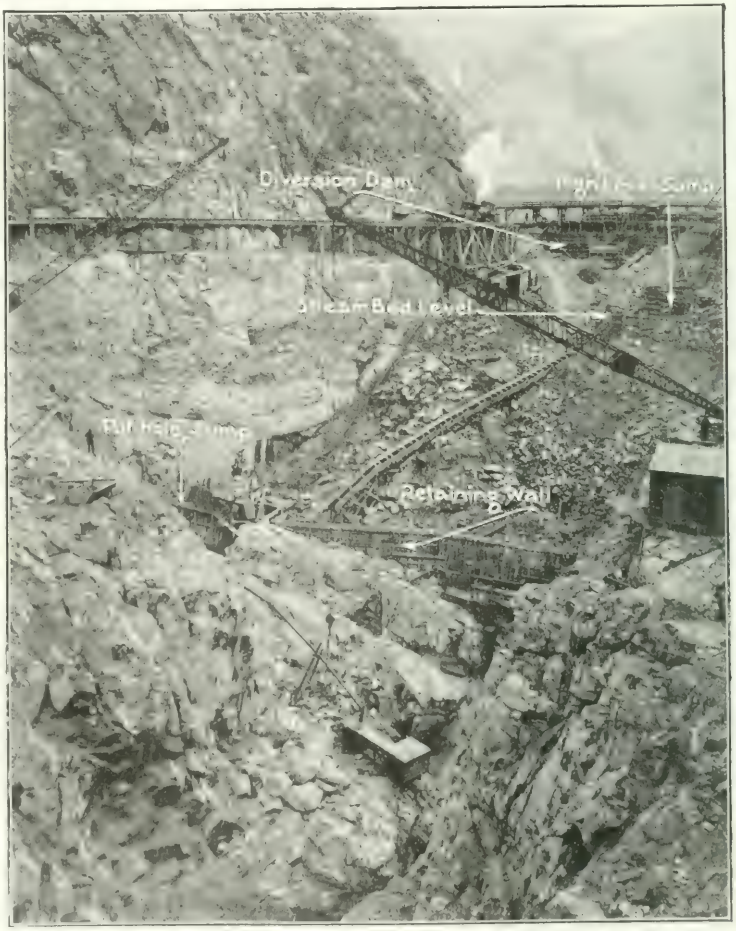
There are obvious limits to the differential in first cost which would be offset by the considerations discussed. What that limitation, even as a percentage figure, is cannot be lightly determined. In fact, much would have to be left for judgment even with the first-cost bids at hand, but certainly the soundness of the decision, economically, can be questioned when the foreign product is excluded without giving the foreigners an opportunity to bid.

# Excavating the Foundation for Hetch Hetchy Dam

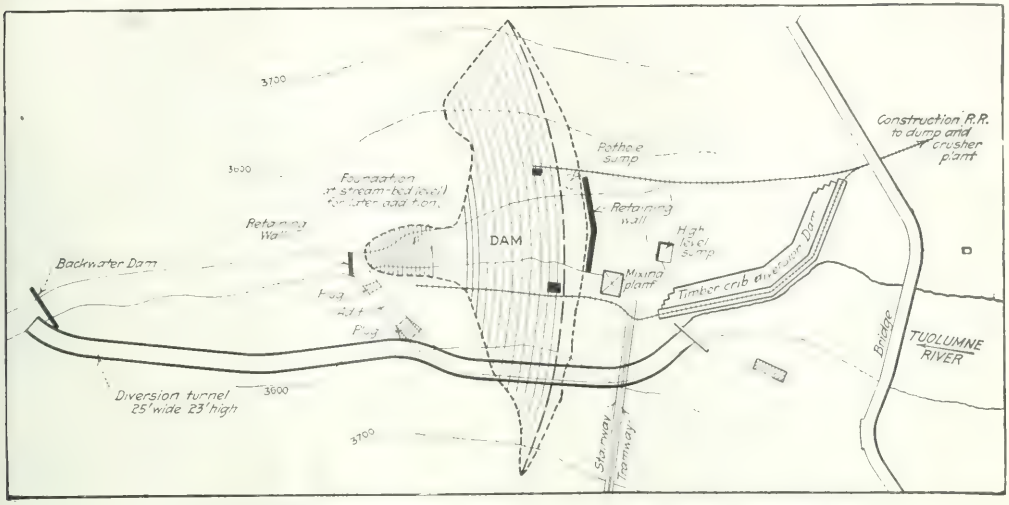
**Open Cut Method Used on New San Francisco Water-Supply Structure Although Depth Reaches 146 Ft. Below Flood-Water Level—Favorable Bedrock Formation Found**

IN ORDER to remove material overlying the bedrock at the Hetch Hetchy dam, now under construction for the water-supply of the City of San Francisco, it was necessary to divert a stream flow of about 12,000 sec.-ft. and excavate to a maximum depth of 146 ft. below flood-water level. Bedrock was found at depths ranging up to a maximum of 113 ft. in the deepest place, below the bed of the stream, although even in the potholes there were very few spots where the depth exceeded 100 ft. When the work began the question of how the water could best be kept out of the excavation was complicated by uncertainty as to the porosity of loose material on the upstream side. A large amount of percolation into the excavation was expected; in fact, the prospect of having to work under compressed air was so definite that the lower portions of pneumatic caissons were brought to the site to be in readiness when needed. However, the excavation was completed in twenty months by the open-cut method without either flooding the excavation or utilizing the full capacity of pumps that had been installed for unwatering. Two factors in the success of the open-cut method are the tightness of the cut-off wall for diverting surface water and the presence of impervious strata in the loose material on the upstream side of the site. The location in the canyon selected for the damsite is such that (1) the foundation slopes upward in a downstream direction, (2) the walls of the canyon converge and, (3) the extreme irregularity of the granite bedrock on bottom and sides should tend to make the concrete a unit with the bedrock itself. The tunnel built to divert the flow of the river through the solid rock south of the site is 23 x 25 ft. in cross-section and 900 ft. long. The capacity of this tunnel proved to be sufficient to carry the flood waters during the excavation of the foundation. In the accompanying sketch the various elements in the construction operations are shown.

Great care was taken in constructing the diversion dam. Not only was it desired to turn as much of the stream flow as possible into the tunnel, but also to reduce to a minimum the percolation below the stream-bed level. To accomplish this a trench was excavated across the natural stream bed almost down to the ground-water level. In this a line of Wakefield sheet-piling extending entirely across the channel was driven to a depth of 6 to 8 ft., this depth being sufficient to reach a more or less impervious stratum which, it was hoped, would aid in decreasing percolation. With this sheet-piling as a cut-off wall, a timber crib dam was built up to a height of 40 ft. and filled with rock. On its upstream side the crib was faced with a double layer of 3-in. plank. Burlap and tar were used between the layers and the outer layer was caulked




GENERAL VIEW OF UPSTREAM SLOPE OF EXCAVATION OF HETCH HETCHY DAM
Canyon is being excavated down to a level 18 ft. below "A"




SKETCH SHOWING METHOD OF UNWATERING HETCH HETCHY DAMSITE

so as to make the dam as tight as possible. Asphalt was run into the crevice between the crib face and the sheet-piling cut-off wall.

Fine material was dumped on the upstream side of the diversion dam to aid in silting up cracks in the structure. On the downstream side, below the level of the crib-dam foundation, rock from the excavation was filled in from time to time as a facing on the slope to prevent a sloughing down into the pit that might endanger the crib foundation.

As the diversion dam was 100 to 300 ft. above the upstream toe of the permanent dam, the upstream slope of the excavation was allowed to seek its own angle of repose until the work was down 63 ft. below the foundation of the diversion dam. Here a trench was excavated and a concrete retaining wall 30 ft. high was built up to hold the toe of the slope. The top of this wall is 58 ft. below the foundation of the diversion dam. Thus, as the material on this long slope had found its angle of repose before the retaining wall was built, the face of the slope did not move materially after this stage of the work. A considerable flow of water came continually from beneath this wall but it was well anchored at both abutments and served effectively in holding back the material while the excavation was carried on to lower levels. No difficulty was experienced in the sloughing down of material under the wall into the excavation below.

Of the water that came through the diversion dam, that which could be caught at a sufficiently high level was collected high up on the slope in an old cofferdam that was made to serve as a sump. At a lower level, near the north end of the retaining wall, a large pothole served as a second collection basin from which the water was pumped back into the stream above the diversion dam, a lift of about 90 ft. Water from lower levels was delivered into the latter sump, two lifts being required to bring up that collected at the lowest points in the excavation.

At the downstream end of the diversion tunnel conditions were more favorable for keeping water out of the excavation. Only a very low backwater dam was required because the bedrock here was near the surface and the excavation was more than 400 ft. upstream from the end of the tunnel. At a point 425 ft. upstream from the backwater dam a small retaining wall was built to hold back the loose material. The pumping installation near the downstream end of the excavation varied to suit changing conditions of the work and ranged from a 6-in. pump working part time to a 6-in.

VIEW DOWNSTREAM FROM UPPER RETAINING WALL AT HETCH HETCHY

and a 14-in. pump. The length of the discharge pipes from these pumps was decreased materially by pumping into the diversion tunnel through a construction shaft.

### Methods of Handling the Material

The material excavated in uncovering bedrock totaled 161,947 cu.yd. of which about 96,000 cu.yd. was solid rock and about 66,000 cu.yd. was loose material. Considerably less than half the total excavation was below the level of the original stream bed. The major portion of the excavation was done with a steam shovel on crawling treads delivering to 4-cu.yd. dump cars on a narrow-gage track. The cars were hauled out of the excavation on the upstream side by 17-ton dinkeys and when the grade became steep a counterbalanced system was used so that incoming trains would aid in pulling out loaded trains. This plan was continued until the track grade reached 20 per cent. A hoisting engine was then installed, and was used until the grade became 34 per cent. During the last days of steam-shovel service in the pit, the shovel delivered directly to the 2-cu.yd. skips handled by the derricks. The shovel was removed when the excavation reached El. 3,435, or 67 ft. below the original stream bed, and thereafter the skips took out a total of about 20,000 cu.yd.

Particularly in the lower portions of the work, progress was slow on account of the steepness of the canyon walls. The danger from falling rock was such that men could be worked only at one level at a time. The steam shovel usually worked 10-ft. lifts on alternate sides of the canyon, scaling crews above being shifted so as to avoid working above the shovel.

All the spoil was delivered to a dump in the valley above, along the line of the railroad to the crusher plant. The railroad location for handling spoil is entirely suited to bring in sand and gravel from the crusher plant to the concrete mixing plant, and will be used for that purpose.

### Insure Tight Bond With Bedrock

The natural gorge uncovered by the excavation contained many potholes, some of them ranging up to 20 or 30 ft. in diameter. The gorge runs through solid granite practically all of which has a very smooth, water-worn surface. Because this smoothed surface would not give a firm bond with the concrete, the contract calls for the removal of all water-worn surfaces, or at least their scarification to the extent that a firm concrete bond would be assured. The same requirement applied to rock whose surface had been weathered or which for any other reason had a scaly or flaky surface. The contractor has the option of hand work or sandblast in finishing the surface to specifications.

As an aid in insuring watertightness a cut-off trench was made 15 to 20 ft. back from the upstream face of the dam. This trench runs from the bottom of the excavation to the crest of the dam on either side of the canyon and ranges from a 15 x 20-ft. cross-section at the bottom to a much smaller size near the top.

All seams were followed into the rock until they "pinched out" thus affording bond for concrete against solid bedrock. The specifications permitted grouting seams where necessary but because no seams of great depth were encountered this was not resorted to. As an indication of the tightness of the bedrock it is pointed out that although the entire flow of the river was carried through the tunnel only a few feet away from the excavation and paralleling the cut for its entire length at a much higher level, there was no seepage from the tunnel into the cut.

The diversion dam served a double purpose in that it was also used as a means of carrying the construction railroad across the channel. The final location of the tracks is as shown in the accompanying plan. By extending spurs along either side of the canyon it was possible so to locate derricks that either the north or the south railroad spur would be under the boom of all the derricks but one. This one served the middle section in the lowest portion of the excavation and the skips it brought up had to be transferred to a second derrick. After completing the uncovering of bedrock the derricks were left in place to be used in placing plums in the concrete.

### Workmen Get Air Ride Twice Daily

The men working at the damsite are housed in a camp on Hodeau Flat from which a five-minute walk on a very slight grade brings them to a point on the Hetch Hetchy railroad immediately overlooking the site and about 500 ft. above the bottom. Early in the work this drop was traversed by an incline on which a car was operated by a hoist. A cableway has since been thrown across the site and a skip takes the various shifts to and from any desired point in the foundation itself. The skip ordinarily carries about 30 men and operates on a 2¼-in. cable. With this arrangement the men are taken to and from the work very much more quickly than would have been possible on the incline. This skip gives a birdseye view of the entire site and the sensations of riding in an airplane. The round trip for a loaded skip, including loading and unloading, occupies about three minutes.

Three shifts are operated in the foundation excavation with working hours from 7 a.m. to 3 p.m., 3 p.m. to 11 p.m. and 11 p.m. to 7 a.m. The night shifts, however, are much smaller than the daylight shift because work on the slopes and in the more difficult locations cannot safely be done at night. Adequate illumination for night work is supplied by 1,000-watt electric lights spaced about 75 ft. apart on two cables some 200 ft. above the lowest point in the excavation.

For the purpose of checking up excavation yardage as well as convenience in plotting exact locations and elevations on a progress chart, a plan of the foundation area has been laid off in 25-ft. squares. All prominent points or points where the grade changes abruptly are marked with red paint on the rock and plotted on this plan.

A base line across the gorge above the dam is used as a reference for all locations, these locations being given by two figures, one representing the ordinate measured on the base line and the second the right-angled offset therefrom. A third figure gives the elevation. Thus the marking 5 + 80 ±/75/3456' locates a point 580.4 ft. from the end of the base line, offset 75 ft. from it, and at El. 3456.8.

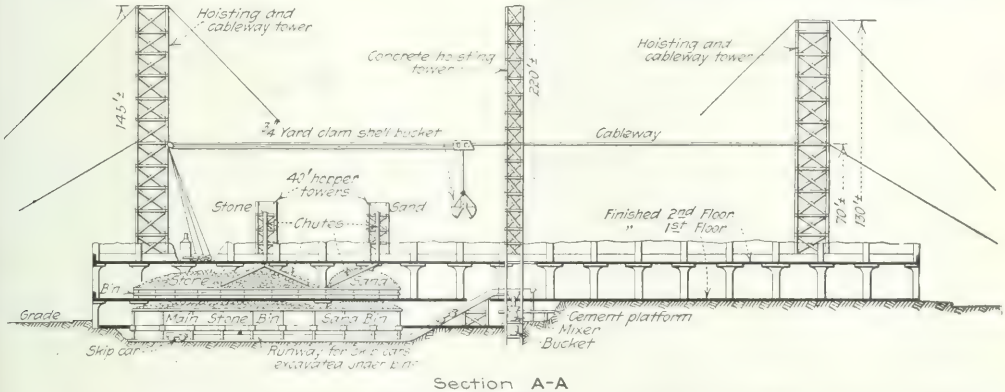
The work on the Hetch Hetchy dam is under contract to the Utah Construction Co. and is under the general supervision of M. M. O'Shaughnessy, city engineer of San Francisco. C. R. Rankin is resident engineer at the dam site for the city and A. E. Paddock is construction engineer in charge for the contractor.

# Concrete Building Plant Layout for Limited Room

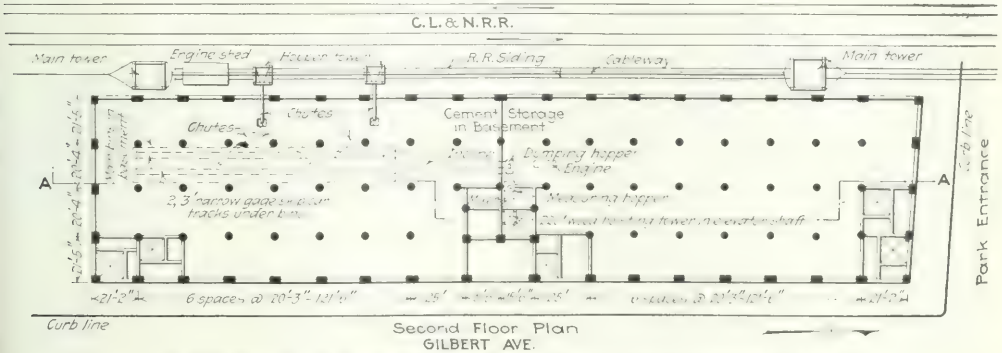
## Cableway Over Siding Unloads Cars—Basement Bins and Mixer Serve Inside Tower—All Concrete Spouted

By Carl A. Markgraf
Cincinnati, O.

A CABLEWAY unloading outfit and inside storage and concrete gravity plant distribution were ingeniously combined to meet conditions of limited exterior plant space in building the Baldwin piano factory at Cincinnati, Ohio. The unique feature was the cableway unloading unit. By means of this cableway a large-volume stone and sand handling operation was conducted in a 20-ft. strip occupied by a siding along one side of the building.




Section A-A




CONCRETING PLANT PLAN FOR BALDWIN PIANO FACTORY, CINCINNATI, OHIO

Structurally the building does not depart from familiar practice. It is reinforced concrete with brick curtain walls carried on concealed spandrel beams, and is approximately 85 x 370 ft. in plan and seven stories high, with a basement under the south half. The average story height is 13 ft. The typical floor bays are 20 ft. 3 in. square and flat slab construction is used practically throughout. The floors are designed for 150 lb. live load; the rough slab being 7½ in. thick with a ¼-in. top coat of special finish placed with the slab. The basement excavation was steam-shovel work, with the exception of the special excavator operation described in *Engineering News-Record*, Feb. 17, 1921, p. 314. In general, construction interest is attracted only by the equipment for mixing and placing the concrete.

### Plant Plan and Equipment

As shown by the plan, the building is bounded by the C. L. & N. R.R. and two busy thoroughfares. An old four-story structure occupied the north half of the site for the new building. In order to interfere as little as possible with factory operations, it was decided to construct the new building in two halves, the old structure not being razed until the south half of the new was completed and put in operation, so that production would be interrupted for the minimum time.

Following from these conditions the general considerations governing the plant plan and equipment were: (1) Although the building was to be constructed in two parts, economy indicated that the equipment should be arranged to handle both parts with as little change as possible. (2) Having no working space at the sides or north end of the building, it would be necessary to place a large part of the equipment and provide storage for materials inside the building. (3) Practically all building materials would be received by rail in car lots. (4) Because of the limited clearance on the existing siding at the west side of the building, ordinary unloading equipment could not be employed.

All concrete was to be spouted to position. By placing the concrete hoist in the elevator shaft of the clock tower, it was possible to concrete both halves of the building from one hoist. This location of the concrete tower in turn determined the location of the main concrete plant in the west central portion of the basement. The location of the concrete plant and railroad siding determined the position of the storage for sand, stone and cement. The general arrangement of the building and equipment is shown by the sketch plan and elevation.

### Material Handling Equipment

The unloading equipment for handling the shipments of sand and stone, totaling some 18,000 cu.yd. consisted of a ¾-cu.yd. clamshell bucket operating on a cableway suspended from two towers. These cableway towers, which straddled the railroad siding, were located approximately 25 ft. from each end of the new building. The south tower was 12 x 15 ft. x 145 ft. high, while the north tower was 15 ft. square and 130 ft. high. The cableway connecting the two towers was placed 70 ft. above the ground in order to clear two bridges which connected the new buildings with portions of the plant on the opposite side of the railroad.

During the construction of the south half of the building, the south cable tower was equipped with an elevator for hoisting terra cotta, stone, brick, etc., while such materials as forms shores and reinforcing steel were hoisted by means of a 30-ft. boom swung from the same tower. The south half completed, the elevator and boom were moved to the north tower.

At 50-ft. intervals from the south cable tower, two additional towers were erected. These were 7 x 8 ft. x 40 ft. high and supported large wooden receiving hoppers, provided with chutes. The engine for operating the clamshell bucket and the cableway carriage was placed on a raised platform near the south tower. In operation, the material was hoisted in the clamshell a sufficient height to clear the bridges, moved along the cable to the sand or stone hopper tower and dumped. The material was then conveyed by chutes, through openings in the steel sash, to the interior of the building. The chutes terminated in temporary holes in the second floor slab, where the material dropped to the bins below.

The main storage bin, constructed of heavy timbers, was located in the basement. It was 120 ft. long, with inclined sides 8 ft. high, braced laterally against the adjacent columns. Quick-shift, hand-operated gates, especially designed to prevent clogging were used for discharging material from the bins. These gates were placed staggered, 3½ ft. on centers. The maximum capacity of this bin was 365 cu.yd. stone and 180 cu.yd. sand. An auxiliary storage bin with a capacity of 350 cu.yd. of stone and 180 cu.yd. of sand was later located on the first floor. The material from this bin was fed to the main bin through temporary 8-in. slots, 4 ft. long, spaced 4 ft. on centers in the first floor slab along the center line of the bin.

Cement was stored in the basement just west of the mixing plant, and was unloaded direct from cars to mixer or storage, as desired, by gravity rollers.

A 220-ft. concrete hoist tower gave a working radius of approximately 185 ft. The first chute was hung from a 40-ft. boom and the other chutes were suspended from gin pole and tripods. Standard 30-ft. chutes were used.

Skip cars conveyed the material from the bin to the mixer. These cars holding 16 cu.ft. of stone and 8 cu.ft. of sand were of special design to fit cramped quarters and were fabricated in the contractors' shop. They were operated on narrow-gage tracks in a narrow passageway excavated under the entire length of the bins. The tracks had a 4-ft. clearance under the bins and ascended to the first floor level through a 7 x 8-ft. opening in the first floor slab. The skip cars were operated together, one returning empty from the mixer while the other carried a charge to the mixer. A three-drum hoist engine operated both skip cars, the bucket in the concrete hoist and a 30-ft. boom at the top of the tower. The concrete was mixed in four-bag batches.

To mix and hoist the concrete there was a crew of eight men, as follows: Two operating the bin gates for sand and stone, two supplying the mixer with cement either from storage or direct from the cars, one opening and emptying the cement sacks, one in charge of mixing and dumping the concrete, one in the crows-nest directing the flow of concrete through the chutes, and one hoisting engineer. Steam was furnished from a local power plant. A crew of six men and one foreman on the floor was sufficient to move all chutes, and do the necessary tamping and grading. This made a total of 14 men required to mix and place the concrete. The efficiency of the plant layout is reflected in this low labor cost of handling the 12,000 cu.yd. of concrete required.

The building was designed by the Detroit office of Lockwood-Greene & Co., F. M. Erwin being their resident engineer. It was erected by The Ferro-Concrete Construction Co., general contractors, Cincinnati, Ohio.

## Controlling Water After Blowing Out 16-In. Plug

By M'Kean Maffitt
Superintendent Water and Sewers, Wilmington, N. C.

IN MAKING repairs to a pipe line after blowing out a 16-in. plug we were unable to yarn the plug because we could not keep down the water coming into the excavation from leaking valves which were in such condition that we did not dare to try further to close them entirely. To overcome the water—about 100 gal. a minute—we adopted the following kink:

From ⅛-in. gum packing we cut a gasket the size of the inside of the 16-in. bell. Placing this gasket on the inside face of the plug we inserted the plug in the bell and braced in a common screw jack behind the plug. As we tightened on the jack we regulated the plug so that we had an even joint all round. With a very few turns of the jack we had the water cut off completely. The hydrant nearest to the job was opened so that there would be only the head of water from the plug to the outlet of the hydrant. When the water was cut off we yarned and poured the plug in double quick time. The only difficulty was in holding the gasket against the face of the plug and that was overcome by tying it on with strong cord going all around the plug. Had we tried to yarn the plug with the water in the hole we would have had a very wet joint, whereas it was as dry as new work.

# Side Slopes of Drainage Ditches in Unstable Soil

## Engineers Advise 1 on 3 for Buckshot Clay After Study of Caving Slopes — Change in Dredging Plant Necessary

A PROBLEM in the design of dredged drainage ditches for soft and unstable soil is the relation of the side slopes to caving and sliding of the banks, this problem having a special bearing upon the permanence of the ditches and their future requirements for maintenance. Economic advantages of a much flatter slope than that generally used are indicated by an investigation of certain ditch systems in Missouri, showing the economy of greater first cost for larger excavation in order to secure more stable ditches which will retain their efficiency for a considerable period. Where drainage ditches become badly obstructed, either they must remain largely ineffective or costly reconstruction may be necessary to restore the original flow capacity, this work sometimes involving special bond issues during the life of the original bonds for the construction of the ditches.

FIG. 1. IMPROVING CAVED DRAINAGE DITCHES
A—Ditch ahead of dredge. B—Ditch behind dredge

In three drainage districts established in Pemiscot County, Mo., under the direction of the county court, the ditches built during a period of about fifteen years were 5 to 8 ft. deep, with specified side slopes of 1 on 1. The amount of caving was considerable in some localities, but was attributed for the most part to poor workmanship, except where water-bearing sand was encountered. In 1919 reconstruction was begun in order to provide more effective drainage, the ditches being enlarged and their depth increased to from 10 to 16 ft. With increased depth, additional caving began early in 1920, when the ground had been saturated by heavy rains, so that in places the enlarged ditches were little if any deeper than in their original condition. This condition greatly reduced the value of the improvement to all of the lower lands in the districts affected. Average examples of these ditches are shown above.

Such a condition had not been foreseen when the reconstruction was undertaken, and by direction of the county court an investigation was made by the Elliott & Harman Engineering Co., Peoria, Ill. The report attributes the difficulty entirely to the caving banks, as the material spreads so as to cover the bottom of the ditch and thus raises the grade. The amount of silting from surface soil washed into the ditches is considered negligible. The remedy recommended is the reduction of the slopes from 1 on 1 to 1 on 3, but using 1 on 1½ in certain places where floating dredges are now installed, with changes in dredging equipment.

Joint clay or "buckshot" clay is the soil principally encountered, but sand or sandy loam occurs on ridges. The clay is composed of very fine particles and is very porous, having numerous well-defined joints or cracks through which water can penetrate the mass readily. When saturated with water the clay becomes soft and mushy, so that when a block of clay slides into the water it softens and flows over the bottom of the ditch. Caving appears to begin near the bottom of the slopes, due to this softening of the clay.

An abstract of the conclusions arrived at and the recommendations made in the report to the county

FIG. 2. CAVING DRAINAGE DITCHES
A—Main ditch. B—Lateral

court is given below. These recommendations have been practically adopted by the court and the improvement is now proceeding along the lines recommended. None of the work with slopes of 1 on 3 has been constructed as yet, but a dragline excavator suitable for the heaviest portion of this work is being installed in one of the three districts. Arrangements have been made with the contractor to complete that part of the work which can be done with the present floating dredge, leaving for later consideration the work which properly requires a dragline machine. The estimated quantities for the three districts aggregated 7,057,200 cu.yd. for slopes of 1 on 1, with a cost of $1,609,452, including outlets, right-of-way, engineering and administration. With the flatter slopes of 1 on 1½ and 1 on 3, as now recommended, the quantity is increased to 9,389,280 cu.yd. and the total cost to $2,199,592.

1. The ditches which are being reconstructed will not be stable and will not give effective drainage if they are finished with side slopes of 1 on 1.

2. Caving has not been prevented by the care exercised by the contractors and engineers in cutting slopes exactly 1 on 1, instead of permitting the dredge bucket to run freely and thus cut the ditches wider at the bottom and with steeper slopes.

3. The floating dipper dredges installed for the reconstruction work cannot readily form slopes flatter than 1 on 1 and at the same time place the material at a sufficient distance from the bank to prevent this material slipping back into the ditch if the banks cave. The flattest slope they can make is 1 on 1½, and with such a slope they cannot deposit the material at such a distance as to leave an adequate berm, except where it is dumped behind the old spoil banks.

4. The work which was done in 1920, with slopes of 1 on 1½ has gone through the winter and wet season and is in much better condition than where the slopes were constructed at 1 on 1, but it is not satisfactory from the standpoint of stability, as the slopes show much caving It is pointed out that ditches with 1 on 1 slopes have stood well until the wet weather of winter and spring, or until the water was drawn down to a low level, the critical time for the caving of banks being when the water is low and the ground is saturated.

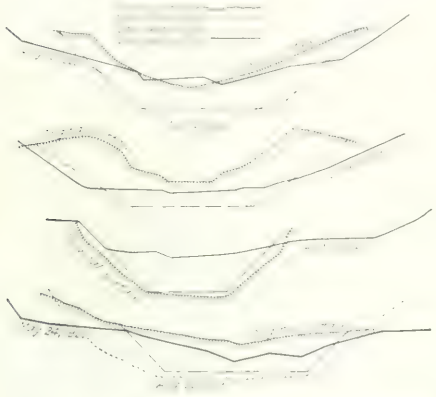


FIG. 2. TYPICAL DITCH SECTIONS IN PEMISCOT COUNTY, MO.

5. In order to have reasonable assurance of the stability of the banks and proper conditions for economical maintenance, the slopes should be constructed 1 on 3, leaving a berm between the ditch and spoil bank of a width about three times the average depth of the ditch. The spoil banks should be made with slopes as flat as the equipment available will permit, so as to encourage the landowners to put the spoil banks under cultivation. Ditch slopes of 1 on 3 will be comparable with the standard slopes for levee construction in this section. They should be planted with Bermuda grass, and kept clipped or grazed and free from any other vegetation.

6. It is recommended that the court should issue orders that will enable the engineers to modify the cross sections and the reconstruction program so that when the ditches are improved they will be permanent structures which may be maintained readily for the effective drainage of the lands.

7. In this work, the floating dredges already in service should be used to complete the smaller ditches with slopes of 1 on 1½ where they can do this effectively. The larger dredges which have to make double cuts should cut one side of the ditch only, not disturbing the old spoil bank but putting the new material behind it. In this way they can excavate from 40 to 50 per cent of the required ditch cross-section, and reach the outlet with one side of the ditch excavated in less than half the time it would take to complete the full cross-section. The remaining portion of the larger ditches, and such of the smaller ditches as the floating dredges cannot handle economically, should be constructed with dragline machines, making the flatter slopes and wider berms recommended in the report.

## Seashore and Track Protection on an Irish Railway

### Concrete Blocks with Protruding Quarry Stones Chained Together Along Beach—Ballast Covered with Concrete

ROWS of large concrete blocks chained together and supplemented by heavy quarry blocks laid between the rows is a type of shore revetment used by the Dublin & Southeastern Ry., of Ireland, to protect a part of its line which is situated close to the seashore between Greystones and Wicklow. A layer of concrete is also placed over the stone ballast to prevent the waves from washing it away. This revetment and the track protection are shown in the accompanying drawing. The threatened section of line is about 10 miles long, and the protective work aggregates 6½ miles, but is not continuous, as there are a number of small cuts and fills. To a great extent the line conforms to the ground level and is 40 to 70 ft. distant from the water. On the land side is low ground subject to periodical flooding.

Concrete blocks 9 x 3 x 3 ft. are used principally, weighing about 6 tons each, a small number being only 3 ft. and 6 ft. long. They are placed close together and connected by chains laid through them and embedded in the concrete, or by short lengths of bars or chains similarly embedded. The concrete is composed of 1 part cement to 5 parts sand and gravel, with rough stone blocks set in it to form an irregular surface and reduce the amount of concrete. A cubic yard of block averages 3 cu.ft. of cement, 15 cu.ft. of sand and gravel and 9 cu.ft. of stone displacers. These blocks are cast in place, as a rule, in rough wood forms, but some have been cast on the high ground and then rolled into the desired position. In addition to the rows of blocks, at some points similar 2-ton blocks are placed in intermediate spaces, rough rock rubble being deposited between the blocks to protect the face of the slope, as shown.

PROTECTIVE WORK ALONG THE SEACOAST: DUBLIN & SOUTHEASTERN RY., IRELAND

*Track Protection*—Upon the sandy subgrade there are two rows of stone spalls and ballast 22 in. wide, and 8 in. deep, to support the ties, concrete being filled

between the ties for a total depth of 12 in. The edges of the concrete are rounded off and are reinforced by longitudinal steel wires. Concrete is laid also between the ballast and the first row of blocks on the shore side, loose stone being laid on the outer side to cover the sand as far as the property fence. The track has the Irish gage of 5 ft. 3 in. and is laid with bull-head rails in cast-iron chairs.

Railway traffic had been interrupted frequently by storms before the construction of the protective work, this part of the line being out of service for three weeks after a storm in November, 1915. Relocating the line farther back from the sea at different points has been proposed, and a ten-mile diversion has been authorized, but though there are no engineering difficulties involved the cost would be considerably greater than that of protective works. Up to the end of 1920 the work had cost about $225,000 (at normal rate of exchange). The work is done by railway forces. This system of protection was invented by C. E. Moore, chief engineer of the Dublin & Southeastern Ry.

## Structural Steel Top Story on Concrete Building

### Large Floor Space, Exceptional Light and Ventilation Needed—Sash Panels Hinged at Top

SPECIAL design of industrial buildings to secure economy in meeting special manufacturing conditions is illustrated by the combination of reinforced concrete and structural steel construction in a three-story pattern shop and core building 83 x 57 ft. Storage for patterns and cores is provided on the first floor, and the second floor is for the manufacture of metal patterns. For these two stories reinforced-concrete construction was suitable and economical, with panels approximately 20 x 18 ft. The general design of the building is shown in Fig. 1 and the steel roof truss details in Fig. 2.

For the core-making shop on the third floor, however, it was desirable to have larger unobstructed floor space, with exceptionally good light and ventilation on account of the smoke and gases produced in manufacture. With steel construction the central row of columns could be omitted and the so-called Pond truss, forming a high monitor, gave opportunity for ample skylight and ventilation space. It was necessary also to provide against roof condensation and dropping moisture, which would have required special construction in a concrete deck. Further the cost of a steel truss roof with gypsum tile covering was found to be about 15 per cent less than that of a flat concrete roof with raised skylights, exclusive of the provision for condensation in the latter case.

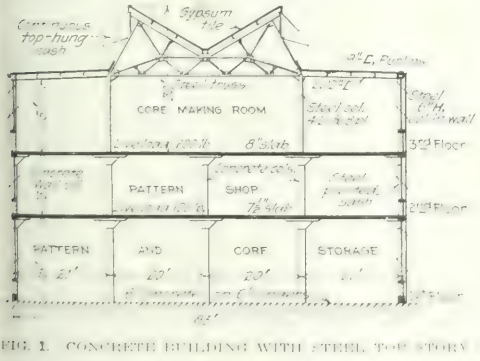



FIG. 1. CONCRETE BUILDING WITH STEEL TOP STORY

Steel columns are anchored to the girders over the concrete wall columns and the two interior rows of columns, the walls being mainly of steel sash on low brick spandrels, as in the lower stories. The two 21-ft. side bays of the roof are flat, with pairs of channels for the joists and single channels framed between them for the purlins. Steel trusses of the Pond or butterfly type span the central 40-ft. space, forming a wide monitor with gypsum tile on the top and swinging sash for the sides. The sash panels are hinged at the top so as to give a freer opening than with sash pivoted at the middle, as in the side walls.

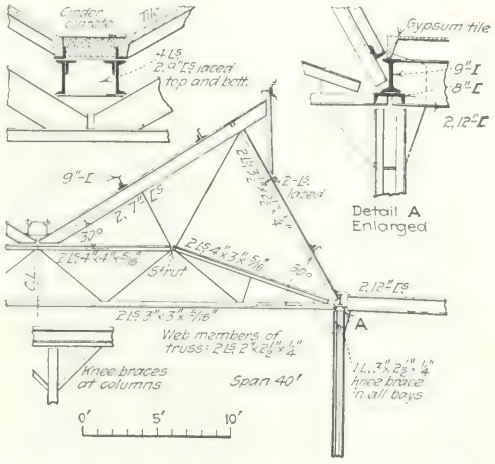



FIG. 2. ROOF TRUSS FOR SPECIAL VENTILATION

This building, which is part of the enlargement of the Chain Belt Co.'s plant at Milwaukee, Wis., was designed by Frank D. Chase, Inc., engineers, Chicago.

### Los Angeles Aqueduct Irrigates Large Area

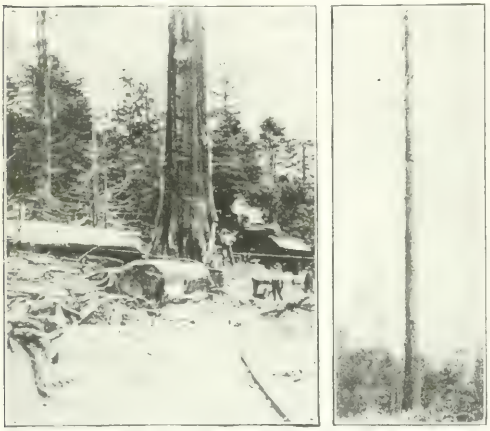
Many extensions have been made in recent years to the pressure pipe irrigation system in the San Fernando Valley which is supplied by water from the Los Angeles aqueduct. There is now under irrigation in this valley about 76,000 acres or seven-eights of the area that could be irrigated by canals from the aqueduct supply. In addition to extending the pipe system various means for increasing storage capacity have been employed to offset the demand for an excessively large volume of water at certain times of the year. Encino reservoir, which is under construction on the south side of the valley above the main canal, will hold about 3,000 acre-feet. On the Westgate project the Stone Canyon tunnel has been driven from the south portal to within 50 ft. of completion and the Stone Canyon dam, to store 7,000 acre-feet, is well under way. Numerous small reservoirs are planned to take the night flow and give local storage for use in daylight hours.

# Moving a Standing 210-ft. Tree

By E. P. Stamm
Eureka, Cal.

A 210-FT. tree with 10-ft. butt moved in its vertical position for a distance of 20 ft. was a recent accomplishment in the logging operations of the Pacific Lumber Co., at Freshwater, Cal. Two redwood trees which had been left standing for use as spar trees or gin poles were too far from the railroad track for effective use, but as it was impracticable to move the railroad it was decided to move one of the trees. This tree was originally 260 ft. high, but had been cut to 240 ft. by a "high climber" who ascended by means of spurs and a belt around the tree. At 240 ft. the trunk was 34 in. in diameter, and a pulley was attached for a ½-in. cable from the donkey engine.

When it was decided to move the tree, the climber



REDWOOD TREE 210 FT. HIGH MOVED 20 FT. (ARROW INDICATES STUMP). RIGHT-HAND VIEW SHOWS TREE CUT UP FOR USE AS GIN POLE DERRICK

ascended in a chair hoisted by the cable and cut off a 30-ft. log. This left a 210-ft. trunk 38 in. in diameter at the top and 10 ft. at the bottom, containing 63,000 board feet by the Spaulding scale, which, at 10 lb. per foot weighed about 315 tons. In addition there was the weight of about 1,500 ft. of guy lines, six 1¼-in. wire cables being attached at 10 ft. below the top and secured to large stumps.

The butt of the tree was then sawed from the same side half through by two cuts, one 12 in. above the other, and the intervening block was blown out. Six vertical holes were then drilled at the center of the butt and fired one at a time until the half stump directly under the cut had been blown loose and removed. Four 30-in. peeled fir logs 25 ft. long were placed parallel and on a 2 per cent grade, with their ends in the undercut of the tree, forming skids on which the tree was moved. The rear guy lines were slacked 2 ft. and the front lines drawn taut, pulling the tree forward to facilitate sawing the trunk free from its stump. The remaining half of the trunk was then sawed through at the elevation of the skids. A holdback line or cable was placed around the bottom of the trunk and made fast to a stump, allowing 4 ft. of slack.

For moving the tree, the rear guys were slacked 4 ft., the front lines were made taut, and with a two-block purchase and a 1-in. wire cable the donkey engine pulled the bottom of the tree 4 ft. ahead on its skids until the ground holdback line was taut. The rear guys and holdback line were again slacked 4 ft., the front guys made taut so as to lean the top ahead 4 ft., and the bottom again pulled 4 ft. forward. These operations were repeated until the tree was adjacent to its new base or seat, which consisted of four 3-ft. redwood logs, 25 ft. long, laid parallel in an earth pit 3 ft. deep.

The two center skids were now chopped off, leaving the tree to move the last 10 ft. over two skids, which were then blasted to splinters so that the tree settled down on its seat, squashing the remaining part of the skids. When all guy lines were made taut by a block purchase with the engine, the tree was ready to receive its buckling guy wires, attached two-thirds of the way up the trunk to prevent it from buckling under excessive strains. A 36-in. bull block was attached at the top of the tree, two loading blocks were placed on two of the buckling guys and with lines threaded through the blocks the tree was ready to do its work as a high lead pole (or gin pole) for pulling in large logs and lifting them bodily on the flat cars to be transported.

# Transport Ministry to Issue Regulations for London Traffic Control

*(London Correspondence)*

REGULATIONS proposed by London members of Parliament to deal with some of the city's traffic problems will, it is understood, be issued by the Ministry of Transport for voluntary adoption. The proposals made by these members have the approval of the Ministry of Transport and a number of local authorities, and legislation is really necessary before they can be put into operation. At the present late stage of the Parliamentary session, however, the government is not likely to push through a bill. It is believed that if the regulations are published with the approval of the Ministry, the Home Office and the majority of the local authorities they will hold good though, of course, they would in these circumstances not be compulsory.

The scheme proposed by the investigating committee includes regulations affecting vehicles waiting in streets, broken down vehicles, vehicles in an unsound condition and likely to break down, unattended vehicles, vehicles used for advertisement purposes, unhired cabs elsewhere in a thoroughfare than on a cab rank, cab ranks, and ranks and stopping places of omnibuses and other vehicles plying for public hire.

If the original scheme goes through Parliament in the form of a bill the Minister of Transport will be empowered to set out:

1. Thoroughfares which are not used by traffic or vehicles of any specified class or classes, either generally or at stated times.

2. Routes to be adhered to by all or any specified class or classes of vehicles or traffic between any stated points.

3. Speed of all of any class or classes of vehicles and the relative highway positions of traffic of varying speeds or types.

4. Precedence to be observed between vehicles proceeding in the same direction, in opposite directions or in crossing.

5. Places where and the conditions under which vehicles may turn in order to proceed in the opposite direction.

6. Conditions subject to which cattle, horses, sheep or other animals may be driven or led.

7. Conditions subject to which articles of unusual weight or dimensions may be carried by road, loaded or unloaded.

8. Conditions subject to which sanitary vehicles or vehicles delivering freight or merchandise of any special class or classes may stand in thoroughfares.

9. Conditions subject to which house and street refuse may be collected.

10. Traffic notices to be exhibited and the form and character of such notices.

By-laws are also proposed which will deal with obstructions to traffic. These include marking and lighting of bridges, lighting and guarding of street works, provision of sufficient head room in new bridges and the adequate lighting of structures with insufficient head room, the erection or placing of any works or objects likely to cause an impediment to the free circulation of traffic, queues of persons waiting for public vehicles or admission to places of entertainment.

The penalties suggested for the infringement of any fixed regulations are: First offense, a fine not exceeding £20; second or subsequent offense, a fine not exceeding £50. The continuance of an offense, after a conviction, would render the offender liable to a fine of £5 per day.

# Concrete Chuting Plant for Dam Laid Out in Miniature

## Swiss Dam Site, Towers, Chutes and Cables Reproduced to Scale by American Manufacturer to Insure Successful Operation

By C. W. Garrison
The Lakewood Engineering Co., Cleveland, O.

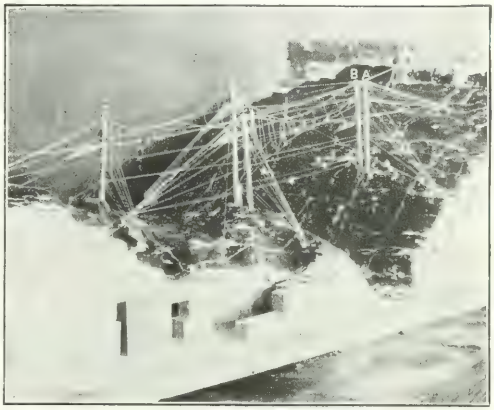
About April 1 our company received an order for a complete mixing and chuting plant for the construction of the Barrage de Barberine, a hydro-electric development in Switzerland. This dam, very similar to the Roosevelt Dam, will be about 875 ft. long, 215 ft. high, 17 ft. at the top and 200 ft. at the widest part of the base. It will contain about 375,000 cu.yd. of concrete. It will take about three years to complete the work because of the short season in which construction can be carried on. Layouts of the plant had to be made for various heights, as the work progressed.

In selling American machinery in foreign countries, it is necessary to "sell" American methods as well. Obviously, it would be ridiculous to suppose that people having no experience whatever with chuting plants, would be able to use the equipment unless complete instructions were provided. Accordingly, when the order was received, our first thought was, as to whether or not the plant, as laid out, would function properly. We wanted to be sure that nothing had been overlooked—that the plant layout was perfect and the various units of equipment selected correctly.

The preliminary layout, from which the equipment had been ordered, had been made before complete details were available. There was a chance that some unforeseen difficulty had arisen that would necessitate a rearrangement of the plant.

So, before attempting to fill the order, our engineering department was asked to check the plant layout and make up complete instructions for its erection and operation. The work had scarcely been started when it was discovered that a cableway for handling plums would interfere with the tower guy lines. This cableway with one end anchored and the other end attached to a movable tower, required 70 ft. vertical clearance, with 40 to 50 ft. horizontal clearance. Naturally, some arrangement of the guy lines, other than standard practice, would have to be evolved to permit the operation of the cableway.

After several attempts on the draughting board, it



MODEL OF CHUTING PLANT FOR SWITZERLAND DAM

was decided that the only way to solve the problem successfully was to build an exact model of the dam site and of the dam and erect the plant to scale.

Accordingly, the contour of the ground was reproduced in clay, following exactly the contour map which, fortunately, had been sent to us. The towers, guy lines, cables and chutes were all built to scale, in the exact positions they would occupy. The troublesome, but necessary, cableway was represented by a heavy white cord. Because accuracy was so essential, the construction of the model was necessarily slow work. In fact, two men spent practically two weeks on this part of the work.

The tedious work of making the model was, however, rewarded by the comparative ease with which the problem was solved. The required clearance for the cableway was apparent at a glance. Guy lines could be located with the certain knowledge that they would not interfere. Many guy lines had to be omitted because the wide valley upstream made it practically impossible to guy on that side without interfering with the cableway. This made it necessary to jack brace the towers and use double instead of single guy lines.

After the complete plant had been satisfactorily arranged, drawing were made to show the work at various levels, with the corresponding arrangement of every detail of the plant. These drawings, supplemented by detailed typewritten instructions, and photographs of the model, made it comparatively easy to understand just how the equipment should be used.

Every precaution was taken to explain clearly even the smallest details. In fact, as the equipment was

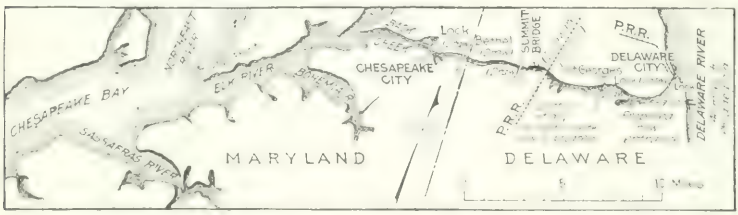
crated each piece and each crate was marked so that by referring to the instructions the plant could be unpacked as it was needed.

The mixing plant, of three 1-yd. mixers, will be located at towers *A* and *B*, shown in the accompanying photograph. *D* is a re-elevating tower, from which the concrete is carried to the tower *E*, where it is again re-elevated and chuted to place. The tower *C* carries the load line for the chute from the tower *A*, and is tied in with the tower *D* to secure maximum strength. Towers *A* and *B* will be 240 ft. high; *C*, 195 ft.; *D*, 240 ft.; and *E*, 120 ft. All towers are of steel. They are all located on the downstream side. The chuting plant is a combination of continuous line and counterweight chutes.

## Begin Work Enlarging Chesapeake and Delaware Canal

### Involves 675,000 Yards of Dry Excavation as First Construction in Building the Authorized Sea-Level Route

WORK OF ENLARGING the old Chesapeake and Delaware Canal has started under contract for the excavation of 675,000 cu.yd. of high land, preliminary to making the old lock canal of 12-ft. depth and 24-ft. lock width into a sea-level canal with 90-ft. width. As shown in the accompanying drawing, the location of this dry excavation work now in progress begins a short distance west of the Pennsylvania R.R. bridge and it is estimated that funds available will carry the work almost to Summit bridge, a little short of a mile distant. By the time work on the present contract nears completion Congress may appropriate sufficient money to proceed with the entire project, involving 6,000,000 cu.yd. of dry excavation and 10,000,000 cu.yd. of dredging.




SEA-LEVEL CANAL TO FOLLOW OLD ROUTE—FIRST WORK IN PROGRESS

The new waterway is to be known officially as the "Inland Waterway from Delaware River to Chesapeake Bay, Delaware and Maryland," and will have the same location as the old Delaware and Chesapeake lock canal built in 1824-29. Locks constructed in 1850 with a width of 24 ft. and a length of 220 ft. remain to the present time as a check to navigation. The present canal has three locks, with the summit level 15 ft. above mean low tide. The mean ranges of tide at Delaware City on the east end of the canal and at Chesapeake City on the west end are respectively 6 ft. and 2 ft. To supplement the supply of water in the summit level furnished by several streams flowing into it, a pumping plant was established at Chesapeake City lifting the water from Back Creek. No records can be found of the original equipment, but when the locks were enlarged about 1850 a waterwheel 34 ft. in diameter, with helicoidal buckets, driven by two walking-beam engines was installed. The wheel, capable of lifting and discharging 20,000 gal. per min., is still performing and according to observers, judging from its appearance, will be able to continue until the canal is lowered to tide level and there is no longer any use for it.

Decision to establish a sea-level canal in the same location as the old canal followed consideration of the subject dating from 1871, when a movement was launched for a ship canal across the peninsula. Subsequently a company was chartered to dig such a canal from the Sassafras River on the Chesapeake side to the Appoquinimink River on the Delaware side, but work never progressed beyond the project stage. In 1894, Major W. P. Craighill, afterward brigadier-general and chief of engineers, submitted a report upon the survey of seven different routes, not including the existing canal. In 1907 a report was submitted upon two routes, the Sassafras River and the existing canal, by a commission consisting of General Felix Agnus, Major C. A. F. Flagler, Corps of Engineers, U. S. Army, and F. T. Chambers, civil engineer, U. S. Navy. These reports were reviewed and further studies made by a special board of engineer officers in 1911-13 whose reports recommended the route of the existing canal.

Congress adopted the recommended project by an appropriation of $3,000,000 in the River and Harbor Act of March 2, 1919. This appropriation provided primarily for the purchase of the canal company's property at the agreed price of $2,514,289.70. Condemnation proceedings were instituted to clear title, other legal and preliminary proceedings were completed and the United States took possession of the canal and appurtenances Aug. 13, 1919. The first act of the Government upon taking charge was to abolish tolls, making the canal a free waterway. The adopted project is for a lockless, tide level canal 12 ft. deep and 90 ft. wide on the bottom, estimated to cost $12,000,000.

The plan of improvement includes a new entrance to the canal at Reedy Point on the Delaware River below Fort Du Pont, the new line joining the present line of the canal about 3 miles westward of the present entrance at Delaware City, north of Fort Du Pont. It is proposed, however, to improve also the present line of the canal from the forking point to Delaware City, to a depth of 12 ft. upon its present bottom width of 36 to 40 ft. for the use of barges bound to and from the upper Delaware River. The new entrance is intended for vessels bound seaward and for the ship canal when the waterway is so enlarged, following the completion of the present improvement.

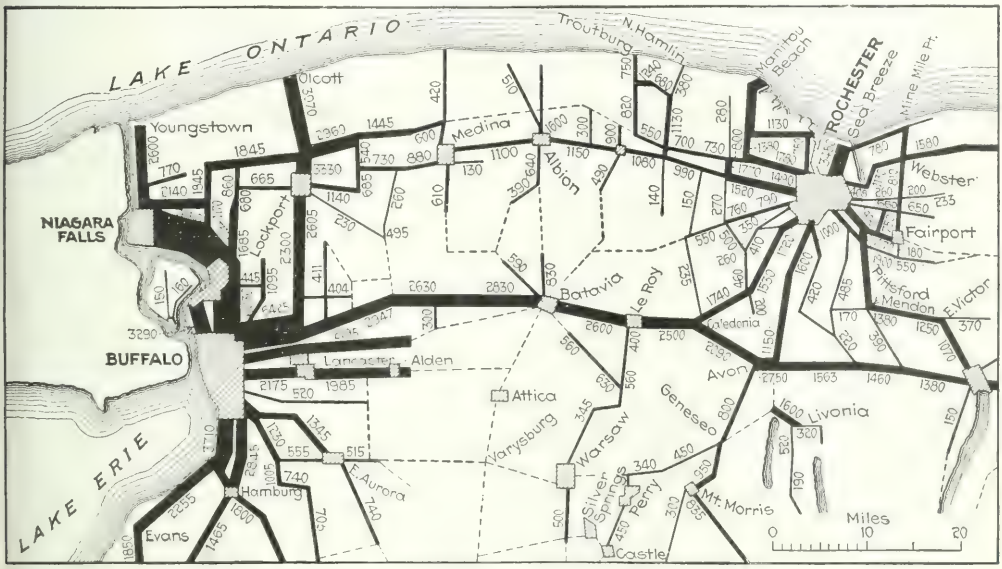
The adopted project provides that traffic through the canal shall not be interrupted during the work of improvement and therefore the plan of improvement had to be arranged to conform to this condition. The program of operation proposes to start with the construction of the six highway bridges to replace the antiquated, inadequate existing structures and at the

same time remove the overburden of dry excavation above the level of the present tow path, elevation 18 ft. above the datum (mean low water at Sandy Hook); then to deepen the summit level 10 ft. to the level of the section between Delaware City and St. Georges or if funds are available to the full depth of 12 ft. below datum; then to remove lock at St. Georges and lower sill of Chesapeake City lock 10 ft., producing one level from end to end of canal. The section between Delaware City and St. Georges will then be deepened to 12 ft. below datum and both Delaware City and Chesapeake City locks removed, thereby obtaining the tide level canal with unobstructed navigation. Finally excavation would be carried out along new line from Delaware River to junction with present canal.

## Traffic Census Map for New York

THE New York State Highway Commission has just completed a traffic census map which shows graphically the maximum traffic over state highways for a period of 12 hr. during the month of August, 1920. The map, of which a portion is reproduced herewith, is drawn to a scale of 10 miles to the inch. The width of each road as shown on the map is made proportional to the observed traffic which it carried, the traffic scale being 20,000 vehicles per inch of width. In addition, the number of vehicles on each stretch of highway during the 12-hr. period is indicated by numerals.

The highway traffic map was originated by Charles M. Edwards, division engineer at Rochester, N. Y., for the New York State Highway Commission. The data for




TRAFFIC CENSUS MAP

Due to the necessity for curtailment of all government expenditures, the River and Harbor Acts of June 5, 1920, and March 1, 1921, did not carry any appropriation for the canal. With the balance of appropriation of 1919 left after the purchase of the canal, some additional land and expenditures for studies and surveys, excavation of the high land to the amount of 675,000 cu.yd. has been started under a contract with W. H. Gahagan Co. of Brooklyn, N. Y., at a unit price of 37c. This work is on the north bank of the canal and begins a short distance west of the bridge of the Delaware Division, Pennsylvania Railroad, at the eastern foot of ridge forming the back-bone of the Delaware Peninsula and it is estimated that the funds available will permit the extension of the work almost to Summit Bridge, a distance a little short of a mile. It is planned to confine the work of dry excavation to the north side of the canal as far as possible, as that side gives a slight advantage in the amount of excavation and also in order that the slopes on the south bank of the canal now well covered with trees and bushes, may be left undisturbed.

the map were collected during the administration of Frederick Stuart Greene, state highway commissioner. The traffic shown on the state highways, according to Mr. Greene, is the normal summer traffic, except possibly for a road between Albany and Saratoga, where the traffic is greater during the races.

### Proposes Testing Rails Head Down

A recent suggestion by M. H. Wickhorst, engineer of tests for the Rail Committee of the American Railway Engineering Association, for better co-ordination of rail tests and service is that bend tests (drop or press) of rail samples be made with the rail head in tension. This position, he claims, would give a ductility closely correlated with the condition of the metal in the interior of the rail head, which in turn is believed to be in close correspondence with the liability of the rail to fail in the track. He claims that the drop test carried out with head in tension covers all the requirements of a chemical segregation test and at the same time is capable of revealing any fissured or shattered condition of the rail-head metal.

# A Study of Stresses in Eyebar Heads

## Past Practice in Proportioning Heads—Conclusions from Tests—Excessive Stretch—Permanent Set in Budapest Suspension Bridge Chains—Analysis Reveals High Stresses—Influence of Pin Diameter

By Josef Beke

EYEBARS are commonly proportioned by empirical rules which have not been checked by stress calculations so far as I know. It is obvious that the stress conditions in eyebars are much too complex for precise calculation, and for this reason dependable rules of design can hardly be derived by pure theory. But approximate analysis based on simplified assumptions is justified, to explain the results of tests and certain experiences that have been had with large chain suspension bridges.

Before entering into such analysis I will cite the test results and experiences that led me to further investigation of the subject.

Tests of eyebars were considered necessary by the Danube Bridge Division of the Hungarian Ministry of Commerce in 1898 as a basis for the proportioning of the eyebar chain members to be used in building the Elizabeth bridge at Budapest. While there was no immediate reason for doubting the approximate validity of the various (not greatly dissimilar) design formulas given by different authors, yet caution was advisable as the bridge in question, with a main span of 943 ft., would far surpass prior chain bridges. Since no existing testing machine was capable of pulling to destruction full-sized eyebars of the size here in question, the tests, carried out in the government shops at Diósgyör, were made on small-scale models, of the form shown in Fig. 1.

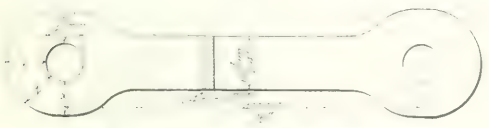


FIG. 1. TESTPIECE FOR DIOSGYOR TESTS

### Hungarian Tests of Model Eyebars

All test bars were cut from the same plate, with a view to eliminating the influence of possible variation in the material. Four bars had circular heads, with width of metal ($x = y$) of 0.6 to 0.63 times width of bar; the other 37 eyebars had an elongated head like that in the sketch, Fig. 1. The latter shape had been used for the chain bars of the old Budapest suspension bridge, built in 1849 by W. Tierney Clark, and it was intended to use the same shape for the bars of the Elizabeth bridge. In these elongated heads the side ratio (ratio of $x$ to the width of body of bar) ranged from 0.5 to 0.63, and the back ratio (ratio of $y$ to width of body of bar) ranged from 0.63 to 0.75.

As in all similar tests, the object of the test was to determine such dimensions as would make the head stronger than the body of the bar. It may be recalled that Theodore Cooper's well-known specifications for American bridges require that rupture shall occur in the body of the bar, but beyond this leave the detailing of the head to the manufacturer.

The main results of the tests may be stated as follows:

1—When the back ratio was 0.75, the side ratio could be made as little as 0.50 without causing the bar to break in the head. With side ratio greater than 0.50, the back ratio could be made less than 0.75; for example, side 0.55, back 0.70; and side, 0.63, back 0.67.

2—In all cases where head and body of bar were of approximately equal strength, the diagonal width $z$, measured on the 45° line, was 0.66 of the width of the bar.

3—None of the bars broke through the back (at dimension $y$), but all broke at $x$ or $z$. Fig. 2 sketches the character of fracture and the very extensive deformation of an originally circular eyebar head in which the side and back ratios were 0.63.

FIG. 2. FRACTURE ON DIAGONAL

4—In every bar tested, whether it broke in the body or in the head, the distortion of the head was very marked. When the side ratio was less than 0.57, the elongation of the head was accompanied by marked reduction of area at the sides. Fig. 3 sketches the deformation of two bars that broke in the body, the bars therefore meeting the Cooper requirement. Bar I (side ratio 0.50, back ratio 0.75) shows a very heavy reduction of area at the side of the head, whereas Bar II (side ratio 0.59, back ratio 0.75) shows only a large elongation, without marked contraction. The dotted line, showing the original shape of the head, indicates that even in Bar II the stretch of the eye was so great that the pin hole elongated nearly 40 per cent. It developed from these results that the condition heretofore considered governing (i.e., rupture to occur in the head) can be met by making the side ratio not less than 0.57, and the back ratio such as to give a diagonal ratio of 0.66. Correspondingly, and in fair agreement with existing rules for proportioning eyebar heads, it was decided to adopt a pin diameter two-thirds of the bar width, side ratio

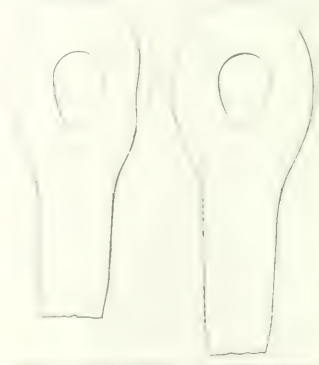


FIG. 3. TWO TYPICAL DISTORTION SKETCHES (Both bars broke in body)

of the head 0.53, back ratio 0.75, and therefore diagonal ratio 0.69. The same formulas were used sixteen years later in the reconstruction of the old Budapest suspension bridge (1914-15), while the original chains of this bridge had pin-diameter ratio 0.44, side ratio 0.53, back ratio 0.68, and diagonal ratio 0.66.

Various authorities have recommended decidedly divergent proportions. Winkler specifies $x = \frac{1}{2}a + \frac{1}{4}d$ and $y = \frac{1}{2}a + \frac{3}{4}d$, which, in the case of a pin diameter $d$ two-thirds the bar width $a$, gives side ratio 0.72 and back ratio 0.94. Berkley gives, for $d = 0.75a$, the side ratio 0.62 and back ratio 1.0. In America, where circular eyebar heads are in general use, the bridge shops use ratios of 0.665 to 0.75, regardless of pin diameter. Clark's proportions as exhibited in the old Budapest bridge chains have already been noted; values lower than those of the tests I have quoted are also given by Gerber, who makes the side ratio 0.55 and the back ratio 0.75. Summarizing, practice hitherto has used side ratios of 0.53 to 0.75, and back ratios of 0.67 to 1.00.

### Stretch of Eyebar Heads

First mention of the very great stretch of eyebar heads was made by Cooper in his paper on tests of eyebars for the first Quebec bridge (*Trans.*, Am. Soc. C. E., 1906, 411). In these tests, with pin diameter 0.8 of the bar width, and head metal ratios of 0.72 to 0.81, permanent stretch in the heads was noted at loads as low as 12,000 lb. per sq.in. in the body of the bar, and at loads of 24,000 lb. per sq.in. this stretch amounted to $\frac{1}{8}$ to $\frac{3}{4}$ in. In the discussion of Cooper's paper, Prof. Mansfield Merriman explained this stretch by the unfavorable distribution of the bearing of head on pin, this pressure being greatest in the axis of the bar and having only small lateral extent.

Though it is obviously true that the maximum pressure is higher than the average (or projected) pressure, yet neither theory nor tests warrant the assumption that, with pin diameter two-thirds the bar width as usual, the bearing pressure exceeds the allowable limit. Even if the bearing pressure becomes excessive, it is not easy to see how it could result in anything more than local crushing. In fact, Prof. Merriman himself did not propose an increase of pin diameter, though this would suffice to reduce the bearing pressure, but he recommended the use of oval pin holes for better distribution of pressure along the sides of the pin.

That change of *maximum* bearing pressure without change of pressure distribution has little effect on the stresses in the eyebar head was shown by Cooper's tests on the influence of pin clearance, as well as by our own tests. In one series the pin was 3 mm. smaller than the pin hole (so as to produce high local bearing pressure), but the test results were not affected; the heads stretched about as much as but not more than in the other tests, in which the pin clearance was only $\frac{1}{2}$ to $\frac{3}{4}$ mm. and therefore the maximum bearing pressure unquestionably much lower.

Nevertheless it seems that some American engineers consider increase of pin diameter to be a means of preventing excessive stretch of the head. Dircksen quotes the practice of the American Bridge Co. as involving pin diameter ratios from 0.9 to 1.3 (*Z. d. Ver. deutscher Ing.*, 1908, 368). Lindenthal recommends pin diameter equal to width of bar. In 1913, preparatory to the construction of the great bridges of the New York Connecting Ry., Lindenthal made large-scale tensile tests on bars of these proportions (reported by J. Melan in *Eisenbau*, 1914, 342). However, those large-scale tests do not supply confirmation of the view referred to. Although the pin diameter was equal to the bar width, and the head was so proportioned that the bars broke in the body, yet the head stretched so much that the 16-in. pin holes elongated by 97 mm. (maximum 122 mm., in a single case even 171 mm.). This very considerable elongation (average 24 per cent), occurring in a material of 64,000 to 71,000 ultimate, with 22.8 per cent elongation on 10-ft. length, demonstrates that in spite of the large pin diameter the head of the bar was subjected to extremely high stresses.

### Elongated Pin Holes at Budapest

In the course of the discussion of the Cooper paper already mentioned, A. J. Himes asserted that stretch of eyebar heads is not observed in actual bridges. The Budapest suspension bridges show the contrary, as will be cited; doubtless other chain bridges would also reveal stretched heads.

When the chains of the old Budapest bridge were taken down, in 1914, we observed in *all* pin holes (original diameter $4\frac{1}{2}$ in., or 0.44 times width of bar) a longitudinal stretch of 2 to 3 mm., although the bar stress did not exceed 16,000 lb. per square inch.

It seemed reasonable, therefore, to anticipate a decided stretch of the chains in the new Elizabeth bridge. On this account, not only was each link shortened by the amount of the elastic stretch due to the dead weight of the bridge, but in addition it was shortened $\frac{1}{2}$ mm. as allowance for its coming to bearing against the pins. After completion of the bridge the sag of the chain was several centimeters greater than the designed amount; the difference is in part at least chargeable to stretch of the heads.

From the preceding it may be concluded that it is worth while to attempt an analysis of the stresses in eyebar heads.

### Stress Analysis of Eyebar Heads

In a circular eyebar head, let it be assumed that all stresses remain below the proportional limit, that radial plane sections remain plane, and that the stress in the body of the bar is uniformly distributed. Let it also be assumed that the bearing pressures between pin and hole are radial and vary as the cosine of the arc between the point considered and the axis of the bar. With this assumption, integrating the bearing pressures and equating the total axial component to the load on the bar, $P$, we find that the bearing pressure at the back of the pin hole is

$$s = \frac{4P}{\pi d} \qquad (1)$$

or 1.273 times the average pressure on the projected diameter. Further, with pin diameter two-thirds the bar width, the maximum bearing pressure is 1.905 times the unit tension in the bar, or well under twice the tension, a safe limit of permissible bearing pressure.

The transfer of stress from bar to head is assumed to take place on the middle line of the head metal, as sketched in Fig. 4. The influence of the fillets $Q$ is neglected. The amount of stress applied to an ele-

mentary arc of the head circle, with radius $r$, is $\frac{P \cos V dV}{2 \sin W}$. The eyebar head is to be investigated as a ring loaded on one side with the bar stress and on the other side with the bearing pressures transmitted from the pin.

To determine the stresses in this ring we will assume it severed by a slot along the center line of the bar, on the side nearest the bar. The right-hand side of this slot, $D'E'$, will be taken as fixed in position, while the left-hand side $DE$ is free to move during the distortion of the ring under its load. Then, since the slot in reality does not exist, and the two surfaces $DE$ and $D'E'$ remain in unchanged relation, such internal forces must be applied at the faces of the imaginary slot as will restore the face $DE$ to its initial position. The forces required for this purpose are a transverse force $X_o$ and a moment $M_o$, acting at the pin center $O$, which for this purpose is taken to be attached by a rigid arm to the face $DE$. On account of the symmetry of the arrangement, no force longitudinal to the bar can act at the faces of the slot.

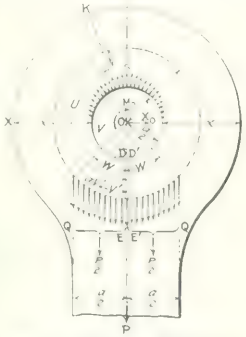


FIG. 4. STRESS DISTRIBUTION ASSUMED FOR ANALYSIS

Mathematical conditions sufficient to determine the unknowns $X_o$ and $M_o$ are furnished by the principles of elastic theory concerning deformation, which must be so applied that the slot face $DE$ retains its original position when all the forces mentioned are acting. Omitting the influence of temperature and shear, the theory of least work may be used to give the following equations:

$$\frac{r}{EF_c}\int n \frac{\delta n}{\delta M_o} dU + \frac{r}{EZ_c}\int M \frac{\delta M}{\delta M_o} = 0$$

$$\frac{r}{EF_c}\int n \frac{\delta n}{\delta X_o} dU + \frac{r}{EZ_c}\int M \frac{\delta M}{\delta X_o} = 0 \qquad (2)$$

in which $n$ and $Z$ denote the values,

$$n = N \frac{M}{r} \text{ and } Z = r\int_r \frac{v^2}{v} dF \qquad (3)$$

while $r$ is the radius of the center line of the head, $N$ is the normal stress on a cross-section $K$ of the ring, $M$ is the bending moment on the same cross-section referred to its gravity axis, $F$ is the area of ring cross-section, $v$ is the distance of any elementary part of the cross-section from its gravity axis, $U$ is the angular distance of this cross-section from the slot face $DE$, and $E$ is the modulus of elasticity of the material. The normal stress $N$ is taken as positive when tension; the moment $M$ is positive when clockwise, and $v$ is positive when measured toward the center. The thickness of the eyebar head being made unity, the area $F$ is numerically equal to $x$, the width of head metal. Equations (2) are to be extended over the whole ring, and the expression for $Z$ over the entire area of cross-section. The expressions for the normal stress and moment must be written separately for each of the loading segments of the ring. When these values and their derivatives with respect to $M_o$ and $X_o$ are substituted in equations (2), the integrations carried out for each segment, and the partial results added so as to embrace the entire ring, the resulting equations when solved for $M_o$ and $X_o$ yield the following:

$$M_o = Pr \frac{\frac{1}{F}\left(\frac{W}{4\sin W} + \frac{\cos W}{4} + \frac{\pi - W}{2}\sin W\right) - \frac{r^2}{Z}\left(\frac{W}{4\sin W} + \frac{3\cos W}{4} - \frac{\pi - W}{2}\sin W + \frac{4}{\pi}\right)}{2\pi\left(\frac{1}{F} + \frac{r^2}{Z}\right)} = B(Pr) \qquad (4)$$

$$X_o = P\frac{1}{2\pi}\left(\frac{1}{2} - \frac{\sin^2 W}{3}\right) = C(P) \qquad (5)$$

The coefficients $B$ and $C$ in these formulas involve nothing but dimensions of the eyebar. The value $Z$ may be computed by integrating after substituting $u = r - v$, or

$$Z = \int_{r-\frac{1}{2}x}^{r+\frac{1}{2}x} \frac{rv^2}{r-v} dv = -r\int_{+\frac{1}{2}x}^{r-\frac{1}{2}x} \frac{(r-u)^2}{u} du$$

$$= r^2\left(r\log_e \frac{r+\frac{1}{2}x}{r-\frac{1}{2}x} - x\right) \qquad (6)$$

Having determined the statically indeterminate stresses $X_o$ and $M_o$ at the imaginary slot, the stresses $N$ and $M$ at any point of the ring can now be found. For the lower quadrant the values are,

$$N_1 = P(\tfrac{1}{2}\sin U + C\cos U)$$
$$M_1 = Pr(\tfrac{1}{2}\sin U + C\cos U + B - \tfrac{1}{4}\sin W) \qquad (7)$$

and for the upper quadrant ($\frac{1}{2}\pi < U < \pi$),

$$N_2 = P\left(\sin U - \frac{U\sin U}{\pi} - \frac{\cos U}{\pi} + C\cos U\right)$$

$$M_2 = Pr\left(\sin U - \frac{U\sin U}{\pi} - \frac{\cos U}{\pi} + C\cos U + B - \tfrac{1}{4}\sin W\right) \qquad (8)$$

while for all cross-sections

$$n = P(\tfrac{1}{4}\sin W - B) \qquad (9)$$

The maximum tension in any cross-section being expressed by

$$S = \frac{n}{F} + \frac{Mx}{2Z}\left(r + \tfrac{1}{2}x\right) \qquad (10)$$

the stress maximum must be simultaneous with maximum $M$, since $n$ is independent of the location of the section. From equations (7) it will be seen that $M$ reaches a maximum in the lower quadrant when $\tan U = \frac{1}{2C}$, which in our case is very near $U = \frac{1}{2}\pi$, so that we may assume that the maximum stress occurs at the horizontal section $X$ in Fig. 4, where

$$M = Pr(\tfrac{1}{4} + B - \tfrac{1}{4}\sin W) \qquad (11)$$

and the maximum tension occurs at the inner edge. In the second quadrant the maximum stress occurs at $U = \pi$, where the greatest tension is at the *outer* edge of the ring; the moment here is

$$M_2 = Pr\left(\frac{1}{4}\sin W + C - B - \frac{1}{\pi}\right) \qquad (12)$$

At the diagonal cross-section $Z$ (see Fig. 6) the moment is,

$$M_2 = Pr\left(\frac{1}{4}+\frac{1}{\pi}-C+B-\tfrac{1}{2}\sin W\right) \quad (13)$$

Applying the preceding formulas to a circular eyebar head with the fairly common proportions of pin hole two-thirds the bar width, and metal width $x$ three-fourths the bar width (thus giving 50 per cent increase of section through the pin hole), we have the following extreme-fiber stresses in terms of the stress $T$ in the body of the bar,

$$S_1 = 2.57\,T$$
$$S_2 = 0.79\,T$$
$$S_y = 0.76\,T$$

and a compressive stress of $0.2\,T$ at the outer edge of cross-section $X$. Cooper computed, for the simplifying assumption that the bearing pressure is concentrated at the back of the pin hole, and neglecting the curvature of the bar, that the tension at the inner edge of section $X$ is $2.95\,T$, while the compression at the outer edge is $1.61\,T$.

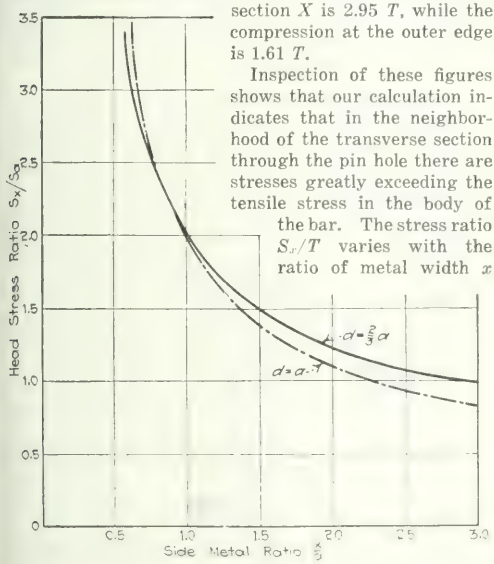



FIG. 5. HEAD-STRESS RATIO FOR VARYING METAL WIDTH

Inspection of these figures shows that our calculation indicates that in the neighborhood of the transverse section through the pin hole there are stresses greatly exceeding the tensile stress in the body of the bar. The stress ratio $S_x/T$ varies with the ratio of metal width $x$ to the bar width $a$. Its manner of variation is diagrammed in Fig. 5 for two sizes of pin hole, pin diameter equal to bar width and equal to two-thirds of the bar width. The diagram shows that, as the metal-width ratio is increased, the stresses in the head decrease very rapidly at first, but later on more slowly, so that for pin hole equal to two-thirds the bar width the maximum tension in the eyebar head does not become as small as the tension in the body of the bar until the head metal width is increased to 2.9 times the bar width, a value out of the question for practice. On the other hand, if for practical reasons the metal width $x$ be kept within the range of 75 to 100 per cent of the bar width (50 per cent to 100 per cent excess of metal through pin hole), the eyebar head would have to be thickened to 2.0 to 2.5 times the bar thickness in order to keep the head stresses down to the stress in the body of the bar.

With pin diameter equal to bar width (as used by Lindenthal), the stress in the head for the customary dimensions is not decreased, but even a trifle increased. Not until the diameter of the head is made very large does increase of pin diameter have a favorable effect on the stress; for example, the maximum head stress becomes reduced to the amount of the stress in the body of the bar when the metal width-ratio is 2.28 as compared with 2.9 for pin diameter two-thirds the bar width.

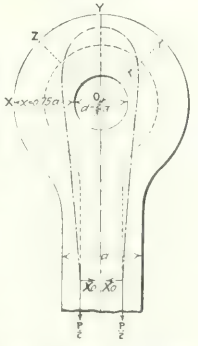



FIG. 6. LINE OF EQUIVALENT TENSION

This analytical result, that for the usual proportions of heads an increase in pin diameter means increase of stress in the head, justifies the opinions of those who, like Winkler, A. J. Du Bois, and others, make the width of head metal vary with the pin diameter. This had, in fact, been suggested by Charles Shaler Smith on the basis of his 1868 tests ("Proportions of Eyebars and Pins," *Transactions A. S. C. E.*, 1877, p. 263).

The formulas above derived make it possible to sketch the line of equivalent tension in any circular eyebar head, since the quantities $M$ and $N$ may be computed for various cross-sections and the distance of the line of tension from the center line of ring $(M/N)$ thereby determined. In Fig. 6 the results are plotted, positive values being laid off inside the center line. The tension $X_0$ at the imaginary slot in Fig. 4 acts at a distance $M_0/X_0$ from the pin center.

## High Stresses in Eyebar Heads

The results of these stress calculations tend to explain the previously observed stretch of eyebar heads, and also agree with the observation that stretch and fracture never develop in the cross-section $Y$ at the back of the pin. Moreover, Cooper's remark that in the transverse cross-section $X$ no stretch develops along the outer edge of the head, *and also no perceptible shortening*, corresponds quite well with the computed result that the compressive stress at this point is relatively small.

But the Diósgyör tests appear to be in contradiction with the results of calculation in one respect. At metal width $x = 0.6$ to $0.7\,a$, the test bars did not break in the head but in the body of the bar. Further, fractures in the head often occurred at the diagonal section $Z$, where, according to the calculation, much lower tension prevails than in the cross-section $X$. It is to be remembered, however, that the calculation is based on assumptions correct enough for service conditions, when the stresses remain within working limits, but no longer valid at stresses exceeding the yield-point. The drawings Figs. 2 and 3, as well as the statements concerning Dr. Lindenthal's tests, show clearly that bars which break in the body show almost as much stretch of the head as those which break in the head. With such extreme stretch of the head metal, and when the pin hole distorts so excessively, the distribution of bearing pressure at the pin surface can no longer follow the same law as at lower stages of stressing.

As the pin hole stretches and correspondingly a lateral contraction develops, the bearing pressure along

the haunches of the pin must increase, while that at the back of the pin hole must decrease. Such change in pressure distribution will—and application of the previously used method of analysis would readily show this—reduce $S_x$, while $S_z$ will increase. Bearing this in mind it is possible to assume a pressure distribution (which, however, could occur only after great distortion) by which the observed fracture phenomena would be explained, and the apparent contradiction of computation and test thus removed.

However, for the purpose of proportioning eyebars, the stress conditions which immediately precede fracture and only occur after large distortion of the head are not particularly important. Though it may be considered reassuring that distortions exert a favorable influence on the stresses in the eyebar, so that even inadequately proportioned heads are safe against fracture by virtue of secondary actions occurring only after considerable distortion, yet the fundamental principles of sound engineering design do not sanction the practice of allowing excessive stresses in certain important structural elements, or that as a result of these excessive stresses permanent distortions should be allowed to occur even at working loads.

At the best we may allow in the eyebar head somewhat larger stresses than we use in the body of the bar, since test shows that this does not entail risk of fracture. But under no circumstances should these stresses be allowed to reach the yield point. With the customary values of stress $T$ in the body of the bar, we should therefore limit the maximum stress in the head, $S_x$, to 1.8 $T$, to guard against permanent elongation. This limit in turn would, according to the values given by the curves in Fig. 5, give us a width of head metal $x = 1.15\,a$ to $1.2\,a$, for pin diameter $\frac{5}{6}\,a$ to $a$; and, on the other hand, if a metal width $x = 0.75\,a$ were adopted, the thickness of the head would require to be 1.4 times that of the body of the bar.

But it is not my intention to use the preceding stress analysis for deriving rules by which eyebar heads may be proportioned. The stress relations are so complicated that it is hardly feasible to appraise the influence of the various assumptions involved. For example, the oval form of head, customary in Europe, doubtless influences the stresses, in a manner hard to evaluate by analysis; probably it tends to reduce the stress at $X$ and increase the stress at $Y$. Despite the difficulty of dealing with the question on a purely theoretical basis, however, the above-calculated results justify one important conclusion concerning eyebar heads: *With the customary proportions of heads, the stresses in the head are much larger than those in the body of the bar, and this unfavorable condition is not relieved by increasing the pin diameter.*

Further, the stress calculations suggest, in my opinion, the need of further tests to clear the question. Such tests should be caried out with accurate strain measurement.

Detailed study of the question is the more important as the eyebar problem affects a very important element of large bridges. Moreover, the results of a full investigation may influence the method of manufacturing eyebars. Cutting eyebars out of plates as wide as the head diameter, as was done in making the chain links for the Elizabeth bridge in Budapest, is too wasteful to be advantageous if very large heads are necessary in the absence of local reinforcement, as the above analytical results lead us to infer. In that event it would be necessary to resort to the method formerly used, and universally employed in America, namely, making the heads by upsetting and press-forging.

The procedure used in the present paper may be applied also for the analysis of eyebars used in machine construction. That the bar heads used in such service have not apparently given any trouble through excessive deformation may be ascribed to the fact that the heads of such bars are commonly reinforced by thickening, and that the stress in the body of the bar is usually far below the limit considered safe in bridge construction.

Large chain bridges are likely to be built in the near future only in America, where, moreover, eyebars are used in important service as the tension members of large truss bridges. For this reason the natural agencies for carrying out the suggested tests with a view to obtaining a final solution of the eyebar question, are the well-endowed and excellently equipped American testing laboratories.

## Comment on London's Traffic Procedure

*(London Correspondence)*

ROAD USERS in London for some time have been urging a revision of the city's traffic by-laws and regulations. Despite the excellent control exerted by the police, the traffic in all the main thoroughfares is so congested that movement at any speed is quite out of the question. At present time all vehicles may use all streets.

The London omnibuses, for instance, on some routes utilize streets where other vehicles must draw into the curb to allow them to pass, and, on one or two bridges where the road is carried over a railway, an official of the omnibus company has to be stationed so as to allow only one bus over at a time.

In the list of powers to be given to the Ministry of Transport, the one which refers to relative highway positions of vehicles of different speeds is not believed to be practicable except on some of the widest and most modern of London streets, such as Kingsway. On the chief thoroughfares there is room for two streams of traffic, one proceeding in either direction. The only practicable method is to divert slower traffic to another street.

In the vicinity of some of the city's markets and elsewhere droves of cattle and sheep hold up traffic for five minutes or more. A remedy for this condition is long overdue.

In some of the city's busiest thoroughfares are situated the warehouses of the large dry-goods merchants, and here may be seen wagons and trucks standing all day loading and unloading huge packing cases, to the danger of traffic and pedestrians. This is especially the case near the river in the older sections of the city.

Coming down Ludgate Hill, one of the busiest city thoroughfares at 10 a.m., one may see refuse carts being loaded and confectioners' delivery vans being unloaded alongside on the curb. The dust carts are huge horse-drawn vehicles with open tops. The refuse is carried to the top of these vehicles in an open basket by a dustman and dumped anywhere and anyhow into the open top of the dust cart. At the same time trays of uncovered cakes are being unloaded and carried into a well-known restaurant.

# What Men in Practice Say About Engineering Education

**They Discuss Prof. Burr's Paper—Comparisons with Legal and Medical Professions Evoke Most Interest**

BOTH agreement and disagreement with the contentions made by Prof. W. H. Burr in his recent address before the Society for the Promotion of Engineering Education (see *Engineering News-Record*, July 14, page 65) are found in the following discussions received in response to the editor's request for an expression of views. Both Messrs. Gustavas and Campbell differ in part from Professor Burr, while the other writers are in general agreement with him. Mr. Perry lays emphasis on the value of the extra-classroom activities, while Mr. Turner points out the need for courses of what he calls vocational type, which will supply the bulk of the workers in engineering.

The subject is far from being exhausted, and we urge those having views other than those here expressed to send them to us.—EDITOR.

BY F. LAVIS
Consulting Engineer, New York

In general the views of Professor Burr are very much in accord with those I expressed at the Conference on Commercial Engineering held at Washington in June, 1919, when I voiced a plea for the broader training of engineers for overseas service, but Prof. Burr has very much more ably presented the subject from the standpoint of the educator.

Too much emphasis cannot be placed on the fact that if engineers do not get the recognition from society that lawyers, doctors and other scientists do, it is because they are lacking in real education and an intelligent interest in business. I think there are enough engineers who have been so recognized to prove the truth of this.

Engineering education should of course aim first and foremost to give the student a thorough training in engineering principles and perhaps a vision of what he may attain in his profession. This latter I think is fairly well attained by those schools who get engineers of some standing in their own special line of work to give one or more lectures to the graduating class—not to teach them engineering—but to indicate to them what the practice of engineering is or may be in its higher aspects. Besides this purely technical training however, I feel very sure that engineers as a whole will never attain a high standing in the community until they are really educated and cultured men.

Some recent happenings in New York tend to show that some engineers also are woefully lacking in a true appreciation of such professional courtesy as would be instinctive in true gentlemen, and while it is true that mere book learning will not help this very much, I believe true education—as distinct from the acquisition of technical knowledge—would help quite a little.

In general I am only repeating what Prof. Burr has so well said, but I think the need of a broader culture and education for engineers in addition to the necessary technical training cannot be too strongly emphasized.

---

BY CHARLES W. GUSTAVUS
Mechanical Engineer, Detroit

It is incorrect to compare the engineering profession and the legal or medical profession, as engineering in its very best form does not measure up to medicine or surgery, never will and never can.

Before taking up the reasons for these statements, I wish to ask where Prof. Burr gets the idea, or at least gives that impression, that members of the medical and legal group are world-beaters. It cannot be proved that every graduate in either one of these branches rises to a pinnacle of success and blazes the way for the rest of the community.

The reason for not comparing medicine and engineering is that they are not near enough alike. Medicine, and surgery, if you please, deal entirely with the human element and that make-up of the individual known as sentiment. The patient, and ones near and dear to him, expect a learned and proficient man to handle the case, capable of performing the operation or the administration of drugs without any blunder. Society, to assure itself of this service, has set up rigid requirements in the way of reputation and license laws. It will not tolerate a person calling himself a doctor who had a chance to break into the medical game by sawing off a few arms or legs now and then to get some experience, and when able to wield a few knives dexterously, wants to hang out a shingle.

Engineering, on the other hand, deals with inanimate materials. No problem in the profession, even if it holds lives in the balance, depending upon its proper execution, is solved upon pure engineering principles alone. Years and years of past experience are brought into play, and form the true basis of the trust that the engineer places in the project before it is proceeded with. Any deviation from this rule calls for experimental work as a preliminary operation in the solution of the case. That is why we have men who, without a technical education, call themselves engineers, who can perform engineering work based upon their past experience. Their blunders do not hold life in the balance as in the medical profession, and society has not felt the need of laws to limit the practice of engineering to technical graduates. Of course, there are exceptions to this, such as bridge work, but from a theoretical standpoint and close analysis, even that exception vanishes. It is only cold-blooded commercialism that requires a technical man to design a bridge. To build a Quebec Bridge on past experience alone and push flat cars across loaded with granite blocks for a safety test is not considered good form. So why try to compare engineering and medicine.

Regarding the legal profession. I think Prof. Burr has lost sight of the fact that a lawyer is so educated that he can fit himself nicely into several other places than a law office and still garner some of the worldly goods and esteem of his fellow-men. And because he makes a good purchasing agent he does not disclaim his profession and act as if everything has gone to the bow-wows. He has sense enough to carry on and consider his law course an asset.

But far be it from me to knock the engineers. I want to see them get their just share of recognition, because I am one myself.

*Improvement of Curriculum*—I agree with Prof. Burr on some phases of his suggestion for improving the engineering curriculum. This can be done, not by giving more time as he suggests, but by stripping colleges and university courses of thesis work and such bunk as design courses in conveying machinery. Good old fundamental work in physics, mathematics and mechanics, along with some cultural subjects like economics, corporation finance and what else time permits, with perhaps an additional year, will give some real engineers who a little later can act as directors and still feel that an engineering education is worth while.

Up to the present time specialization, and fancy names invented by engineers themselves tending to bring it about, has caused a good deal of the difficulty. When we get rid of efficiency engineers, concrete engineers, industrial engineers and a thousand and one others, and realize that a man who knows his fundamental theory from A to Z can tackle any of these so-called branches, then we can talk about engineering as a profession.

The tendency is now for vocational ideas in engineering,

which must be stopped. Why let a student become an automotive engineer, when if he knew his beam theory or fundamental electricity as he should he would have courage to move about and find himself, instead of throwing up the sponge when he finds that he does not like the smell of gas and begins work in a bank. Then all graduates will have a good education to make them logical, clear and concise thinkers, which is all that is needed for leadership, plus a little pep.

As soon as engineering is put on a level where a technical course is recognized as a prime requisite, instead of a time-killer in work that can be just as well obtained in shop and practice before or after graduation, professional grade will be a possibility.

### By J. P. H. Perry

Vice President, Turner Construction Co., New York

I am in such hearty accord with nearly everything that Prof. Burr has had to say that I would seem almost to be painting the lily if I attempted to discuss this admirable contribution at any length.

It seems to me that one of the very greatest things that a fellow gets out of a university education is the acquaintanceships that he forms and the learning how to meet men on a plane of equality. Entirely aside from the A, B, C's acquired by a student, the taking part in college affairs and the playing together with his fellows stands him in good stead throughout his life. The game of life is not all serious drudgery and it is common knowledge that often the man who played hard in college is a bigger success in after life than the brilliant student who never took his nose from off his text books.

Another point in favor of the college education preceding the technical course is the value of the friendships formed in after-life in lines other than engineering. A student at an "engineering school" makes his life-long friends among his competitors whereas an engineering student who had three years of college would make many strong friends who in their after-life could give him business in place of competing with him. It is this condition which undoubtedly helps doctors and lawyers to get many of the advantages which the engineering profession is supposed to envy them.

Prof. Burr's plea for a six-year course, half of broad college education and half hard technical study, it seems to me, would result in engineers having learned how to play and to mix with their fellows, which faculty, as a class today, they so sadly lack. It is right here that the college-trained man, including the lawyer and the doctor, is a different animal from the average graduate of an engineering "school."

Among the major qualities that seem to me to be responsible for the difference between success and failure among engineers is that of personality, which, regarded from the point of view under discussion, includes particularly breadth of interest, ability to play and an easy manner among men, combined with forcefulness and a knack of getting what one goes after. These talents can unquestionably be better cultivated at an institution where the college education is followed by a post-graduate technical course than at the average engineering school which concentrates on engineering training.

It seems to me that Prof. Burr has put his finger on the very heart of the reason back of the frequently heard complaint that engineers do not receive their just share of the world's rewards for their activities.

### By J. L. Campbell

El Paso, Texas

Professor Burr lays down several allegations substantially at follows:

1. Professional education should rest on a prior general college education of cultural character.

2. Engineers and the profession of engineering do not have the recognition and standing accorded law and medicine because engineers do not have a general cultural college education.

3. Lawyers and doctors and the profession of law and medicine have the recognition and standing which engineers and engineering lack because lawyers and doctors have a general cultural college education.

It is generally (almost unanimously) acknowledged that a broad cultural college education is most desirable and should be acquired when practicable and that with it men can advance farther and attain greater success and eminence in any calling than without it.

But the allegation that engineers and engineering do not and that lawyers and doctors and law and medicine do have recognition and standing because the first have not and the second have broad cultural college education is found to be unproved by the facts.

The facts are not as alleged or implied. Not all engineers lack and not all lawyers and doctors have cultural education. The profession of law and medicine have never made a broad cultural college education a pre-requisite to the study of law and medicine and practice therein. The profession of the law is generally rated at the head of the learned callings, but the percentage of its members who have been admitted to the bar by passing the required examination after a brief law course or even only one or two years' reading of law in a law firm office is surprisingly large.

I make the allegation that the members of the bar who have had a broad cultural college education are in the minority and that the percentage of cultured men in engineering is as large as it is in law or medicine.

### By W. O. Hinkley

Stanley Mines, Idaho Springs, Colo.

I agree with Prof. Burr, in his article in the *News-Record* of July 14, that a broader education for engineers would help materially in bettering their professional status, and if as he suggests it would be possible to graduate men from a course of this length without increasing the average age of graduation then indeed there would be nothing against it.

I think, however, that there is another factor which is often overlooked, that is, that besides educating him we must also educate the public to a slightly different opinion of professional status.

I believe that, in spite of what the facts may be, a large part of the public regards a professional man as essentially a white-collar man, and this is largely true. The medical and legal professions are essentially of an office and laboratory nature. A large proportion of their contacts tend toward continual polish. Even their clients try to appear at their best to the doctors and lawyers.

The engineer, on the other hand, must spend a large share of his time on the job, on field work, in contact with an element where a white collar would be out of place. A considerable number of the people with whom he is thrown seem to make it a point to conceal any culture which they have. Bad English is the rule rather than the exception. These contacts are bound to leave their mark on any man no matter how careful he is or what his previous education may have been. The entire process is roughening rather than polishing or cultural. Then too, as has been mentioned in your columns, a large percentage of engineers are working for wages or a salary rather than a fee. This again classes them with the trades rather than the profession.

To secure full recognition of the engineer as a professional man the public must be educated away from these beliefs. Undoubtedly a broader general knowledge on the part of the engineer would tend a great deal to this education of the public.

I would like to suggest a few courses not strictly engineering in character which would be of great benefit to any prospective engineer; the average engineering student regards these courses with great dislike but in after life, feels their loss:

English, civics, economics and, in the West, Spanish.

A remark that is often made jokingly, "Don't let your studies interfere with your college education," is a very good one if not carried to extremes. Many engineers with

an excellent knowledge of the theory and practice of the work are seriously handicapped by an inability to mix, and college is the best place to acquire this knack.

In other words, a foundation, at least, in the business methods of the country, and, even better, of the civilized world, should be a part of the education of every engineer.

By D. L. Turner
Consulting Engineer, Transit Commission
New York

In diagnosing and so forcefully emphasizing the defects in engineering education, Prof. Burr has rendered a notable service.

His address should be read by every engineer who is really interested in the future of the engineering profession, or better still, some way should be found to bring Prof. Burr's ideas home to the boys in the public schools and in the preparatory schools, where they are beginning to form ideas as to what their future careers are to be, and how they may best attain them. These boys are the raw material. They need to be guided. If they are guided properly and seek the right kind of an education for a professional career in engineering, the schools must respond.

Unfortunately, engineering education is being *sold* in a commercial sense. A great many—and it may even be safely said, a majority—of the students entering the engineering courses, do so because they have been led to believe that it is a quick road to self-support. The acquiring of a professional education has probably been of secondary importance with them.

This being the condition, it has been a case of obtaining the maximum amount of quickly negotiable information in the shortest possible time. Probably many of our technical schools have responded to this demand and even have competed to supply it. They have been in the market primarily to get the maximum number of students. They have been seeking quantity rather than quality, and by so doing they have cheapened engineering education.

### The Professional Attitude

Law and medicine, on the other hand, have long enjoyed a high prestige as learned professions. The young men selecting these professions as careers, have, to a greater extent, been actuated by a different motive. They have looked ahead to the future. They have considered the high standing in the community which most lawyers and doctors enjoy.

It has been the professional career which has attracted them—not the expectancy of quick return—not merely the acquisition of knowledge to permit them to carry on a vocation. This difference in mental attitude toward what they are setting out to do, is, I believe, the underlying reason for the great difference between engineering education and that provided in law and in medicine.

In one case vocational training is sought; in the other, a professional career. The engineering schools seem to strive to supply the vocational training. To do so satisfactorily, they must constantly change their courses to include the most up-to-date and saleable information. This accounts for the condition of affairs so forcefully set forth in the last part of the first paragraph of Prof. Burr's address, which I quote as follows: "In other words, the whole field of engineering education seems to be in a dynamic condition, or perhaps we may better put it, in a state of violent ebullition, without any surface evidence of having stable strata at any depth whatever."

Our technical institutions should be concerned more about the quality of the graduates, than of the quantity. A great many of them are crowded. Their equipment must be expanded if more students are to be accommodated. Instead of providing for the increase in numbers, why not grasp the opportunity and raise the standard of the education, and by so doing, automatically eliminate the less desirable?

Or, if large numbers must be educated, why not differentiate their education? Why not supply the vocational training for the students who happen to want that kind of an education?

And why not reserve professional degrees for those students who are able, and who desire to acquire the education that a learned profession should have?

Until their education is of the same high quality in every respect, engineers will never be accorded the same professional recognition as is enjoyed by those practising law and medicine.

I have believed this for many years, and have sought to have the professional degree given only to those students who can find the time and money to enable them to superimpose their professional education upon a general college education as a foundation. In other words, I believe a professional degree in engineering should be a post-graduate degree, as it is now with law and medicine, in the best professional schools.

I fully concur with Prof. Burr in advocating a six-year course in engineering, with a professional engineering degree at its completion. But I would partly parallel this course always with the so-called vocational training course of three or four years in length, and recognized by a Bachelor of Science degree. Such a vocational course and such a Bachelor of Science degree would supply the rank and file of engineering workers, who do not now, and never will attain to a high position as professional engineers.

## Thunderstorm-Breeding Spots and Engineering Design

AFTER discussing the probability that thunderstorms are likely to develop with more frequency in certain localities than in others, due to local conditions, Robert E. Horton, consulting engineer, Voorheesville, N. Y., suggests in the April *Monthly Weather Review* that the subject is worthy of study because of its relation to the design of engineering works. Mr. Horton notes that he has observed thunderstorms over cities, particularly Albany, N. Y., and Providence, R. I., "which originated immediately over the city and did not travel far outside their limits on days when there were no other adjacent thunderstorms." He expresses the belief that "some cities, if not indeed most inland cities of say 100,000 population or more, appear to be thunderstorm spots." He also points out that "a shallow lake with sandy margins located in a forest may serve as a thunderstorm breeder" and cites as proof observations made by him over Oneida Lake, N. Y. Furthermore, "Some western arroyos are notable for the frequency of occurrence of so-called cloud-burst thunderstorms" . . . "whereas another adjacent to it might rarely produce them." The desirability of observations to show what particular areas, rural or urban, are what Mr. Horton terms "thunderstorm-breeding spots" is urged as bearing upon the design of dams and of sewers. What Mr. Horton says in conclusion about cities breeding thunderstorms and the relation of this possibility to sewer design follows:

"An indication of the truth of the supposition that cities breed thunderstorms might be obtained by comparison of rain gages in the surrounding country with records taken in the city during the thunderstorm months. Records of the number of thunderstorms taken in large cities are probably not sufficiently accurate to afford a reliable basis of comparison with thunderstorm frequency in the immediate surrounding country. Should it prove true that cities are in some instances thunderstorm breeders, whereas other nearby cities may not possess this characteristic, then such facts might have a very important bearing on various engineering problems, notably storm-sewer design, and might vitiate the utility of application of records of thunderstorm rain intensities in one city to another nearby city, even though the climate of the two places and the total rainfall per annum might be very nearly the same."

# Swiss Technical Notes

## Improvement Program of Federal Railways Includes Double Tracking, Bridge Reinforcement, Electrification and Stations

*By Engineering News-Record's Swiss Correspondent*

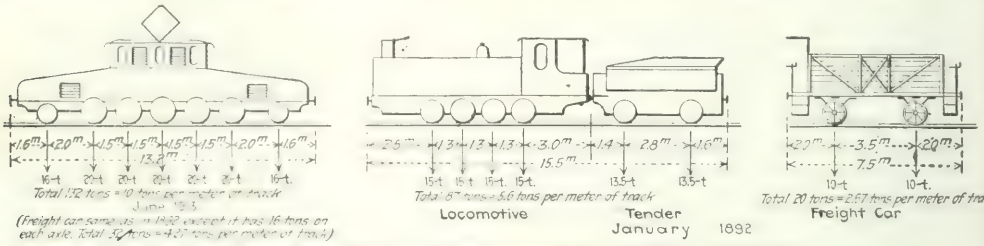
COMPARATIVELY a new undertaking, the Swiss Federal Railways have developed greatly since the popular vote of Feb. 20, 1898, which provided that the state take over the Swiss railroad system, with the slogan "The Swiss Railways for the Swiss People." In carrying out the new federal law, the state took over the Central R.R., the Northeast R.R., and the United Swiss Rys., Jan. 1, 1901, and in 1903, the Tura-Simplon road. With the taking over of the Gotthard road in 1909, the buying in of the principal privately owned lines was concluded. Since that time an extensive improvement program has gone forward including double tracking, bridge reinforcement and replacement, heavier rail and track, electrification, and new stations. In the meantime some of the smaller and less important lines have also passed over to the state, and in 1919 the Swiss federal railways comprised 2,755 km.

As in other countries during the transition period from private to state control, the first few years of operating the federal railways naturally entailed many difficulties. Further considering the fact that, after barely ten years of government control, the World War intervened with its very serious effects on neutral Switzerland, shut in on all sides, it will readily be recognized that the federal roads are experiencing great difficulties in maintaining a balance between income and operating expenses and at the same time trying to carry out a program of improvement.

The original investment in the lines of the federal railways was 1,062 million francs. The improvement program to date represents an additional 469 million francs for capital account, so that new expenditures amount to about 44 per cent of the original investment. Included in important betterment work may be mentioned the completion of the Simplon tunnel, started by the Tura-Simplon road, the total cost of which was 81,000,000 francs, which included the 35,000,000 francs expended by the federal railways to complete the work. Net profits of operation of the Swiss Federal Railways per kilometer of line operated, since 1903, at intervals of four years, were as follows: In 1903, 15,749 francs; in 1907, 18,873 francs; in 1911, 26,113 francs; in 1915, 18,109 francs, and in 1919, 20,800 francs.

Up to the end of 1919, 357 km. of single-track line had been double tracked, so that the total length of double track has been increased to 893 km., or 32 per cent of the total length of line. This may seem a small proportion of double tracking in comparison with railroad systems of other European states, but it must be considered that physical conditions in Switzerland are considerably more difficult. In this respect those who know Switzerland may be reminded of the international character of the Gotthard road, the difficult Brunner-Fluelen division of which still awaits double tracking. Nevertheless, this single-track section has to meet the heaviest traffic demands, and in 1913 sixty-eight trains per day passed over it without accident, while in general sixty trains per day had been considered the limit for safe operation.

An important feature of the development of the federal railways has been the program of bridge reinforcement and heavier rail and track which followed the introduction of bigger power. In 1903 there were only some 94 km. of track laid with rail of section heavier than 45 kg. per m., but at the end of 1919, 2,350 km. of line was equipped with heavy section rail. The increase in track loads resulting from the introduction of heavier locomotives required the reinforcement and replacement of existing iron bridges, in accordance with new loading standards shown in the accompanying diagram in comparison with the old standard of loading. Even the new standard loadings have again been exceeded with further development in the program of electrification and new electric locomotives having axle loads of 25 tons and 11 tons weight per meter of track.


1.6m 2.0m 1.5m 1.5m 1.5m 1.5m 2.0m 1.6m
13.2m
16-t 20-t 20-t 20-t 20-t 20-t 16-t.
Total 132 tons = 10 tons per meter of track
June 1913
(Freight car same as in 1892 except it has 16 tons on each axle. Total 32 tons = 4.27 tons per meter of track)
2.6m 1.3 1.3 1.3 3.0m 1.4 2.8m 1.6m
15.5m
15-t 15-t 15-t. 15-t. 13.5-t 13.5-t
Total 87 tons = 5.6 tons per meter of track
Locomotive
Tender
January 1892
2.0m 3.5m 2.0m
7.5m
10-t 10-t.
Total 20 tons = 2.67 tons per meter of track
Freight Car

OLD AND NEW STANDARD BRIDGE LOADINGS OF SWISS RAILWAYS

Right two diagrams specified in first Swiss decree governing calculations of iron bridges in 1892. Left-hand diagram indicates standard loadings as required by a decree of June 7, 1913.

More than 8,000,000 francs were required for the rebuilding and reinforcement of bridges alone up to the end of 1919. A series of rather small iron bridges was replaced by more massive structures. On the thirty-two iron bridges remaining, regulations are in force providing limiting speeds, prohibition against two trains crossing double-track bridges at the same time, and prohibition against braking on the bridges.

Large sums have been required in the construction of station buildings and stations. The program still provides for the building of eighty new stations, fifteen of which are in the course of construction. A total of 550 million francs will be required for this work, of which 100 million alone is to be provided as a first installment for the reconstruction of the station at Zurich.

Greater safety of operation has received careful attention in the program for improvement by the construction of additional block sections, telephone block dispatching and warning signals, and in the rapid replacement of oil lighting by electric signal lighting. Switches on express tracks are being equipped with

"double tongue locks" so that it will be possible to operate express trains over them without decreasing speed.

Finally, in recent years, larger sums have been required to initiate the program of electrication, which is now fully under way. In addition to the building of the usual transmission lines and overhead and the building of electric traction equipment, the work involves three railway power plants in Tessin, Reusstal and Wallis that are now under construction.

If this entire program of improvement and reconstruction should be carried out within a period of fifteen years, it would require capital expenditures per year, according to the report of the general management of the Swiss Federal Railways, of the following amounts:

| | Million Francs |
|---|---|
| Reconstruction and extension of station buildings and station equipment | 37 |
| Double tracking | 25 |
| Bridge alterations, interlocking and signal devices, telephones, telegraph, furniture, etc | 15 |
| New lines | 3 |
| Electric traction | 40 |
| Rolling stock | 30 |
| Total | 150 |

However, the effects of the great war on raising capital will probably not permit such rapid completion. Therefore, it is intended to proceed with electrification according to a program already approved with construction expenses provisionally reduced.

The Swiss people have made a large sacrifice to create and improve the state railway system. Small Switzerland, with an area about half that of Lake Superior, has done everything within its power toward developing transportation and tourist traffic.

## Wood Pipe Preferred for Tunnel Ventilation

In taking over the work of driving 10 miles of tunnel in the mountain division of the Hetch Hetchy project, A. C. Dennis discontinued the use of 24-in. steel ventilating pipe and substituted wire-wrapped wood-stave pipe 14 in. in diameter. This has now been in use in the several headings for about 8 months, and Mr. Dennis states that it is more easily placed than the metal pipe, requires fewer supports, is much more likely to remain tight and is less subject to leakage due to being thrust slightly out of alignment. The chief advantage of the wood-stave pipe, however, is that it is not easily damaged by flying rock fragments, which makes it possible to carry it close to the heading. The metal pipe was not ordinarily placed nearer than 250 to 300 ft. of the heading, due to the danger of damage from flying rocks. This left a pocket or dead-end from which the foul gas cleared much more slowly than in the case of a ventilating pipe that could safely be carried closer to the heading. The wood pipe is ordinarily kept up to within about 50 ft. of the heading and at this distance gives less trouble in maintenance than did the metal pipes terminating 200 ft. back of the heading.

## French to Irrigate the Niger Valley

Irrigation of 1,870,000 acres of land in the Niger River Valley of the Soudan within 12 years is the intention of the French government according to a recent report from the French Commission in the United States. The work will involve an impounding reservoir at Lake Faguibine, diversion dams and canals.

# Causes of Equipment Delays in Highway Construction

### Careless Operatives Increase Accidents—Poor Standardization Delays Repairs—Lack of Data on Efficiency

By R. C. Marshall
General Manager, Associated General Contractors of America, Washington, D. C.

*The equipment ideal of the paved road builder is a light mobile plant capable of handling, mixing and finishing 400 cu.yd. of concrete every day, with no delay for repairs.*

*Few road construction plants attained this ideal in 1919 and 1920, the two greatest years of paved road output in the history of American road building.*

*There were various reasons for this failure, but the two most important were poor railway transportation and delays due to construction equipment troubles.*

*In the article which follows, the latter difficulty is discussed by the spokesman for the Associated General Contractors of America at the meeting of the American Society of Mechanical Engineers, Chicago, May 26, 1921.*

*Briefly the task is laid upon contractors of providing skilled mechanical direction and operation of construction machinery, and upon equipment manufacturers, of standardizing design and of presenting reliable information of machine efficiency.*—Editor.

EQUIPMENT delays in highway construction are due mainly to lack of skilled mechanics, lack of standardization in design and lack of accurate information concerning adaptability, capacity and operation of machines.

The lack of skilled mechanics concerns both manufacturers and contractors. An equipment company may expend much time and money in perfecting design or improving workmanship, but if its machines are placed in the hands of incompetent operators, the money spent is wasted. Incompetent operators can readily offset the advantages of efficient equipment and well-planned work. Heavy delays for repairs due to careless operation means a loss of money to the road builder, and loss of that valuable asset, good will, to manufacturers.

The shortage of good operators might be relieved by establishing a short course of instruction for mechanics. During winter months when construction is slack these men could be instructed at the manufacturers' shops or possibly at some of the engineering schools. In either case they could be instructed to operate and exercise care in maintaining equipment. Savings effected in the field by competent operators would amount to many times the cost of their instruction. One of the worst obstacles to continuous output would thus be removed.

### Standardization Badly Needed

The second significant source of delay is a lack of standardization in equipment when standardization is possible. Road building plants are generally made up of machines from half a dozen different manufacturers and to be prepared even for the usual run of minor field repairs on all machines requires a more or less elaborate machine shop. The financial burden of carrying duplicate units or a sufficient number of spare parts is too great for an already heavy overhead, and in order that this expense may be held within reason, greater interchangeability of parts should be possible.

It is not expected that a mixer casting should be adaptable to a locomotive crane, but the interchangeability of parts on different portions of the same machine can undoubtedly be increased. Undue variation in the pitch of threads is an inconvenience which might be materially lessened or removed. It is not practicable in a small construction machine shop to carry stocks and dies for every

thread in the outfit, and yet if this is not done, some insignificant bolt may hold up the work for several hours or a day. By reducing the number of different sized bolts and threads, many more repairs could be made at the site of operation.

Gas engines are especially annoying when a breakdown occurs. Repairs usually involve a shipment of some part by express. In the meantime the work is delayed and the overhead is absorbing profits. Even allowing for difference of opinion in designs, the power delivered by a gas engine surely bears some definite relation to size of bore and bolts that would permit more uniformity in their manufacture. Any uniformity that can be effected will be reflected in the cost of road construction.

The amount of saving that might be effected through standardization of road equipment is not generally appreciated. To build a medium-sized, high type section requires a daily field payroll of $300 or $400 and an overhead of probably another $100, so that $500 a day is not an unusual cost. Employees cannot be laid off every time a breakdown occurs, and since the overhead goes steadily on, $50 an hour may be considered the cost of equipment delays.

By bringing about some degree of standardization, many more repairs could be made quickly in the field, and the saving would accrue to the public in lower highway costs. At present these costs are discouragingly high and it is the duty of every group of men involved in construction to place their energies squarely behind the movement to bring costs within reason. It is exceedingly doubtful whether the present equipment expense of high type roads is justified, and if it proves not so, mechanical engineers and contractors will have an interesting problem in cutting the expense to economical proportions. This problem will involve, and to some extent depend upon, both the standardization of equipment and instruction of mechanics.

For every type of machine sold the manufacturer should prepare at least two assortments of spare parts to be sold at a stipulated price with his machine. The assortment should be based upon actual experience in operating similar machines. The mere fact that there are parts so listed should not detract from the value of the machine but a grossly erroneous list would surely militate against its future sale. These lists, besides their value to the highway contractor, would keep vividly before the designers the number of different kinds of vulnerable parts and would tend to encourage standardization and simplification.

### Reliable Equipment Advice Essential

The third pressing need of road builders, and the one which probably results most frequently in disaster, is a lack of unbiased and authoritative information concerning the adaptability, capacity and operation of machines. Lack of such information has already brought disaster to numerous individual companies, both old and young; and as new concerns are constantly taking up road work, it is essential that they secure authoritative mechanical advice.

The road program has so expanded that to complete the work desired by each state many companies new to road work must be relied upon. These companies have not always realized that problems of road construction differ vastly from those on work confined to a small area, and in choosing their method of operation they have made grave mistakes. Many of these mistakes are due directly to a lack of authoritative information which should be available in any country as widely developed as the United States.

It is a significant fact that in writing to a manufacturer for information the reply almost invariably comes from the sales department. Frequently the reply is entirely unbiased, or apparently so, but more frequently the writer, if a contractor, is apt to be deluged with a mass of sales literature and glowing testimonials. He may be informed that the district salesman will call and take his order, all of which leaves the hurried contractor exactly where he started. That is not engineering service.

Manufacturers in some instances do supply engineering service—supply it in profusion. In fact, a prospective road builder can hardly escape it, but the service is not of the kind that contractors need. It is a combination of salesmanship, estimating and civil engineering—all of which a live construction company possess in abundance.

What contractors need are accurate data showing under what conditions a certain type of machine is suitable, how long it may reasonably be expected to last and what output it can deliver under normal working conditions. If this information can be made available, construction companies may be relied upon intelligently to select machines. They will then be able to co-ordinate their plant and estimate their costs.

A questionnaire sent to a hundred manufacturers in 1920 showed that they possess practically none of this needed information. A few of them were able to state figures for depreciation, but the figures would unquestionably cause an unwary bidder to underestimate. One firm gave twenty years as the average life of a slip scraper. Yet an earth mover knows that constant use of a slip may wear it out in a season. This is merely an example to show that manufacturers themselves are frequently lacking in facts concerning their own equipment.

Collecting the information needed by equipment owners may not be strictly the work of mechanical engineers but it would undoubtedly be of assistance to them. They would, moreover, perform a valuable service by undertaking the task so that contractors could rely upon the accuracy of their information. It is principally by securing dependable information and by bringing about co-operation between the constituent industries of construction that the leaders in construction expect to make it an efficiently conducted industry.

## Hudson River Pontoon Bridge Preliminary Plans

Anticipating the passage of the Hudson River Pontoon Bridge Co. bill recently introduced in Congress by Senator Frelinghuysen of New Jersey, as reported on p. 207, Aug. 4, Gustav Lindenthal, consulting engineer, is developing the plans for the structure. He gives the following as the principal features of the proposed structure:

Highway traffic exclusively is to be accomodated by the proposed bridge. The deck will provide a 30-ft. roadway and a 10-ft. sidewalk, and will have an underclearance height of 40 ft., bringing the roadway about 50 ft. above water. On the Yonkers or east side the bridge will land on Hawthorne Ave. near the foot of Downing St., giving direct traffic connection with the main routes south, east, and north. On the west side the line encounters the vertical face of the Palisades, at this point about 450 ft. high. The new Palisades Park road extends along the face of the cliff 90 ft. above water or 40 ft. above the bridge roadway level; connection will be made to this road by approaches rising on 5 per cent grade along the slope at the foot of the cliff.

The main or pontoon-supported part of the structure will be in the neighborhood of 4,800 ft. long; this is to be flanked by a short section of timber trestle supported on piles on either bank, and a span over the New York Central right-of-way on the east bank. The wooden vessels of the Shipping Board which it is proposed to use as pontoons for carrying the main bridge, of about 4,000 tons displacement, are to be placed 160 ft. on centers, bow upstream, and will be moored by cables attached to screw-pile anchorages at a distance of 300 or 402 ft. up and down stream. On account of the great depth of soft bottom these piles will have to be put down to a considerable depth, possibly 100 ft. or more. The superstructure carried on the pontoons will consist of four lines of lattice girders, floorbeams resting on them, and a floor of double planking directly on these beams. The width of the ships being about 46 ft.,

clear openings of something over 110 ft. will be obtained. A drawspan will be provided.

Because of the large amount of wood in the structure a complete fire-protection system will be provided. The principal other natural difficulty to be contended with is the possibility of ice pressure in winter. The tidal currents at the site of the bridge have a velocity of 3 to 4 miles per hour and there is a possibility that a large field of ice moving in this current might put excessive pressures on the moorings. To guard against this danger ice-breaking vessels will be provided, to operate across the river along the bridge in winter and break up field ice.

Present estimates indicate that the structure can be built and put in service for a sum within $2,000,000. The tolls to be charged will be under the control of the Secretary of War, according to the chartering bill. The structure must be removed at the end of ten years, within which time it is belived possible to complete the permanent bridge projected at 57th St., New York City, by the Hudson River Bridge Corporation, made up of related interests.

# Tuning Up Anew an Eight-Year Old Filtration Plant

## Inadequate Mixing and Bypassed Untreated Water Produced Uncoagulated Water—Mudballs and Inverted Gravel Result

WHEN the filter plant at Waco, Texas, was built in 1913 it was provided with the most modern equipment. (See *Engineering Record* June 20, 1914, p. 694.) Recently the plant has had a thorough overhauling and the designs checked with present day practice, particularly with reference to the mixing chamber, settling basin and the baffles. C. Arthur Brown, consulting engineer, in making a report on the plant to E. L. Fulkerson, superintendent, states that due to insufficient coagulation and subsequent imperfect sedimentation the uncoagulated sediment clogs the filters rapidly, lowers the efficiency of the filters, has a tendency to cause mud balls, hard spots, bed settlement, breaking of the sand bed away from the side walls and inversion of the supporting gravel. The following notes are from the report:

The most serious errors in design now apparent were made in the mixing chamber. One of these resulted in the top of the mixing chamber and the floor of the filter gallery being placed at the same elevation. Another resultled in a number of openings in the walls between the different compartments of the mixing chamber. Because of the lov elevation of the mixing chamber it is impossible to get enough head to create sufficient velocity to carry along the suspended matter. At least 4½ ft. of head should have been allowed. As the laboratory and coagulant apparatus are built over the mixing chamber it is impossible to correct this difficulty. By rearrangement of baffles in the mixing chambers and reducing the weir height between the settling basins and filters, a small amount of head was made available, but the real cure lies in building a new chamber.

The mixing chamber is divided into two halves by an east-and-west wall. The north section is divided into three compartments by two division walls running north and south. The one to the east is the accelerator chamber, the one to the west is the mixing chamber proper and the central compartment is the flume chamber. The untreated water enters the accelerator chamber through a 30-in. cast-iron main, in which there is installed the accelerator or pressure difference tube equipped with pitot and piezometer tubes in its throat. This accelerator ends in a 30-in. flange and spigot ell which is turned downward, causing the flow from the discharge to impinge against the floor. In the wall between the north and south halves there is one large opening near the floor through which the water passes from the accelerator chamber to the south half of the mixing chamber and in addition there are a number of smaller openings, also at the floor line, through which water may flow from the accelerator chamber to the south half of the mixing chamber. An equal number of these small openings of the same size, about 4 in. square, are to be found in the wall between the accelerator chamber and the flume chamber, which enables flow to occur between these two compartments.

The normal course of flow through the mixing chamber is into the accelerator chamber near its west end, thence to the east end of the chamber and through the large opening at the floor line into the east end of the south half of the mixing chamber. Flowing westwardly to the center of this chamber, it passes through old wooden baffles to the west end of the south half and discharges under the middle wall at the floor level into the real baffling or mixing chamber compartment of the so-called mixing chamber. The baffles in the south half of the mixing chamber perform no useful function and might as well not be there for any good they do; in fact, they might better be removed as they are an actual hindrance to the plant.

### Insufficient Baffling

Just after the flow passes from the south half of the mixing chamber into the real mixing chamber section, or the west section of the north half, the chemical treatment of caustic lime and sulphate of iron is introduced into the flow. From here on until the water leaves the west compartment, the water is compelled to flow over and under a number of baffles, making several up and down cycles of flow, at so low velocity as to be of little benefit. From the mixing section it flows into the flume section, which is unbaffled. This central or flume section serves as a distributing point to effect flow into the two settling basins, two flumes taking off from the flume chamber at the bottom and extending through the mixing chamber section and the accelerator section into the bottom of the western half of the western settling basin and the eastern half of the eastern settling basin.

These flumes discharge at the bottom of the settling basin sections through a number of small openings which look upward. As originally constructed, the openings from the flumes discharged horizontally, but the flow in this direction created so much scouring action across the bottom of the settling basins that the openings were changed to a vertical discharge. To secure a proper distribution of flow, a baffle was built in front of these flumes and the upward flow was made to pass over the top of this baffle to enter the settling basins. The benefits from this change were immediately apparent.

About five-sixths of the space in the mixing chamber is either unbaffled or baffled so as to give no results of any value.

The chemicals, being introduced after the flow has passed through two-thirds of the mixing chamber, are then only very inadequately mixed with the water, with the result that the floc is not well formed. The openings between the accelerator section and the flume section permit a very considerable volume of flow to pass directly from the accelerator section to the flume section, none of which receives any chemical treatment. The mixture of untreated raw water and treated water passes through the flumes to the settling basins. Although the percentage of untreated water as compared to the volume of treated water is relatively small it is just about ample to nullify the effects of the chemical treatment in the treated water.

As a result of this deplorable condition in the mixer, the water entering the settling basins is not completely coagulated nor in fit condition to undergo sedimentation. It is smoky and streaked and cannot be made to settle clear. The fine, uncoagulated sediment rapidly clogs the filters and lowers the efficiency of filtration. It has a tendency to

cäuse mud balls, with all their attendant evils, from which this plant is now suffering. If permitted to continue, we may confidently expect to see hard spots continually developing, even to a much greater extent than they now exist. Evidence of bed settlement, with the filter beds breaking away from the walls, is now observable. Hard spots have been found and if these things were to be permitted to continue, cracks and crevices would surely follow the present bed inversion found in one of the filters.

When the water level in the filters was drawn down a careful investigation indicated that the filter beds were in poor condition. The sand showed unmistakable evidence of bed settlement, which manifested itself in a pulling away from the walls of the filter. The sand level was too high, a part of each wash trough being buried in sand. The sand was heaped up between the wash troughs and from 60 to 80 sq.ft. of filter bed were rendered ineffective by the high sand level. When the air was turned on, it did not break evenly, there being no considerable uniformity even after the air had been applied for several minutes. When one of the filter beds had been opened down to the gravel, the conditions were found to be considerably worse than could have been anticipated from the surface indications aside from the mud balls. Not only had the mud balls penetrated the filter bed to the gravel layer but to a considerable extent they had even penetrated the gravel. Hard spots of considerable area were found, practically blanketing the bottom over these areas. Bed inversion had taken place, considerable areas of the gravel layer had lifted from 4 to 8 in. In fact, all the indications were that filtration efficiency had practically ceased and that if the plant had been permitted to continue in operation on the same basis the time would have arrived at a fairly early date when it would have proved impossible to obtain enough filtered water through the beds to have met the needs of the city.

The recommendations made and put into effect consisted of the following: To remove all sand and gravel from each filter bed in turn; to remove and clean the air manifold; to secure 6 in. of gravel of approximately 3-in. diameter and place it above the water strainers in the filter bottom; to screen and grade the present gravel and replace it on top of the 6 in. of new gravel; to raise the air manifold from 6 to 8 in. above its present location; to add about 2 in. of new sand to the old sand to give the requisite layer of fine sand on the surface of the filter bed, keeping the bed at least 2 in. below the bottom of the wash troughs. The sand has increased in size and weight by accretion but the specific gravity of the material as a whole has decreased. The percentage of increase by volume is 31.58 per cent, while the increase by weight amounts to only 15.62 per cent.

Among the things which are practically worn out may be mentioned the solution tanks for sulphate of iron. These tanks are leaking in a number of places and have already been patched up a number of times. The lime tanks are in better condition, practically as good as when new. The equipment of both lime and iron tanks is practically worn out and will shortly have to undergo repair or replacement, which will be rather expensive. Dry-feed mechanical machines, not available at the time the plant was built, are now perfected sufficiently to warrant their use. Rather than rebuild the chemical tanks and apparatus, I suggest that three dry-feed machines be equipped to operate on functional control. The plant at the time it was built was not equipped with a recording meter to measure the flow into the plant. An accelerator tube was provided, however, and this was used to actuate the wet feed chemical devices. This accelerator tube can now be utilized to actuate the dry-feed chemical machines in the same way.

The individual filter controllers and the master controller are in fair condition and could be made operative without a great deal of trouble or expense, but none of these controllers are now in service and have not been for a very considerable period of time in the past. I am strongly of the opinion that you will never be able to do much better with them in the future than you have in the past. A part of the troubles you have experienced with your filter bottoms may be charged to this lack of filter control and I believe you will always have more or less of this trouble unless a better practice is followed. It is recommended that the present filter and master controllers be replaced with a more modern type which will not only control the flow from the filters but also meter it, the master controller metering the total output of the filters. I should expect to utilize the accelerator tubes of the present controllers, selling the hydraulically-operated throttling valve and replacing it with a diaphragm-operated throttling valve. The price obtained for the one should go a long ways toward paying for the other.

## Timber Truss Roof Designed for Special Conditions

BY THE special design of a 76-ft. timber truss roof which would not require large timbers or steel rods and which would utilize material on hand in relatively small sizes a saving of 20 per cent in cost was effected in the construction of a new freight-car repair shed for the Atlantic Coast Line R.R. at Waycross, Ga. This is

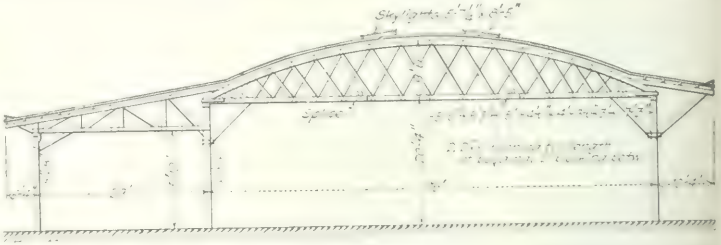


FIG. 1. TIMBER ROOF FOR CAR REPAIR SHED, A. C. L. R.R.

the saving estimated by the railway officers, who state also that there was a reduction of about 30 per cent in the time of erection as compared with the original design for ordinary wood truss construction requiring larger timbers. The greatest saving or advantage, however, was in the fact that car repair work proceeded without interruption while the shed was being erected and the roof trusses were placed, as temporary abandonment of the repair tracks had been expected.

The 76-ft. timber trusses designed for this work have curved top chords of 9½ ft. rise and a web system of intersecting members, as shown in the general and detail drawings, Figs. 1 and 2. The chords are in two parallel sections, with the ends of the web members bolted between them. Each portion of the top chord consists of six 2 x 3-in. pieces laid flat, bent to the required curve and nailed together at 18-in. intervals. For the bottom chord there are two pieces 3 x 8-in., with splices at the third-points of the span. Web members are 2 x 6 in. except that at the ends they are 2 x 8 in. and placed close together.

The ends of the bottom chord are shaped to butt against the top chord and a heavy steel strap is put around each end of the truss, this strap having side angles which rest on a wall plate laid along the tops of the side posts of the building. Knee braces extend from the posts to the truss chords and the wall plates. Joists 2 x 8 in., with overlapping ends, are laid across the top

chords and nailed in place, the plank sheathing for the roof being laid upon these. Upon the bottom chords are laid two lines of longitudinal timbers to carry hoists for use in car repair work.

This repair shed is 672 ft. long, except that a 30-ft. gap is left at the middle in order to reduce the fire risk. Its posts and trusses are spaced 15 ft. c. to c. The 76-ft. roof spans four repair tracks and a service track. At one side is a 29-ft. span over the machinery space and blacksmith forges, and at the other side is a 10-ft. lean-to or shelter roof. Light is provided by a metal-frame skylight in each bay, these skylights being on opposite sides in alternate bays.

Assembly of the trusses was done at a framing yard 2,000 ft. distant. Each truss was carried to the site by a locomotive crane, and after being raised parallel with the track to a sufficient height to clear the posts, the truss was swung round and placed on the wall plates. Only about 18 minutes were required to transport a truss and set it in position. The entire structure was erected in forty eight-hour working days by a force averaging two foremen, a timekeeper, sixteen mechanics and twelve laborers. The trusses are said to have cost less than $2 per foot of span.

With a cost of $43,000 for the structure the cost per square foot of area covered averaged 19c. for labor and overhead and 56c. for the building complete. This design, as a substitute for the railway company's plans, was submitted by George F. Jenkins, president of the George B. Swift Co., contractors, Chicago, and Savannah, Ga. The timber truss was designed by William J. Summerbell, Chicago, who has patents pending. The work was carried out by the George B. Swift Co.

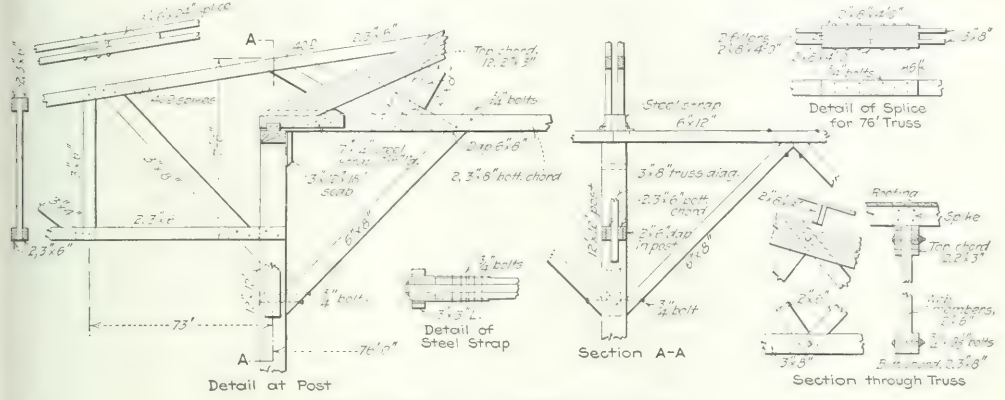


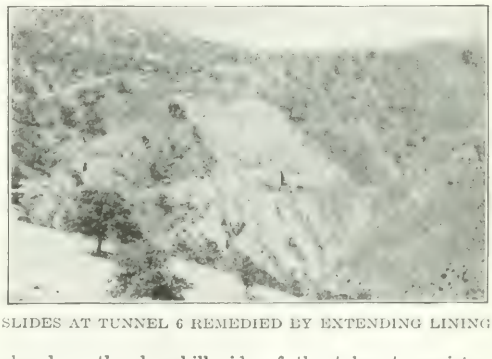

FIG. 2. DETAILS OF TIMBER ROOF TRUSS

## Fewer Horses in Cities

The extent to which horses are being displaced by motor vehicles is shown by the report of the Bureau of the Census covering the number of horses in various cities. The decrease in the number of horses in New York in 1920 as compared to 1910 was 40 per cent. The percentage of decrease in certain other cities is as follows: Chicago, 44 per cent; Boston, 43 per cent; Cincinnati, 36 per cent; Cleveland, 30 per cent; Pittsburgh, 6 per cent, Baltimore, 48 per cent, and Philadelphia, 38 per cent.

## Tunnel Lining Continued Beyond Portals for Protection from Slides

IN REPLACING timber lining with concrete on railroad tunnels of the Tehachapi Pass, a variation from standard was followed on the west ends of Tunnels 4 and 6, where there had been considerable difficulty with slides. Using the usual tunnel forms on the inside, and building up outside forms of wood, the concrete lining of these tunnels was continued as a protective tube for distances of 76 and 60 ft. respectively into the open. The walls of the tubes were made 13 and 16 in. thick respectively and have the same reinforcement ordinarily used in the tunnel lining. Buttresses were placed on the downhill side of the tubes to resist a tendency to slide. These buttresses are 15 in. thick and 10 to 12 ft. long in the footing and were placed 11 ft. apart on Tunnel 4 and 13 ft. apart on Tunnel 6.



SLIDES AT TUNNEL 6 REMEDIED BY EXTENDING LINING

At Tunnel 6 the first remedy tried was the construction of a retaining wall to hold the toe of the slope. This did not accomplish the desired result so the full tunnel arch was built, as shown in the accompanying illustration, for that part of the retaining wall where heavy sliding was common. At Tunnel 4 no experiment with retaining walls was made, the concrete arch being built up for the full length of the slide when the tunnel was lined the standard portal and wing wall construction being used to finish off the end of the concrete tube.

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## San Francisco Bay Tunnel Project

Sir—For earliest possible realization of the bay crossing project at San Francisco it seems to me unwise to bother with the question of suburban traffic at this time. We have the best and the cheapest suburban service from San Francisco to Alameda County that I have seen anywhere in the country, and there is no need to improve further upon it at this time. Perhaps when there are 2,000,000 or 3,000,000 people around the bay it may be advisable to have some other means of accommodating this traffic, but at the present I see no reason whatever for a change, except a possible objection to crossing the bay by boat in foggy weather.

If the proposed causeway and tube are confined to vehicular traffic, the cost will not exceed $15,000,000 and the crossing will supply service for which there is a real demand. Revenue could be obtained sufficient to pay a decent interest on the cost. There is a tremendous demand for improvement in vehicular traffic, while I do not believe there is any very strong demand for change in suburban service. In any event, it is perfectly possible to expand the causeway and build additional tubes whenever the time is ripe for running trains and street cars across the causeway to get rid of the ferry service.

C. H. SNYDER,
San Francisco, July 26. Consulting Engineer.

## Open Shop for Builders in Buffalo

Sir—My attention has recently been called to an article in your issue of May 26, 1921, p. 886, which is quoted from a letter written by William J. Barney, of New York, to a prominent manufacturer of Buffalo.

Mr. Barney shows strong pro-union sympathies and gives as his excuse the same stock reason which has been advanced from time to time immemorial, namely, the difference in the position of the contractor and the manufacturer, as regards labor conditions.

There is much truth in the statement that the manufacturer, having a more or less permanent organization, is in a better position to assert his independence, but the fact remains that the contractor in spite of adverse circumstances can obtain the same degree of liberty, if he is possessed of a real desire to be free of union domination. This is proved by the fact that there are a number of contractors who have successfully freed themselves from union rule and are and have been for many years maintaining their independence.

To be sure, they started with a genuine wish for freedom, reinforced by a firm determination to have it. The unions, not slow to recognize the strength of character of such men as these, soon learn to respect them and eventually decide to let them severely alone.

If the Barney-Ahlers Co. prefers a union organization, their preference should be respected and so far as the writer knows, was duly respected when they were working in Buffalo, but for Mr. Barney to say that open-shop conditions in Buffalo are theoretical, is hardly fair, for they are beyond doubt very real, as he could easily have ascertained, had he so wished, by a positive attempt to work certain trades under open-shop conditions.

It is only fair to admit that it is hard for a builder whose work is not strictly local, to enforce the open-shop rule, but it has been done in Buffalo during the past year by a contractor who worked open-shop men here, while working union men exclusively on jobs going forward in closed-shop cities.

He says he worked here under the "so-called open-shop conditions" and I, for one, am glad to know it, for he saved himself a deal of trouble thereby, as he certainly avoided strikes resulting from broken agreements and jurisdictional disputes and his project went forward without any delays of which we have heard. Everyone agreed that his work was completed in record time.

F. N. FARRAR,
Secretary, Builders' Association
Buffalo, N. Y., Aug. 1. Exchange of Buffalo.

## Engineering Courses of Professional Grade

Sir—I am not sure that it is desirable to discuss Prof. Burr's paper in the technical press and thus leave the Society for the Promotion of Engineering Education less to do with this discussion at its next annual meeting, but I should like to call to your attention the fact that the College of Applied Science in the State University of Iowa is in entire sympathy with Prof. Burr's proposals, as is evidenced by the following resolution or statement that was adopted by the Faculty of this college last April:

"1. It is desirable to establish five-year engineering courses, the first year of which should be given in the College of Liberal Arts and no specialization made except in the course in chemical engineering until the fifth year, the establishment of such five-year course being considered as a preliminary step toward the establishment of six-year courses.

"2 That it is desirable first to make an effort to have the American Engineering Council of the Federated American Engineering Societies establish standards of engineering education and for engineering colleges of different grades; and to rate the engineering colleges of the country in accordance with the classification adopted."

With respect to (2) I may say that it was not our thought—as might be supposed from a reading of the paragraph—that the Engineering Council should rate engineering colleges at once, or before they had had time to respond to its suggestion as to what should constitute the proper training for college stutents of engineering in the different grades; but that some time after such suggestions had been made it would be entirely proper to rate these colleges.

We suggest the American Engineering Council rather than the Society for the Promotion of Engineering Education because we believe that the council would speak with more authority than the teachers can possibly have. It was the American Medical Association, not any group of college teachers of medicine, that made it possible to raise the standards of medical education, and we think that it is to the national societies of practising men that we must look for a demand to be made with authority.

WM. G. RAYMOND,
Dean, College of Applied Science, State University of Iowa.
Iowa City, July 18.

---

Sir—During the past two years a definite movement has been inaugurated to advance the prestige of the engineer through legislation. This effort has been fostered notably by one organization of engineers which itself is but a few years old. Reference is made to the registration and licensing laws that have now been passed by many states.

This movement may have been fostered by the overenthusiam of a newly organized body to accomplish in a short period what it takes many years of training to do. It is presumed that the elevating of the status of the engineer is one of the prime objects of the license law; for if this law was only designed to protect the life, health and property of the public there are existing, as Prof Geo. F. Swain has pointed out recently, adequate safeguards in the construction of buildings, public and private utilities, etc., through supervision by competent commissions and engineers, through building laws and other special laws requiring official supervision, approval of plans and inspection of work.

Furthermore a joint committee of engineers reported adversely to the passage of the engineers registration and

licensing law now before the Massachussetts Legislature, stating that there would be tendency through licensing to place the inexperienced man before the public on a plane with the experienced engineer of higher professional attainments.

Certainly this higher professional attainment cannot be obtained through any of the present registration laws; it is a matter which demands the serious consideration of the educators of our country, acting through an effective organization whose true vision is the development of an engineer who will have the fundamentals, the culture and the stamina worthy of the professions.

There are two types of engineering education; the usual four year college course and the professional engineering course requiring a science degree for entrance, with the former much more in evidence.

A graduate from the usual college course has had a training principally with materials of an inanimate nature and the laws and forces acting thereon. He has had little or nothing to do with the things of life and society. Only too often he looks upon his training bluntly as a means of future existence. As an engineer he makes an excellent tool and serves the public in an admirable way, although many times resting snugly in a predetermined niche. Such a man has been characterized as an applied scientist. This well fits Prof Burr's remarks about many engineering colleges.

The professional engineering course of six years produces men of higher attainments. The best professional spirit demands more than ever that a man must know something of foreign as well as domestic politics, of social problems (often called humanities) and an acquaintance with the world's best literature. Education of engineers for the new era must train and teach with all the vision possible and must instill in them a love for the profession which will carry with it the enthusiasm which has been characteristic of our engineers of highest attainments.

This type of training elevates and leads to lofty ideals, giving that refinement which is instantly noticeable.

Prof. Burr's outline of a six-year course is a highly pertinent topic and only by discussion and popularizing through an effective organization can the demand be created and progress made in the direction of a six-year course.

HARRY G. PAYROW,
Ass't. Prof. of Civil Engineering, Lehigh University.
Bethlehem, Pa., Aug. 2.

---

Sir—Prof. Burr's paper is timely and has opened for discussion a subject that has been given considerable attention by teachers and practicing engineers.

One point commonly overlooked is that the aim of our engineering schools and colleges (the name signifies little) in the undergraduate courses is largely to fit men for the business and industrial world. Those students who intend to follow engineering as a profession must either take graduate work or serve an apprenticeship under professional advice. Thus, engineering institutions are really trying to fit men for two types of life work, namely, that of the graduate who undertakes construction, drafting, sales, etc., and that of the truly professional man who goes into design or consulting work. One course can not be made to meet both conditions. Our present system serves its purpose well with the exception that the courses are often too highly specialized. Unfortunately, as Prof. Burr points out, the student who intends to enter the profession of engineering is handicapped by lack of instruction necessary to place him on a par with men of the other professions. His endeavors must be confined to graduate study which in many instances consists in doing senior work in greater detail. In addition to the present curricula, there should be scheduled six-year courses for those who intend to enter the profession. Only institutions well equipped to undertake graduate work should attempt to install the long courses and some distinction in the degree granted must be made. The number of applicants will be limited not because of financial inability nor lack of intelligence but because most of our students do not intend to enter the profession. Furthermore, the opportunities of the professional engineer are more limited in the amount of work to be done than are those of the lawyer or the physician. It is again a case of supply and demand.

The practice of lawyers and physicians is consulting work and when comparison is made with engineers such comparison should be limited to consulting engineers who represent the truly technical men. The standing of consulting engineers in a community is as high on the average as that of the members of any of the other professions.

Lafayette, Ind. F. W. GREVE,
July 29. Assoc. Prof. of Hydraulic Engineering,
Purdue University.

---

## Foreign Practice in Bank Protection

Sir—The problem of bank protection, which appears to be of interest to your readers (see Letters to Editor in your issues of May 26 and July 14, 1921) was solved by European engineers early in the last century, and the Rhine, Rhone, Danube and Poe rivers afford excellent examples of the methods employed by them. French, German, English and Russian engineers have investigated the causes of bank erosion and published their conclusions. Your pages indicate that a text-book on the elementary principles of river hydraulics could be utilized by the engineers of the United States.

About 1838, M. Defontaine published his work "Des Travaux du Fleuve du Rhin" of which a portion has been translated and appears in Volume IX, "Memoirs of the Corps of Engineers, U. S. A." In this work he investigates the flow of water around impermeable dikes making various angles with the bank and finds that there is no relation between the angles of incidence and of reflection of flowing water, but that instead a very complicated eddy action is set up. On his diagrams he plots three eddy currents below the dikes, one flowing just below them with sufficient force to sometimes cause caving at a distance from the dike equal to two and one-half times the perpendicular distance of its end from the bank, a second striking the bank about five times the said perpendicular distance and a third moving diagonally toward the opposite bank. Between the first two currents a sand bar forms. Eddy action, above the dike, also deposits silt, but separated from the dike and river bank by a channel, which under certain conditions causes scour along both.

When the dikes are inclined downstream this scouring action is intensified and the deposit above the dike diminished. During high stages there is an overflow which directly impinges against the bank below causing caving and which is converted into an eddy action if the dikes incline upstream.

During the 18th century the Germans employed dikes inclining downstream very extensively, but with such disastrous results that they afterward connected the outer end of one dike to the inner end of the next, producing what was termed "Trianglewerke" (Jassmunds' "Die Arbeiten der Rheinstrom—Bauverwaltung"), but after the investigations of Profs. Hagen and Schlichting the dikes were given an inclination upstream. Modern French, Austrian and Italian practice is similar.

M. Defontaine proposed as a means of counteracting these injurious eddy currents to leave openings in the dikes through which a current could flow along the bank, but with a diminished velocity, which would induce the deposit of material held in suspension, instead of relying on material rolled along the river bed to create the fill. The permeable dike was then unknown and his method exhibited great ingenuity in utilizing the material he had at his disposal. With the introduction of permeable dikes of which the Retard described by Mr. Atwood in *Engineering News-Record*, July 14, 1921, is an excellent example, this deposition is readily accomplished. The permeable pile dikes constructed on the Missouri River work on the same principle. The Retard has, however, the advantage that it is not as easily damaged by floating ice and drift, since the branches of trees are not as rigid, as the tops of driven piles. On the Mississippi River, where permeable pile dikes have also been extensively employed, it is necessary to watch the accumulation of drift and to sink it in place with a mass of rock, before it assumes dangerous proportion.

Foreign text-books specify the space which should separate the dikes on a concave or convex bank or in straight reaches, but for the purpose of regulating the channel depth, rather than for bank protection. Nobilings, which are sloping submerged dikes, extensively employed for bank protection on the Rhine River, are separated by a distance equal to about twice their length. Where permeable dikes are employed this distance can be increased. The dikes on Indian Rivers quoted by Mr. Thackwell are intended for land reclination rather than bank protection. The intermediate dike could be omitted without endangering the original bank.

C. McD. Townsend,
Brooklyn, N. Y., July 18. Colonel, U. S. A., Retired.

## Steel Lower

Sir—We are greatly interested in your editorial under the heading of "Steel Lower," as set forth on page 48 of the July 14 issue of *Engineering News-Record*.

With respect to that part of your paragraph wherein you cite the minimum of $1.08 reached in December, 1914: Without dwelling lengthily on this subject, we beg to advise that this minimum price only lasted for one week, and from that time on there was a steady advance. Furthermore, the writer was hiring men for $1.25 per 10-hour day. We were buying gas coal at the mines for $1 to $1.10, and we were getting a freight rate of $1.35. Office help was getting just about half the money they are now getting. We could get all the stenographers we wanted for $12 per week, and typists could be had at $5 per week, all of which had a bearing on the costs.

In order to bring the price of shapes down to 2c., we have got to cut labor to 25c. per hour. Office help has taken a cut of 25 per cent. In other words, for a man today to make $15 per week, he has got to work 60 hours, and you can see whether a man can pay rent, keep a family, have medical attendance, pay insurance, and then have some one of our economists tell him that he must save for a "rainy day." There has been no decline in rents, and there will not be. Meats are not any cheaper, and not only that, but foodstuffs are beginning to advance in price. The worst of it is that men can't get six days of work per week at the present time, and their condition is beginning to become pitiful, especially in small towns where other employment is scarce.

You know how much chance there is of reducing freight rates to the old levels. To do so you have to cut the rest of the organized brotherhoods of the railroads, and they are too well intrenched and fortified, by law as well as by financial strength, to take any substantial reduction except over a period of time.

If you were out selling the material you would find that it is not so much the cost of material that is holding up the jobs as the fact that projects cannot be financed at a reasonable rate of interest.

Going back to December, 1914, you will find that the mills were only working a few days a week, and this is indicative of the present condition. We have reached a higher price level in this country, and the people have become accustomed to a higher standard of living, and the conditions are such that there can be no recession to the prices back in 1914, to which the economists so delight to refer.

One of the troubles in writing editorials is the fact that the man simply deals with the subject from a superficial standpoint rather than having a thorough knowledge and insight into the trade about which he is writing. It is just such editorials as these that are doing incalculable harm to the building business, as well as the other industries.

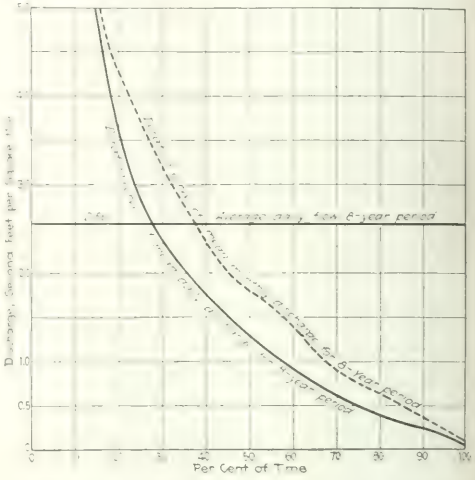
Chemung Iron & Steel Company,
New York City, July 15, 1921. Per E. F. Quirke.

[Mr. Quirke makes his argument on production cost. Regarding that the editorial in question said, "Probably under existing conditions of low demand, the bottom level will be determined less by production cost than by the confidence of the industrial world in the soundness of the schedule." It is not what costs are but what the public thinks they ought to be that will stimulate buying.—Editor.]

## The Time Units in Flow-Duration Curves

Sir—In the various methods of estimating the water power available at a particular site the flow-duration curve seems to be quite generally used, especially in the East. It has been noticed in various reports of private engineers and in some state reports that in constructing duration curves of flow there seems to be a general tendency to use the month as the time unit instead of the day and that this always gives higher values than would result if daily flow data were used.

If the mean daily flows for each month were uniform there would be no difference in the curve made up from mean monthly flows or mean daily flows, but in most rivers




FLOW-DURATION CURVE, PISCATAQUIS RIVER, FOR EIGHT YEARS ENDING SEPT. 30, 1920
At a point near Foxcroft, Me.; drainage area, 286 square miles.

for several months in the year there is a wide variation between the average flow for the month and the highest and lowest average daily flows in that month.

The accompanying diagram shows the difference between the duration curves of mean monthly discharge and mean daily discharge for a river in Maine. In picking off the discharge for 90 and 60 per cent of time, which might be used as the limits of primary and secondary power respectively, the following wide difference is shown:

| Per Cent of Time | Discharge in Second Feet per Square Mile from Monthly Curve | Daily Curve | Value from Monthly Curve Larger Than Value from Daily Curve by Per Cent |
|---|---|---|---|
| 90 | 0 42 | 0 24 | 75 0 |
| 60 | 1 40 | 0 91 | 53 8 |

While this particular stream is of the flashy type and the difference between the curves is large, the difference between similar curves for a stream under practically complete regulation would be small.

There seems to be a general tendency, however, to use the month as the unit of time for most any type of stream. Can this be because it is easier, or, is it believed that the error incurred by using monthly averages will disappear in using and compiling resulting data?

M. R. Stackpole,
Assistant Engineer, Maine Water Power Commission.
Augusta, Me., July 7.

## Meters and Water Consumption at Providence

With 94 per cent of the services metered the water consumption at Providence, R. I., in 1920 was 80 gal. per inhabitant. Practically all the 270,472 population of the district supplied takes water from the system.

# HINTS FOR THE CONTRACTOR

## Whitewash Prevents Asphalt from Running Under Summer Sun

SO CLOSE to the melting point is the asphalt waterproofing coat on the top and side walls of the Galveston causeway that a coat of whitewash will prevent the paint coat from running. The views shown were taken during the inspection trip of the American Society of Civil Engineers at the time of the Houston meeting.

LEFT—APPLYING WHITEWASH TO THE SIDE WALL
RIGHT—SLIGHTLY THICKER COAT AT BURLAP STRIP RUNS

Guesses as to what "Uncle Tom" was applying, and why, ranged from a chemical hardener to a "dolling" up of the job for inspection. The explanation of Mr. Washington, engineer in charge, that white absorbs less heat rays than black and further that the difference was enough to prevent melting, seemed too simple. Where the thickness is increased as at a burlap patch, the extra body of asphalt absorbs enough heat to melt the mass.

## Depot Footway Built in Quick Time

TO CONNECT the concourse of the Union Station, Chicago, with a cab yard half-a-block distant, it was recently necessary to build a footway 12 ft. wide and 160 ft. long as a sunken way because of the congestion and dense traffic in the narrow street above. The work was carried out quickly and conveniently, partly as a tunneling operation and partly, by dropping into an excavation a cribwork assembled on the surface.

First, a building opposite the station was jacked up the height of one story and the basement made a part of the footway, the sidewalk being tunneled and an open incline extended to the cab yard in the rear. The station sidewalk was also tunneled from the concourse.

Half of the 48-ft. roadway was closed for a short distance, the paving being then removed and a locomotive crane on traction wheels brought in to excavate a trench with a ½-yd. clamshell bucket. The earth was removed in motor trucks, there being no room for storage. A crib already assembled in sections was then hauled in by trucks, lowered into the trench and sheeted. Material for backfilling was brought in by trucks and the paving was then laid. The same operations were repeated on the other half of the street No concrete was used, as this footway is only a temporary expedient for use until the new station now under way is completed.

The entire work in the 48-ft. roadway was done in eleven days, the east half occupying only four days. This footway was designed under the direction of J. D'Esposito, chief engineer of the Chicago Union Station Co., and was built by the W. J. Newman Co.

## Universal Knuckle Allows Piledriving With Leads in Any Position

BY M. L. VAIL
Inspector of Construction, Brann & Stuart, Philadelphia, Pa.

IN THE RENEWAL of a bridge on the New York & Long Branch R.R. over Shark River, N. J., it was necessary to remove all of the old piles that had been driven in previous years. This was to be accomplished by pulling or driving the old piles down with the aid of a follower 5 ft. below the bed of the stream. The majority of the piles were pulled but those upon which it was impossible to fasten a wire sling were driven down after the new bridge was built.

To drive these old piles down under the new bridge required much time and effort to center the leads. The hammer used was a 5-ton steam hammer suspended from a 50-ft. steel boom in 50-ft. leads. A derrick car of 50-ton capacity carried the piledriver.

UNIVERSAL-PILE-LEAD KNUCKLE

In order to overcome the delay of re-reaving the steam hammer after each change in the line of piles, John O. Fetter, superintendent for the Brann & Stuart Co., Philadelphia, who had the contract for doing the work, designed and had fabricated a universal-pile-lead knuckle which would allow the hammer falls to work freely under any position of the leads and at the same time the leads could be turned in any position for the driving of plumb and batter piles. The knuckle was constructed of two ⅜-in. x 10-in. channels 9 ft. long, bolted to a wrought-iron pipe 30 in. in diameter and 30 in. long. At the bottom of the pipe was riveted a band of 1½-in. x 4-in. iron. This band acted as a seat for the segmental clamps, containing the two trunnions which carried the leads, to turn upon. The channels were bored to take the pin at the outer end of the boom, the knuckle hanging as a unit and sustaining only the weight of the leads, the hammer and falls hanging clear.

The turning of the leads was accomplished by three men. No steam line was required. The knuckle was used under all conditions. Tests first were conducted on shore in driving plumb batter piles, as well as the driving down of old piles with a follower. The performance of the knuckle was entirely satisfactory. The knuckle could be used from any style boom capable of holding pile leads with the same satisfactory results.

# NEWS OF THE WEEK

New York, August 11, 1921

## Upham Outlines $50,000,000 Road Program for N. C.

**Local Material Survey in Progress—Scenic Highways a Feature—400 Miles the First Year**

*(Special Correspondence)*

Charles M. Upham, the new chief engineer of the North Carolina Highway Commission, has given to a correspondent of *Engineering News-Record*, who is making trips with Mr. Upham in the field, an outline of some of his plans for highway construction, improvement and maintenance in that state, which has authorized a bond issue of $50,000,000 for highway improvement, in addition to the money that may be spent on such work by the counties and as the result of federal aid. Mr. Upham foresees no difficulties in carrying out the proposed highway program of North Carolina, beyond, first, developing and using the supply of local materials, and, second, overcoming the lack of sufficient trained highway engineers. It is planned to include in the program scenic highways through the Blue Ridge Mountains.

"I find that North Carolina has about 6,000 miles of roadways of all kinds," Mr. Upham said, "these roadways ranging from mountain trails of earth to modern asphalt or concrete highways. We estimate, and will attempt a program based on it, that we will construct, for the first year, 400 miles of new hard surface roads of improved type, consisting of macadam, concrete and bituminous construction, or combinations of these, and that we shall construct 500 miles in each succeeding year. I cannot make any estimate at this time of the earth roads to be constructed. This construction may run as much as the new hard surface roads.

### Materials Survey

"One of the most most important things to be done at once—and we have begun on it—is to make a material survey of the state. We must find larger sources of supply than are now available of stone, gravel and sand, suitable for road building. At present, there are few commercial developments of these, but these sources must be tripled, even quadrupled, before they can begin to supply the demand we shall make for carrying out our large program. As to the supply of suitable labor, there seems to be an abundance at present."

Mr. Upham sees an opportunity for the North Carolina highway department to work with the colleges in their summer courses, taking their graduates as inspectors and engineers.

One good thing about the highway building program in North Carolina, it is pointed out, is the lack of excessive frost. Then, too, the state regulation of motor trucks means that the system of highways will not be obliged to carry the excessive loads found in and near the larger northern cities, for the North Carolina statutes prohibit the use of trucks heavier than 7½ tons, including weight of both vehicle and load.

## Ridgway to Study Urban Transit in Europe

Robert Ridgway, chief engineer of the New York Transit Commission, has been directed by that body to visit Europe for the purpose of studying urban transit construction and conditions and to submit a report of his observations on his return to New York City. He plans to sail on the "Olympic," Aug. 13, and will visit London, Glasgow, Hamburg, Berlin and Paris. The trip will require about six weeks.

On the outgoing transatlantic trip Mr. Ridgway will have as a fellow passenger, Clifford M. Holland, chief engineer of the New York-New Jersey Tunnel Commission who has been authorized to investigate vehicular tunnels abroad.

## Begin Construction Surveys for Philadelphia Bridge

Funds having been made available by all three of the communities participating in building the Philadelphia-Camden bridge, construction surveys have been started. A preliminary triangulation and real estate surveys are being made, in charge of Assistant Engineer John Briggs, formerly of the Philadelphia Bureau of Surveys.

The Philadelphia Council has appropriated $500,000, which, together with the balance of a prior appropriation of $250,000, is available to apply on real estate purchases and substructure contracts. Of Pennsylvania state funds, the sum of $1,750,000 is now available, and of the total New Jersey appropriation of $28,000,000 (to cover both the Hudson River tunnel and the Camden bridge), as much as may be required is at the disposal of the commission.

Daniel E. Moran, of Mendham, N. J., has been appointed consulting engineer on foundations on a fee of $10,000 per year. Rapid progress is being made with plans for the main piers and anchorages, and at the same time a complete review of the entire design project has been started as a check on the preliminary design.

## To Discuss Snow Removal

Snow removal methods will form the main topic of discussion at the meeting of the metropolitan section of the American Society of Mechanical Engineers to be held in the Engineering Societies Building, New York City Sept. 23.

## New York City Rules Against Foreign Pier Machinery

**Board of Estimate Decides Staten Island Port Development Must Have American Machinery.**

On Aug. 2 the Board of Estimate and Apportionment of the City of New York by a unanimous vote decided that the advertisements for bids for cranes, elevators and electric power transmission plants on piers 12 and 13 of the new port development at Stapleton, Staten Island, shall specify that the machinery be of American manufacture. This is the culmination of a controversy which has had little public notice but which has been under way for some time.

The City of New York is building on Staten Island a number of shipping piers which have been leased for long terms to various steamship companies. Piers 12 and 13, the largest of the group, have been leased to the Pan-American Terminal & Dock Corporation, an American corporation but one which is reported to be made up largely of foreign interests and shipping people who have operated mainly in foreign ports. All of the lessees were permitted large powers of alteration of the various designs of the piers and the lessees of piers 12 and 13 asked and were granted a two-story, wide pier design in which a great amount of handling machinery was provided. The principal units of this machinery were thirty-four cargo cranes of a unit value of $10,000 to $15,000.

### Discussion Over Specifications

Specifications for these cranes were submitted some weeks ago by the Dock Department to the Board of Estimate, which is required by law to see such specifications and to authorize their advertising. Prior to the submission to the Board of Estimate of the specifications a number of the material handling machinery manufacturers of the United States went before the dock commissioner with a plea that the specifications be written in such form as to preclude the awarding of the bids to foreign bidders. They claimed that the specifications then about to be advertised were prepared mainly by the lessee and that its experience and predilection led it to favor foreign designs in the specifications. Furthermore, these manufacturers stated that owing to the very low labor cost abroad, particularly in Germany, and to the adverse exchange, again particularly against Germany, European countries could put in bids on these specifications radically lower than any American manufacturer could meet. It was contended that while the lowest American bid might be $500,000, Ger-

man manufactures could—and furthermore were prepared to—bid on machines which would meet the specifications at a cost to the city of about $400,000.

The American manufacturers further claimed that the foreign cranes which might meet the specifications would have details peculiar to foreign practice and would not only be of shorter life than American made cranes but would be difficult of operation by American labor and extremely difficult of repair when the extra parts furnished under the bid had run out. They further contended that the situation at present which would permit so much lower bids by Europeans is only temporary and that the foreigners could not hope to hold the American market. They, therefore, would be under no incentive to do other than to furnish a machine which would pass the specifications and would care little whether it would stand up under service because they would not hope to get future business. They pointed out, too, that little, if any, work of this character was under way in American shops and that the $500,000 award would mean giving work to a number of idle American workmen.

All these arguments were later brought before the Board of Estimate with the result above noted. Neither the specifications nor the advertisement under them, have yet been made public.

## Labor Elections of P. R.R. Held Illegal by Rail Board

Recent elections of employees' committees held by the Pennsylvania R.R. were declared illegal and void by the Railroad Labor Board in a decision rendered July 31. The decision also ordered a new ballot to select a committee to negotiate rules to supercede the national agreements of federal control. The railroad had refused to negotiate with the labor unions directly in the matter of working out revised agreements and subsequently held a ballot vote to select individuals for employees' committees without provision for organization representation. The union men issued a ballot of their own which the railroad again refused to recognize. In making the decision the labor board said: "The carrier had no more right to undertake to assume control of the selection of representatives of the employees than the employees would have had in supervising the naming of the carrier representatives. In this sophisticated land of popular elections, no political party would submit it having its primary held and managed by the oppsing party."

In the meantime petitions had been presented by four industrial associations to appear before the Railroad Labor Board in behalf of the public, and in support of the open shop policy of the Pennsylvania R.R. The petitions are from the National Association of Manufacturers, the National Founders' Association, the National Erectors' Association, and the Employers' Association of Chicago.

## A. A. A. Objects to Further Motor Vehicle Taxes

Summarizing the opposition of the American Automobile Association to any further taxation of motor vehicles, with the reasons therefor, President George C. Diehl has authorized for publication a statement from which the following extracts have been taken:

"There are today some 10,000,000 motor vehicles in the United States of which approximately 1,000,000 are motor trucks. According to data prepared by the U. S. Bureau of Public Roads one man in every eleven owns a motor vehicle. These 10,000,000 owners are now paying several separate and distinct taxes aggregating $348,878,878 or $34.67 per car, detailed as follows:

| | |
|---|---|
| Federal excise tax, passenger cars, 1920 | $83,600,294 |
| Federal excise tax, motor trucks, 1920 | 15,160,456 |
| Federal excise tax, parts, accessories, tires | 19,960,128 |
| Federal registration vehicles for hire | 2,049,000 |
| State motor vehicle registration fees | 102,000,000 |
| Personal property taxes | 75,000,000 |
| State motor fuel, franchise, mileage, business, etc. | 10,000,000 |
| Local motor fuel, franchise, mileage, business, etc. | 10,000,000 |
| Municipal registration and license fees | 1,000,000 |
| Total | $348,769,878 |

"Fundamentally, the motor vehicle is an element in transportation and if, as Secretary of the Treasury Mellon has indicated, we should repeal or cut down transportation taxes, then certainly the burden of this factor in highway transportation, which last year was estimated to have hauled more than 1,000,000,000 tons of freight and carried almost 5,000,000,000 passengers, is entitled to the same consideration as the older agencies. Railroad and water operation is dependent upon delivery of the load. Highway transport is the indispensable link in the chain.

"It is unnecessary to indicate how deeply the motor vehicle has penetrated into farm life. It is enough to say that 72 per cent of all cars are sold in towns having a population of 50,000 or less, 55 per cent in towns of 5,000 or less and 33 per cent in towns and hamlets of 1,000 or less. Approximately 66 per cent of all passenger cars are owned and operated by men having an income of $4,000 or less.

"Today the entire cost of construction and maintenance of state highways or of state bonds for road improvement is levied against the motor vehicle in many states. The pre-emption of this source of revenue by the states would be immediately interfered with by any further federal tax and would cause a strong and reasoned protest by state legislatures who already see many of their earlier sources of revenue taken over by the government. It is true that the federal government, wisely we believe, has aided the states in road building, but it would be as fallacious for the nation to tax the motor vehicle for road construction as for the states to do so, particularly in view of what President Harding has termed 'a shocking waste' in the lack of adequate funds for road maintenance."

## Senate Committee Busy on Townsend Bill Changes

### Action Desired Before Congress Takes Recess — Appropriations Are Discussed

*Washington Correspondence*

The Senate committee on post offices and post roads is working actively on amendments to the Townsend bill, with the idea of making it more acceptable to the Senate and to the House. It practically has been decided to take the bill which passed the House and strike out all after the enacting clause and insert as a substitute the Townsend in its amended form. Work has not been completed on the amendments at this writing, but it is expected that the amended bill will be reported out of committee during the latter part of the week ending Aug. 13. Every effort will be made to get the bill out before the Senate takes a recess. No changes will be made in the provision of the Townsend bill, which call for a federal highway commission and an interstate system of roads, it is understood.

An attempt will be made to amend the bill so that it will be unnecessary for any state to change its constitution before it would be able to participate in federal highway funds. As each of the bills stand today, constitutional changes would be necessitated in Texas, Arkansas, South Carolina, and Alabama. It is probable that the provision detailing military officers to the highway commission will be eliminated by the committee.

#### Appropriation Discussed

There has been considerable discussion in the committe as to what appropriation should be recommended. Some favor an amount less than the $400,000,000 authorized in the Townsend bill. The probabilities are, however, that the committee will make no change in the proposed $100,000,000 a year program.

The recess which Congress is about to take is expected to expedite highway legislation and improve the chance of securing the appropriation. This is based on the assumption that the public is determined that nothing shall interfere with the progress of highway construction and that this sentiment will become so evident to the legislators when they have an opportunity to mingle with the people of their respective states, that they will return to Washington convinced of the public demand for highway legislation.

Unless there is legislation, New Hampshire, Utah and Nevada will not be able to construct a mile of highway next year. Twenty-six states now have all of their apportionment of federal funds under contract or will have the entire amount under contract before the end of the year. In the case of nine other states, there will be only small balances after the end of the year.

## Scale of Fees Proposed in Federal Motor-Vehicle Bill

That portion of the Appleby bill, introduced in the House of Representatives July 28, as noted in last week's issue, specifying the amounts of the proposed federal tax on motor vehicles, in addition to existing state taxes, is as follows:

"Forty cents per horsepower or fraction thereof in the case of all vehicles having pneumatic tires, with a minimum charge of $5 for any motor vehicle. For each motor vehicle equipped with solid tires and having a rated carrying capacity of not more than 1 ton, $10; of not more than 2 tons, $20; of not more than 3 tons, $30; of not more than 4 tons, $40; of not more than 5 tons, $50; of not more than 6 tons, $60; of not more than 7 tons, $70."

Trailers of 1 ton or less capacity are taxed $5, with provision of an additional $5 for each additional ton of capacity. The administration of the proposed act is vested in the U. S. Bureau of Public Roads.

Whether or not Representative Appleby will be able to secure consideration of his bill proposing a federal license for the convenience of motorists in interstate travel will depend largely upon the action of the House Ways and Means committee on the proposal by the Secretary of the Treasury that there be a flat federal motor vehicle license tax of $10.

## Conference on Highway Transport Education Meets

"Highway transport now involves a total capital investment in excess of that of the railroads while the annual operating charge is nearly as large as that of the rail carriers," declared Roy D. Chapin, chairman of the highways committee of the National Automobile Chamber of Commerce at a conference on highway transport education held at the University of Maryland July 29. The meeting was called by the national committee on highway and highway transport education, of which Prof. C. J. Tilden, is director, to outline the most pressing phases of this subject for study and research in the colleges, universities and other agencies interested. Charles S. Howe, president of the Case School of Applied Science, presided.

A general outline of the problem was given by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, who said that many of the states are approaching the limit of highway bond issue financing under their present laws and called attention to the need for a further extension in order to facilitate what he termed a most needed development.

L. M. Estabrook, assistant director of the bureau of markets and crop estimates of the Department of Agriculture, said that 153,400,000 tons of farm produce were transported over highways to the railroads annually and that additional thousands of tons are carried on the highways which never reach the rail denoting the need for improved highways.

Prof. W. K. Hatt, of the National Research Council, and Prof. J. G. McKay, University of Wisconsin, outlined constructive programs for research into highway finance, valuation, transportation, administration, construction, maintenance and legislation.

## Indiana Engineer Registration Board Named

Governor McCray of Indiana has appointed the new state board for the registration and examination of engineers, one of the boards created by the last Legislature. The appointees, together with the length of time they will serve, follow: Ray Seeley, Hammond, three years; Clyde A. Walb, Lagrange, two years; Harvey Michael Anthony, Muncie, two years; Charles W. Cole, South Bend, one year, and Prof. R. L. McCormick, of the Rose Polytechnic Institute, Terre Haute, one year. The members of the board are paid a salary of $10 per diem. One member of the board will be designated to act as secretary. The law prescribes certain qualifications for engineers and specifies a fee of $25 for registration and license.

## Congress Authorizes the Port of New York Compact

Congressional approval has been granted the compact between the States of New York and New Jersey, constituting the Port of New York Authority, by the action of the Senate, Aug. 5, 1921, in adopting the House resolution. The text of the resolution is as follows:

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of the Congress is hereby granted to the States of New York and New Jersey to enter into the agreement for the establishment of "the port of New York Authority" for the comprehensive development of the Port of New York, pursuant to chapter 154 of the Laws of New York, 1921, and chapter 151 of the Laws of New Jersey, 1921: Provided, That nothing in this resolution shall be construed as waiving or surrendering any right now vested in the Federal Government.

Sec. 2. That the right to alter, amend, or repeal this resolution is hereby expressly reserved.

## Ford to Operate Own Barges on New York State Canal

Announcement was made in New York City Aug. 1, by Gaston Plantiff, Henry Ford's eastern representative, that the Ford company is preparing to put into operation at an early date a fleet of barges to transport the materials and products of the Ford plants between Detroit, Troy, N. Y., and the port of New York. The plan has been considered for some time in connection with the recent completion of the Ford assembly plant at Kearney, N. J., and the plant now building at Troy. The barges will be propelled by internal combustion engines. They will have a capacity of 1,000 tons and will be 150 ft. long with 20-ft. beam.

## Engineers Appointed for N. Y. Harbor Tunnel

**Jesse B. Snow, of Vehicle Tunnel Staff, becomes Engineer in Charge—Wilgus and Sullivan, consultants.**

A nucleus of the organization which will have charge of the projected freight and passenger tunnel under New York Harbor between Staten Island and Brooklyn was created last week when the Board of Estimate and Apportionment of New York City approved the appointment of Jesse B. Snow as tunnel engineer at a salary of $12,000 a year and of Col. W. J. Wilgus and John F. Sullivan as consulting engineers, each at a salary of $10,000 a year. The board also confirmed the selection of Charles B. Drew at $7,500 a year as principal assistant engineer. All of the foregoing appointments, except that of Mr. Sullivan, follows the recommendation of Arthur S. Tuttle, chief engineer of the Board of Estimate, who will be in general direction of the tunnel project. Mr. Tuttle had proposed the name of Frederick C. Noble as one of the two consulting engineers, but the board failed to act on this recommendation.

In becoming the engineering head in responsible charge of the proposed tunnel, Mr. Snow gives up his present work as principal assistant to Clifford B. Holland, chief engineer to the New York-New Jersey Tunnel Commissions on the Hudson River vehicular tubes. Mr. Snow was graduated from Union College with the degree of C. E. in 1889, and his early professional experience covered a number of years on municipal work, including paving, water supply and sewerage in a numer of cities in New York and Pennsylvania.

### Snow's Tunnel Experience

In May 1900 he became resident engineer in charge of 10 miles of single-track construction on the Jamestown, Chautauqua & Lake Erie Ry., and two years later was appointed chief engineer of the Jersey Central Traction Co., on electric railway construction. After being engaged on surveys for the Tennessee Power Co., in 1905, he began his experience in subaqueous tunneling with an appointment, in 1905, as inspector on the East River tunnels of the Pennsylvania Railroad in New York City. He was promoted through the various grades until he became principal assistant to the resident engineer, in which capacity he continued throughout the period of the Pennsylvania tunnel construction.

Beginning in July 1910 Mr. Snow served as engineer and assistant superintendent for the Foundation Co. on the reconstruction of the Hauser Lake dam in Montana by means of a caisson cofferdam, and in 1911 became engineer for the Canada Syndicate of surveys for hydro-electric power development. He remained with this organization until 1914 when he was appointed resident engineer with the Public Service Commission of New York on the construc-

tion of the subway tunnels under the East River, later becoming principal assistant to Mr. Holland, then tunnel engineer for the commission.

When the engineering organization for the Hudson River vehicular tunnels was being formed in 1919 the chief engineer chose his former associate to serve as principal assistant. Mr. Snow has been with the New York-New Jersey Tunnel Commissions since 1919.

Mr. Tuttle has announced that conferences have already begun between the City of New York and executives of the railway companies involved in the tunnel project.

## Pittsburgh to Build Concrete Bridge

Plans are being prepared by the Department of Public Works of Pittsburgh, for a reinforced-concrete bridge on Beechwood Boulevard, over Forward Ave. The old timber structure which made the crossing, 555 ft. long, with maximum height 125 ft. above Forward Ave., collapsed on June 18, two days before its removal was to be begun. The old structure had been condemned a year ago and closed to vehicular traffic, and on June 11, of the present year, it was closed to pedestrian traffic. The new reinforced-concrete structure should be under contract within a month.

## Increases in Sight for Patent Office Personnel

The bill providing for an increase of force and salaries in the U. S. Patent Office has been reported out by the House committee on patents with the recommendation that it be passed at the earliest possible date. The bill increases the salaries of the principal examiners in the Patent Office from $2,700 to $3,900 per year. Assistant examiners are allowed increases ranging from $150 per year to $900 per year. The bill also increases the commissioner's salary from $5,000 to $6,000.

The demoralized condition of the Patent Office may be understood when it is known that there are now 46,472 applications awaiting attention. The number of pending applications is increasing all the time. In a little over a year, 110 examiners—one-fourth of the total examining force—have resigned. These men were experienced examiners, with from 2 to 20 years' training. Their places have been taken by young men just out of college—the only ones apparently to whom the salaries appeal.

## Clark Resigns From Interstate Commerce Commission

Chairman Edgar E. Clark, of the Interstate Commerce Commission, has resigned from that body and will enter the private practice of law. To fill the vacancy caused by his resignation, the President has nominated Frederick I. Cox, of New Jersey, as a member of the commission.

## Federation Has 27 Members

Including the three organizations elected to membership at the meeting of the executive board of the American Engineering Council in St. Louis, June 3. there are now twenty-seven member organizations of the Federated American Engineering Societies. Two additional applications are now pending. As a result of the efforts of members of the council, other engineering organizations have the question of joining the federation under consideration and in several cases are now in the process of voting.

According to a recent statement by L. W. Wallace, executive secretary of the federation, the council is actively at work advancing the plans for a national department of public works, helping improve the status of public health engineers, obtaining equitable engineering research legislation, co-operating with the American Engineering Standards Committee, working for the appointment of engineers to engineering positions in the federal government and supporting the topographic mapping program. A special employment committee has under consideration a definite plan for improvement and extension of the service, whereby it is contemplated that special arrangements will be made to care for the interest of constitutents of member organizations in the present employment crisis.

The special committee on licensing has been directed to hold a hearing for the purpose of further reviewing and perfecting the model law so as to meet all requirements. This is to be done prior to the next meeting of council, but no definite date has been set.

The American engineering congress committee is at work planning for the engineering congress which is to be held in connection with the annual meeting of the American Engineering Council.

## Timber Columns To Be Tested

For a series of tests to determine the effect of density and such defects as knots, checks and cross-grain on the strength of structural columns, forty southern pine timbers 12x12 in., 24 ft. long, have been selected by D. H. Holtman, construction engineer of the National Lumber Manufacturers' Association, and J. A. Newlin, of the U. S. Forest Products Laboratory. Half of the timbers were selected in Texas and the others in Alabama and Mississippi. Similar tests are to be made on Douglas fir columns.

## Rea Joined P. R.R. 50 Years Ago

Samuel Rea, president of the Pennsylvania R. R., celebrated last month the fiftieth anniversary of his association with the railroad. He entered the service of the Pennsylvania as a rodman in 1871 and was promoted through the various grades of the engineering department until in 1899 he was appointed fourth vice-president. Mr. Rea became president of the road in 1912, succeeding James McCrea.

## Data on Foundation Settlement Wanted

In a call for information just issued by the special committee on bearing value of soils of the American Society of Civil Engineers (R. A. Cummings, ch.) data are requested on settlement of foundations and of foundation soils in tests. The committee desires to secure statistical material bearing on the recommendations made in its last annual report, to the effect that the limit of allowable loading on foundation soils should be based on some definite portion of that part of the compression diagram showing a practically uniform rate of compression with increase of load. A question sheet has been prepared covering items of desired information. Copies may be obtained from E. G. Haines, 49 Lafayette St., New York, to whom the data should also be sent.

## Graphic Reproduction by Wireless

Facsimile reproduction of a written document by wireless from New York to Paris was accomplished Aug. 4, when a message, written by C. V. Van Anda, managing editor of the New York *Times*, addressed to *Le Matin*, was successfully transmitted in seven minutes. The trial was carried out by applying the Belinograph to wireless. This instrument has been used for some time for transmitting autographic messages and photographs by wire. Dr. Belin, inventor of the instrument, declared that it would soon be possible to transmit photographs by wireless from one side of the Atlantic to the other.

## $13,500,000 Hetch Hetchy Bonds Sold to Complete First Unit

The Construction Company of North America, which holds the contract for tunnel work in the mountain division of the Hetch Hetchy project, purchased $13,500,000 worth of 4½ per cent Hetch Hetchy bonds on Aug. 1. The bonds were bought at a discount which, by standard tables, puts them on a 5⅓ per cent basis, but they yielded a premium of $10,000. Earlier offerings at 4½ per cent, at par, brought no bids, so a charter amendment was secured permitting sale below par. The company also secured an option until Nov. 1, 1921, on an additional $8,520,000 worth of the same bonds on the same basis.

This sale of bonds makes available sufficient funds with which to complete the 18 miles of tunnel from Early Intake to Priest, the earth fill dam at Priest, penstock from that point to the Moccasin Creek power house and also for the construction of the power house and the equipment to be installed in it. When the tunnel work is completed, which is expected to be about June, 1923, water will be available for the development of power and 66,000 hp. is to be ready for delivery by the end of 1923.

If the option on additional bonds is taken up, funds therefrom are to be used to finance work on the project in the bay and peninsular divisions which are the next logical steps.

### Kansas City Engineers Club Severs Association With A. A. E.

By a letter ballot recently taken the Kansas City Engineers Club has decided to withdraw from its affiliation with the American Association of Engineers. Steps have already been taken for the establishment of a chapter of the A. A. E. in Kansas City, as the withdrawal of the engineers club leaves the A. A. E. unrepresented in that city.

### A Second Garbage-Feeding Contract at Los Angeles

Because of opposition to the location of a hog ranch at two proposed sites in Los Angeles County and due to an ordinance passed by the County Board of Supervisors forbidding the hauling and feeding of garbage to hogs outside the limits of any city within the county, G. W. Whitman notified the City Council of Los Angeles, on July 30, that he was unable to carry out the hog-feeding contract outlined in *Engineering News-Record*, July 14, p. 81. Subsequently the council voted to accept an offer from the Farmsland Co. for a ten-year contract at 60c. per ton, effective Sept. 10. The offer was accompanied by a $10,000 certified check and by a proposal to file a $75,000 guarantee bond. Application will be made for an amendment to the ordinance already mentioned, so garbage may be transported in closed steel cars to the contractor's hog ranch in San Bernardino County, where 5,000 hogs have been kept and where the contractor says 20,000 hogs can be in readiness by Sept. 10.

The city has made a temporary agreement with the Pacific Reduction Co., whose plant had been ordered closed Aug. 1, to continue disposal of the garbage by reduction. This company contracted some years ago to pay the city 51c. per ton for garbage delivered to a central point, but claims that it has been operating at a loss of late. Under the Whitman contract the city was to have been paid 96c. a ton for its garbage for ten years. Mr. Whitman first proposed to locate a hog-feeding plant near Montebello and then on land near El Monte and Baldwin Park, used for similar purposes before the reduction works were abandoned because of opposition and alleged menace to health.

## ENGINEERING SOCIETIES

### Calendar

**Annual Meetings**

NEW ENGLAND WATER WORKS ASSOCIATION: [illegible] Mass. [illegible] Conn., Sept. 13-16.

The Western Society of Engineers has elected the following officers: President, Charles H. MacDowell; vice-presidents, Julius L. Hecht, F. F. Fowle and B. S. Shapiro; treasurer, Homer E. Niess.

The Texas Road Builders' Association, at its semi-anuual meeting in Austin, July 20, appointed the following committee to consult with the state highway department, the University of Texas and the Texas Agricultural and Mechanical College, in order to broaden the scope of research work and secure proper appropriations therefor: H. C. Koch, chairman; E. Eikel and M. C. Welborn. The association appropriated $200 from the treasury for the purchase of a gift for T. H. Webb, whose resignation as secretary-treasurer was announced.

## PERSONAL NOTES

ROBERT. S. PLUMB, formerly with the Lines Flynn Co., New York, is now connected with the J. P. White Co., Passaic, N. J., contractors, in charge of the purchase and sale of construction equipment.

P. C. PAINTER, city engineer of Washington, N. C., has been elected city manager of Greensboro, N. C.

H. M. RIGHTER has been appointed division engineer, Erie R. R., with headquarters at Susquehanna, Pa., succeeding Charles M. Lewis.

C. M. STAPLES, previously assistant to the corporate engineer, Southern Pacific Co., with headquarters at San Francisco, Cal., has been appointed division engineer of the Houston division at San Antonio, Tex.

C. W. H. RONDEAU of Westmount, Que., has been elected president of the Union of Canadian Municipalities.

DR. ROBERT J. ALEY, former superintendent of public instruction in Indiana, and for eleven years president of the University of Maine, has accepted the presidency of Butler College, effective Sept. 1.

EDWARD H. MAIER, formerly civil engineer for the Seabrook Farms Co., Bridgeton, N. J., has been appointed city engineer of Bridgeton.

SNOWDEN ASHFORD, for 26 years municipal architect for the District of Columbia, has become associated with Carroll Beale, civil engineer, Washington, D. C., where they will engage in the design and construction of fireproof buildings, under the firm name of the Beale Co.

CHARLES E. WADDELL, of Asheville, N. C., has been appointed chairman of the North Carolina state board of registration for engineers and surveyors created by the last legislature.

ROBERT J. MARONEY, assistant secretary and assistant treasurer of the Chicago, Milwaukee & St. Paul Ry., with headquarters in New York City, has been elected vice-president, succeeding G. G. Mason, resigned. He will continue to serve as assistant secretary and asistant treasurer in addition to his duties as vice-president.

H. W. COLEMAN, formerly superintendent of the water and sewer departments, Greenville, Miss., has been appointed city engineer and superintendent of streets, Albany, Ga.

C. M. COOPER, for many years county engineer of Cherokee County, Kan., and at one time city engineer of Columbus, Kan., has been appointed county engineer of Crawford County, Kan.

## OBITUARY

J. G. SING, consulting engineer of Toronto, Ont., died in Medford, Ont., July 29. He was 64 years of age. Early in his career he entered the service of the Dominion Government and served for ten years as district engineer, Canadian Public Works Department, Toronto, Ont. He was also consulting engineer of the Toronto Harbor Commission and supervised harbor improvements in eastern and northern Ontario, including practically all the water front of the Great Lakes. In 1914 he resigned from the government service to engage in private consulting engineering practice. He was chairman of the advisory board of commissioners to report on the water supply for Toronto.

JAMES H. STROBRIDGE, emeritus superintendent of construction for the Southern Pacific R.R. and builder of the Central Pacific R.R., died near Hayward, Cal., July 27. He was born in Albany, Vt., in 1827. His first railroad contract was for 2 miles of line for the Naugatuck road in Connecticut. In 1864 he became connected with the Central Pacific R.R. and was later placed in charge of its entire construction program. He was one of the foremost figures in the construction of the transcontinental line when the Central Pacific R.R. and the Union Pacific R.R were united at Promontory, Utah, in 1868. He built the Oakland mole of the Southern Pacific Co.

J. EMILE GIRARD, civil engineer, superintendent and chief inspector of surveys, Quebec Department of Crown Lands and Forests, died recently while en route to Chicoutimi, P. Q. He was born at Becancour, P. Q. In 1901 he was appointed technical officer of the lands department of the Province of Quebec and in 1907 he became assistant superintendent, and 1910, superintendent. In 1911 he was appointed chief inspector of surveys.

S. H. CHATTEN, president and controlling owner of the Union Lumber Co., Union Mills, Wash., died in Kansas City, Mo., recently. He was 58 years old, and was one of the leading lumber manufacturers of Northwest. He was also president of the Southern Lumber Co., Myrtis, La.

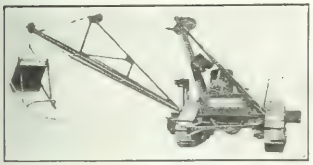
A. B. HOUSTON, for many years superintendent of construction and of the city water works of Decatur, Ga., died July 20. He was 50 years old.

## Prepared-Joint Cast-Iron Pipe

Two-inch cast iron pipe, with prepared lead points, ready for calking, are being made by the American Cast-Iron Pipe Co. The pipe is supplied in 5-ft. lengths and may be had with hub and spigot or double hub or double-thread joints. Repair hubs are also available. The company is preparing to supply the same kind of pipe in diameter of 3, 4 and 6 in.

## A New Backfiller

A backfiller with 30-ft. maximum and 20-ft. minimum boom, driven by a heavy-duty 18-hp. four-cylinder gaso line engine, is just being put on the market by the Pawling & Harnischfeger Co., of Milwaukee. It is mounted on



full corduroy treads and is operated entirely by one man. With the boom extended to maximum length of 30 ft., four loads may be filled in per minute. With shorter boom lengths, the number of loads is naturally greater.

## New Seven-Ton Road-Type Crane

To round out its line of road-type cranes the John F. Byers Machine Co., of Ravenna, Ohio, is putting on the market a seven-ton "full-revolving" crane. The company is now in a posi-

tion to furnish the road type in three sizes—½ cu. yd. and ¾ cu. yd. "Auto-Cranes" and the new full-revolving, seven-ton unit. As with the other models, the "full-revolving" crane may be had with steam, gasoline, or electric power. Likewise the mountings can be made to suit the customer—road wheels, rail tracks, or single, double, or full-length crawler treads. The machine will handle ⅝ cu. yd. of material with a clam-shell or ¾ cu. yd. with an excavating bucket. It may be equipped with a 4-kw. generating unit and a 36-in. lifting magnet, or with pile leaders for driving or pulling piles.

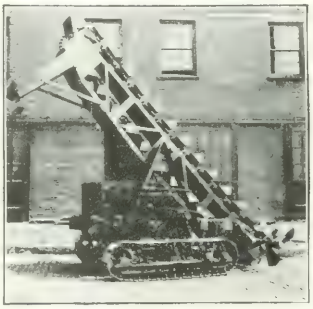
All gears are steel with bronze bushings. To assure sturdy service, 90 per cent of the total weight of the outfit is steel.

An indication of the manufacturer's judgment of the market for this type of crane is shown by the building of a 60 x 120-ft. shop for the manufacture of the new machine.

## Wagon Loader Mounted on Creepers

A wagon loader mounted on creepers and especially designed for sturdy service is being built by the George Haiss Manufacturing Co., Inc., New York. It is not a mere adaptation of the Haiss "path-digging" wagon loader equipped with wheels, but is of an entirely new design, heavier and stronger than the wheel-equipped type.

The creepers are 8 ft. long overall and on 6-ft. centers. The loader has a



forward speed of 75 ft. per minute, reverse speed of 45 ft., and a crowding speed of 22 in. per minute, and is equipped with extra-heavy buckets fitted with saw-tooth cutting edges. The height under the chute is 8 ft. 6 in. and when the elevator is collapsed the overall height is 9 ft.

In test these machines have been driven into a clay bank and have excavated it satisfactorily, the task being comparable to steam shovel work. The machine is not recommended for such service, but the test was undertaken to prove the sturdiness of the design.

## Scarifier-Grader

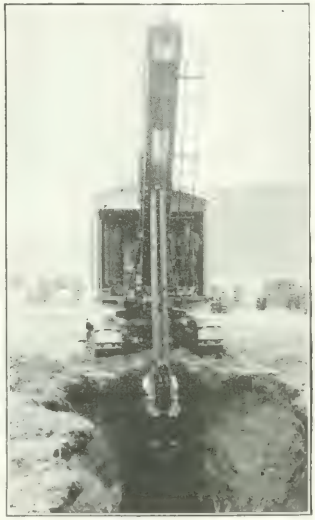
Scarifying and grading old gravel stone or macadam roads and streets in one operation, or using scarifier and grader independently, is possibe with the use of the Adams scarifier-grader No. 8A, manufactured by J. D. Adams & Company, Indianapolis, Ind. The main grader drawbar is made of two 3 x 3 x 5-in. Z-bars with a wide spread at the rear end. The grader has a length between front and rear axles of 15 ft. a front wheel tread of 3 ft. 6 in. and a rear wheel tread of 5 ft. 9 in. The front wheels are 30 in. in diameter with a 6 in. tire and the rear wheels 36 in. with a 6 in. tire. The blade of the grader is 8 ft. long, 18 in. wide, with the moldboard. The scarifier makes a cut 45 in. wide. The teeth are seven in number, 3 in. x 1 in. x 20 in. in length.

## "Steam Hoe," for Trench Excavation

The "Steam Hoe," built by the Ball Engine Co., of Erie, Pa., for trench excavation work, might be described as a "back-acting steam-shovel," for the dipper moves toward the machine in digging, and fills with a "hoe" motion, instead of being hoisted upward and outward.

The hoe backs away from the trench as it digs. Thus it works always on solid ground, instead of being supported on a platform over the excavated trench like a steam shovel, with the consequent danger of cave-ins. The new machine also does away with much of the trench bracing.

Equipped with a 22-ft. dipper handle, the machine digs a trench as deep as 14



ft. When digging a trench of this depth, it is best to carry the boom at 40 deg. with the horizontal. At this angle, the Hoe can dump material 13 ft. 9 in. above grade and 33 ft. from the center line. Excavated material is piled high, well away from the trench. By means of a power-driven, worm-gear-operated boom hoist the boom can be quickly set at the most effective digging angle. The manufacturers state that in earth and gravel, an output of 200 to 300 cu.yd. a day can readily be counted on.

It is furnished with either traction wheel or crawler-type mounting, and is readily converted into a steam shovel or a locomotive crane, or can be rigged with a dragline bucket.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Building in American Cities

The civic development department of the Chamber of Commerce of the United States has recently made known the results of its investigation of building in the United States during 1920. Information was sought from cities of over 25,000 inhabitants. On the cities of this class which represent a population in excess of 37,000,000, partial or complete reports were received from 131 cities representing a total population in excess of 30,000,000.

The figures compiled by the chamber indicate that in 1920, 70 per cent of the families provided for got one-family dwellings, 11 per cent, two-family dwellings, and 19 per cent apartments in multi-family dwellings. It is also shown that the proportion of multi-family dwellings that were provided in 1920 was largest in the small cities which have not had as much experience with this type of habitation. More house building in proportion to population was found in the smaller than in larger cities.

Of the estimated $1,943,000,000 spent on buildings in 1920 in the cities reporting over 36 per cent were devoted to dwellings. Factories and workshops came second with 16.8 per cent; stores and mercantile buildings third, with 13.3 per cent, while office buildings and garages tied for fourth place with 8.2 per cent each. Schools, hospitals, and charitable buildings together called for an expenditure in excess of $77,000,000. Amusement places cost more than churches, hospitals, or public buildings, or $38,627,000.

## Ohio Investigates Freight Rates on Road-Building Materials

The Ohio Utilities Commission started August 3 to investigate the question of freight rates on road-building materials with the view of ascertaining if they were reasonable.

Complaint against the rates was brought by the various associations producing road-building materials, such as the Ohio Sand and Gravel Association, the National Crushed Stone Association, the National Slag Association and the Ohio Paving Brick Manufacturers' Association. George J. Bolender, traffic manager of the Chamber of Commerce of Kalamazoo, Mich., who was instrumental in securing heavy freight reductions in Michigan, has been employed by the Ohio Department of Highways and Public Works. The Ohio Paving Brick Manufacturers' Association was represented by Beecher W. Waltermire, formerly of the Ohio Tax Commission. Evidence adduced showed that rates on all road-building materials in Ohio were higher than in any other state in the union. The case is being watched with great interest by many lines of industry, including all building-material men.

## Lumber Production, 1920-1921

Cumulative figures of lumber production, shipments and orders for the first half of the year 1921, according to the weekly trade barometer of the National Lumber Manufacturers' Association, show a decrease over totals for the similar period in 1920, but the figures for the months of May and June, especially in orders, show a substantial increase.

For the period of the first twenty-six weeks of each year the figures are as follows for the seven reporting associations (Southern Pine Association, West Coast Lumbermen's Association, Western Pine Manufacturers' Association, California White and Sugar Pine Manufacturers' Association, California Redwood Association, North Carolina Pine Association and Northern Hemlock and Hardwood Manufacturers' Association): 1920 production, 5,657,274,474 ft. b.m.; 1921 production, 3,851,238,236 ft. b.m.; shipments, 5,115,299,374 ft. b.m., and 3,959,427,201 ft. b.m., respectively, and orders, 4,658,243,117 ft. b.m., and 4,044,635,724 ft. b.m., respectively.

This shows a decline of 1,806,036,238 ft. b.m. in production, of 1,155,872,172 ft. b.m., in shipments and 613,607,393 ft. b.m. in orders.

## Pennsylvania Receives Bids on 60 Miles Durable Highways

During the past week the Pennsylvania Highway Department received bids for the construction of about 60 miles of durable highways, most of the projects being reinforced-concrete roads. The bid opening was remarkable in the fact that on the twenty-seven projects involved there were 220 bidders. On one 4-mile job seventeen contractors bid. Another project drew sixteen bidders and another fourteen. The total low bid approximated $3,200,000.

Bids submitted for the building of 31.7 miles of 18-ft. reinforced-concrete pavement aggregated $1,735,314, or an average cost of $54,000 per mile. On 21.7 miles of 16-ft. reinforced-concrete road the bids averaged $45,000 per mile.

## Building Plans for July in Manhattan Borough Extensive

The report of Rudolph P. Miller, superintendent of buildings for the Borough of Manhattan, New York City, is to the effect that during the month of July of this year plans were filed for fifty-three new buildings costing a total of $17,878,825, as against 141 costing a total of $6,269,800 for the corresponding month of 1920. The gain is mostly in office buildings. During July, 1920, plans were filed for the erection of nine to cost $2,190,000, whereas during July of this year six office buildings costing $13,500,000 were planned.

## Industries Meet With Commerce Department Chiefs

A new opportunity for industry to suggest how governmental statistics and research can be of maximum value to it was afforded July 29 by the Secretary of Commerce when, at his request, representatives of the principal industries assembled in Washington. The invitation was extended through the National Manufacturers' Association. While the conference was called primarily to discuss matters pertaining to the census of manufactures, the whole subject of the department's work came in for discussion during the course of the day. After many angles of opinion had been developed, a committee of nine was appointed to perfect recommendations.

Secretary Hoover opened the meeting with the explanation that it had been determined to gather the next biennial manufacturing census so as to show commodity units, as well as monetary values. He explained that the department is very anxious to gather data which will be helpful without plaguing the industries. In order that this information can be put in a form which will be of practical utility it is the desire of the department, Mr. Hoover said, to consult at every step with those whom it is intended to benefit.

F. M. Feiker, assistant to the Secretary of Commerce, told the assembly that the department had been conferring for a number of weeks with committees from the various industries and trades, and had secured a large number of suggestions as to how the department could be most helpful. The plan now is to classify and apply these suggestions in a way that will be entirely practical.

Among the suggestions that the department is particularly anxious to carry into effect are those indicating how waste in industry can be eliminated and how figures can be made the basis of prophecy rather than possess historical value only. Mr. Feiker explained that the work on elimination of waste is being done by the Bureau of Standards along with its efforts looking to the simplification of variety. He also stated that one effort of the department will be to bring into closer touch the associations representing the buyer and the associations representative of the seller.

## Ohio to Open Road Bids Aug. 19

The Ohio Highway Department will receive bids Aug. 19 for the construction of 20 miles of durable type paving and a bridge estimated to cost $870,443. Including the bridge, thirteen projects are involved. The projects cover the construction of 5 miles of brick paving, 11 of concrete, and 5 of bituminous macadam.

## Refuse Incinerator Bids Asked by City of Philadelphia

The City of Philadelphia will receive bids on Aug. 26 for not less than four refuse incinerator units with a total capacity of 280 tons of mixed refuse and 480 tons of rubbish per 24 hours, to be installed on what is known as the Cambria St. site. The plant is to be so designed as to be capable of burning garbage with rubbish, or rubbish alone.

The city proposes to erect the building, the runway leading to it, and the chimney. The bidder is to furnish plans and specifications for the incinerator foundations and to state the capacity and sections of the chimney required.

It is the intention of the city to dispose of all garbage and rubbish delivered to this plant from the districts it is intended to serve. One of its purposes is to relieve pressure upon the garbage reduction plant, but mainly to eliminate the present long haul involved. It is not the intention to close down the garbage reduction plant, which is now owned by the city, together with wagons, equipment and other paraphernalia formerly owned by the contractor.

Frank H. Caven is director of public works and Fred C. Dunlap is chief and J. H. Neeson deputy chief of the bureau of highways under the department named. Samuel A. Greeley, Chicago, is the consulting engineer.

## Car Loadings Show Heavy Grain Movement

An increase of 14,096 in the number of cars loaded with revenue freight on American railroads during the week which ended on July 23, compared with the previous week, was shown by reports just received from carriers by the car service division of the American Railway Association. The total for the week was 790,348 cars which was, however, a decrease of 138,070 cars compared with the corresponding week last year, and a decrease of 119,334 cars compared with the corresponding week in 1919.

The principal increase during the week of July 23 was in the loading of grain and grain products, which totaled 64,919 cars or 7,928 cars more than during the preceding week. This total was 29,442 cars greater than that for the corresponding week in 1920 and 13,374 cars in excess of that for the corresponding week in 1919. It also was 7,804 cars above the peak loading of any week since January 1919, which is as far back as the records go.

## Building Gains Impetus

In analyzing employment conditions during July the United States Employment Service reports that "general building operations are gathering impetus steadily and, while marked activities in this line are still somewhat sporadic, construction programs of greater or less magnitude are maturing gradually in practically all parts of the country."

## General Electric Company Cuts Wages at Lynn Plant

A wage reduction of about 12 per cent and affecting approximately 12,000 employees of the General Electric Company, at the Lynn, Mass., plant, was announced last week and became effective Aug. 7. The cut will vary with different classes of employment, and was decided upon after a conference between company officials and representatives of the employees composing the general joint committee on adjustment, when means to secure continued operation of the various departments of the company's business were discussed.

## San Francisco Building Situation Gradually Improving

The American plan is now an accepted fact in San Francisco except among certain unions and the building trades council leaders who are reported to be endeavoring to precipitate a general strike. The Industries Association of San Francisco with a determined purpose to maintain permanently the American plan, has completed its organization, has adequate funds for carrying on its work and has as officials some of the best known San Francisco business men. Previous reference to the formation of this organization appeared in *Engineering News-Record* July 21, 1921, p. 128.

There is a shortage of skilled workers in certain lines of the building trades which is delaying progress but work is under way on all principal jobs. The builders exchange has brought in large numbers of workmen under contract and many more have come in unattached. A guard system is maintained on all jobs by the builders exchange and there has been no appreciable disorder.

## Unemployment Relief Work Provided at Racine, Wis.

Municipal work for 300 unemployed heads of families was started at Racine, Wis., Aug. 1, on street, park and cemetery improvements for which a bond issue of $150,000 has been provided. The wage is 35c. an hour and the men are employed six days a week or less, according to their needs. H. G. Presser, local head of the U. S. Employment Bureau, is connected with the relief work, which is said to have originated with the Racine Commercial Club and to have been backed by other organizations, while a special committee of the City Council planned what work should be undertaken.

## Cement $2.40 Net, Alongside Dock, New York

Cement still sells for $2.40 net, alongside dock, New York. Through a typographical error it was given in the latest monthly list of material prices as $2.15, which is the price at the mills supplying the New York district. It can be bought delivered in New York for $2.60, which allows the dealers an extremely narrow margin, as handling charges are 35 to 40c. per bbl.

## Seattle Votes $5,500,000 More for Skagit Project

On July 26 the Seattle City Council by a vote of 7 to 2 approved a measure authorizing another $5,500,000 bond issue with which to finance work on the Gorge Creek plant of the Skagit project. The action of the council was immediately approved by the mayor. This makes a total of $11,000,000 in bonds thus far issued for the Skagit work.

## Concrete Road Contracts Average Less Than $30,000 Per Mile

During the past week the Illinois Commission of Highways let contracts for the construction of 112 miles of concrete roads for an aggregate price of $2,318,238. This is an average of $20,700 per mile excluding the cost of the cement which is furnished by the state. With the cement the highway will cost considerably less than $30,000 per mile. Contracts for 20 miles more were awarded at the same time, but no prices were mentioned. The 112 miles are divided among thirty projects.

## British Government Announces Housing Policy

(*London Correspondence*)

The British Government has decided that the number of houses to be constructed by local authorities and by public utility societies with government assistance under the present scheme will be limited to 156,000, that being the number building and for which tenders have been approved. Under the subsidy scheme for private builders the number of houses built or to be built is estimated at near 23,000.

The annual cost to the state under the local authority and public utility society schemes is about £10,000,000 per annum, and the amount required for the payment of subsidies to private builders about £5,000,000 per year.

The construction of houses now building or yet to be built under the government housing scheme will utilize all available labor for at least twelve months, including a considerable number of ex-service men yet to be absorbed by the industry.

## Civil Service to Appoint Production Engineer

Examinations for appointment as production engineer in the hot metal division of the naval ordnance plant, South Charleston, W. Va., and vacancies in positions requiring similar qualifications are announced by the United States Civil Service Commission. Applications may be received up to Aug. 30. The appointee must have a general practical knowledge of raw materials, melting, forging, heat treatment, and machining of guns, projectiles and armor plate, and must understand the sequence of factory operations and be able to compute cost and time studies. The appointee to the vacancy in the South Charleston plant is to receive $9.76 per day. Applicants should apply

at once for Form 1,312 to the Civil Service Commission, Washington, D. C., or other qualified individuals and agencies indicated in the announcement circular, No. 361.

### Low Bids on Road Jobs Far Below Engineer's Estimates

Last week the Ohio Highway Department receiveds bids for the construction of about 10 miles of highways and for the building of a bridge which totaled but 77 per cent of the engineer's estimate. The total low bid was $496,435, while the total estimate was $644,549. On one small project the estimate was $2,034 and the low bid $1,087.

### Increase in Unemployment Is 1.1 per Cent for July

According to the monthly figures compiled by the employment service of the U. S. Department of Labor there was a decrease during the month of July of 1.1 per cent in employment throughout the United States in selected industries. The figures are gathered monthly in sixty-five industrial centers from 1,428 firms, each normally employing more than 500 workers. The total decrease in employment for these centers since Jan. 1 has been 7.3 per cent. Industries reporting increases are automobile manufacturers, railroad repair shops, textiles, lumber, tobacco and paper and printing.

### Contracts for the Week Total More Than $23,000,000

The total value of contracts let during the past week, as reported in *Engineering News-Record*, was $23,330,900. Street and road contracts were not so large as in previous weeks but the amount of proposed work reported indicates that no cessation in the letting of highway contracts is to come yet. The value of miscellaneous building contracts is above the average.

Two of the principal contracts let were for the construction of the first unit of the marine terminals at Wilmington, Del., for $1,372,570; and a grain elevator at South Deering, Ill., the contract price being about $4,500,000.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 4, the next on September 1.

| | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products:** | | | | | | | | | |
| Structural shapes, 100 lb | $2.88 | —$3.50 | $4.50 | $3.03 | —$3.10 | —$4.10 | —$3.70 | —$4.00 | $5.00 |
| Structural rivets, 100 lb | 4.40 | 5.25 | 5.75 | 4.03 | 5.20 | —4.25 | —5.50 | 5.50 | 8.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.78 | —3.20 | —3.50 | 2.93 | —3.18 | —3.97½ | 2.35 | 4.00 | 4.25 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 52.65–5% | 45% | 58½% | 53.9–5% | 36% | —46.25% | 47½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 48.30 | 43.33 | 57.50 | 49.10 | —52.80 | —57.50 | —60.00 | 63.00 | 75.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@2.70(del.) | 2.75 | 2.80 | 2.17 | 2.41 | 3.10 | 3.09 | 3.10 | 2.75 |
| Gravel, ¾ in., cu.yd | 2.25 | 2.25 | 3.00 | 2.25 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.50 | 2.25 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.90 to 2.00 | 2.25 | 2.80 | 2.50 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 48.00 | 38.00 | 35.00 | 55.00 | 35.00 | 47.00 | 27.00 | —21.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 20.00 | 29.00 | 32.00 | 25.40 | 24.00 | 28.00 |
| Lime common, lump, per bbl | 3.79 | 1.50 | 2.75 | 1.65 | 1.50 | 3.10 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | 10.00 | 12.65 | 12.00 | 17.00 | 14.00 | 18.00 | 14.00 | 18.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | 13 | .09475 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | .1232 | .14 | .13 | .07410 | .092 | .10 | .14½ | .12 | |
| Linseed oil, raw, 5 bbl. lots, gal | .80 | .85 | .97 | .87 | .91 | +1.01 | +.98 | .79 | .84 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | | 1.00 | .50 | .50@.63½ | .81½ | .75 | |
| Common labor, non-union, hour | | .20@.25 | .35@.45 | .40 | .50 | .37½@.50 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45-5-50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is 15c. additional. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Health tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment

## Changes Since Last Week

The attitude of the steel industry is to quote attractive prices on large orders. There is little new business in the fabricating shops, and the official price of $1.85 per 100 lb. applies only to small tonnages. Mill shipments of shapes, New York, cost $2.18 to $2.23, with warehouse charging $2.88 delivered. Since our last weekly resume, prices have declined in Atlanta, Minneapolis, Denver, San Francisco and Seattle. The heaviest decreases were in San Francisco, 55c. and Atlanta, 50c. Rivets are down 30c. in San Francisco. Reinforcing bars are down in five of the nine cities from which we obtain quotations. Bars from stock cost $3.50 in Dallas, with mill shipments at $3.10.

Steel pipe has changed only in San Francisco, but cast-iron pipe is down in New York, Minneapolis, Denver and San Francisco. Last week we quoted $70 for cast-iron pipe in San Francisco, this week, $60.

The cement situation continues unchanged throughout the various cities, awaiting lower mill prices; the same conditions applying to the other concreting materials — stone and sand.

Douglas fir is down $1 per M. ft. in Seattle. Linseed oil has advanced 5c. in Denver and 2c. per gal. in San Francisco.

Non-union common labor is obtainable at 20 to 25c. per hour in Atlanta. In order to stimulate construction work in Central Ohio the Columbus Contractor's Association has demanded that carpenters reduce from 90 to 80c. per hour; bricklayers from $1.25 to $1. The hoisting engineers have already reduced to 80c. per hour.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 87 — NEW YORK, AUGUST 18, 1921 — Number 7

## Federal Sanitary Engineers

RECOGNITION of the value of the work of the sanitary engineers in the United States Public Health Service has been increasing in a gratifying way for several years past. A considerable number of such engineers are now employed in the Public Health Service. Some months ago their salaries and promotions were put on substantially the same basis as medical officers in the Public Health Service. What the sanitary engineers now lack to give them full recognition and status is being commissioned by the President the same as the medical officers. A bill to this end is now before Congress and is receiving a considerable measure of organized support from engineers, as stated in our news section this week. Engineering societies and individual engineers can render good service both to the public and the profession by backing this bill. Appeals to congressmen by engineers and local engineering societies in home districts would be of great assistance. The bill calls for no increased expenditures. It merely places the engineers in the Public Health Service on a par with the doctors.

## Balloting on New Constitution

THERE is now in the hands of the corporate members of the American Society of Civil Engineers for ballot the proposed revised constitution. It is the outcome of more than two years of study and discussion and incorporates the essential demands of those who worked for a revision. The chief changes from the old constitution lie in giving to all of the country proportionate representation in the Board of Direction, in the distribution of the vice-presidencies by zones, in the restriction of voting for nominations to the members in the respective districts, and, finally, in giving a more definite status to the sections. Without a doubt experience will indicate desirable revisions in the new method of nomination, but, considering that this document has been evolved after so much study and discussion and meets long-standing demands in essential elements, it should be adopted by an overwhelming vote. Certainly the discussions at the last annual meeting and at the convention in Houston have exhausted the subject and have shown that for the well wishers of the society there is no alternative to approval of the constitution, thus clearing away discussion of administrative problems and allowing the society to resume its technical work.

## Increased Individual Output

FEW better concrete examples of the economic advantage of high efficiency in pulling down inflated costs are offered than two which are noted in the news columns of a recent issue of *Automotive Industries*. The Willys-Overland Corporation at its Toledo plant is producing 50 more cars per day at the present time with 7,700 employees than it did a year ago with 13,000 employees. Employment records from the nine major rubber companies in Akron are to the effect that with a total force approximating 36 per cent of that of the 1920 peak 80 per cent of the peak production of 1920 is being recorded. In other words, during 1920 about 72,000 employees were working in these nine factories as against between 26,000 and 27,000 now, yet the present production is 80 per cent of that of 1920. It is not ordinarily easy for the layman to grasp the significance of the assertion that increased production will deflate prices, but the foregoing figures present in an indisputable and concrete way the value to general business of a high degree of efficiency. Undoubtedly other industries are increasing their per-man production, though exact figures are not so easily obtained. The instances cited are healthy indications that we are regaining our industrial balance.

## In Aid of Vehicle Legislation

MOTOR-VEHICLE legislation is receiving in the aggregate a tremendous amount of study. The public manifests an interest equal to that of the highway engineer, the public official and the motor-vehicle manufacturer. Attempt at uniformity in legislation has been made through the work of the committee which drew up the proposed uniform motor-vehicle law. Yet uniformity and reasonableness are almost as far away now as when that excellent step was undertaken. We are certain, though, that the degree of lack of uniformity is not at all comprehended—even by highway officials. To get at the facts *Engineering News-Record* has spent much time in the preparation of an analysis of the subject. Every state motor-vehicle law has been studied and digested and the essential data thrown into a comprehensive table. This compilation is of unusual interest. The great value of the study, however, lies in the conclusions that have been drawn and that are presented in individual tables and graphs. Some of the results are truly astonishing. The analyses accompanying the big table and the conclusions are so clearly put that while having all of the thoroughness demanded by the engineer and the motor-vehicle manufacturer they are put in a way that will appeal to public officials and legislators as well. This study will appear in the issue of Sept. 1 and is here announced that there may be wide knowledge of it and the public benefit be thereby broadened.

## Overwork and Underpay

ON RESIGNING after thirty years of engineering service for the District of Columbia, Asa E. Phillips submitted a letter to the engineer commissioner which is notable from several viewpoints: it outlines the nature and growth of the work of a municipal engineer who stood by a city for three decades; it illustrates the heavy burden carried by many engineers in public service because of insuf-

ficient technical staff; it adds another to the many instances of not merely overwork but also underpay of engineers in city, state and federal employ.

So far as he himself is concerned, Mr. Phillips says not a word as to underpay, but any one who knows Washington conditions, as regards both the district and the general government, need not be told that the salaries paid technical men of large experience and ability are far below their deserts and also far below the compensation of men occupying like positions in private service. What Mr. Phillips does urge is that for years past he has had to do, by his own hand, the designing of work costing millions of dollars; that salaries of assistant engineers have been so low that he has not been able to retain the services of men of high standing, and that draftsmen's pay is below that of day laborers. Although Mr. Phillips passes lightly over the condition of his health as a reason for resigning, it might readily be that his overburden has so undermined his strength as to make resignation imperative.

The incident affords another illustration of "the ingratitude of republics"—a phrase that applies to cities as well as states. But viewed broadly, the injury to the individual, in all these cases, fades into insignificance compared with the harm done to the public as a whole. When such things occur in federal jobs, a nation suffers. All of which points to the need of continuing with added vigor the efforts being made by individuals and societies to see that engineers in the public service are not underpaid—to which may be added attention to safeguards against overwork because of staffs inadequate in number or ability.

## A Plea Based on Knowledge

WHEN an expert in an art complains of the imperfections of that art, his charges are not likely to be challenged, least so in the field of paint and painting, where every private citizen has had his fill of unsatisfactory experiences. Prof. Sabin, who holds a recognized position as paint expert, complains of the lack of knowledge in a specialized application of paint, namely the protection of wooden motor-truck wheels from the destructive effects of moisture changes. But the entire subject of the physical action of paint coatings is closely related to the specific case referred to, and is as much involved in ignorance. Nor is there any more knowledge on the chemical problems of paint, as in fact is directly suggested by a second case which Prof. Sabin cites to support his argument. In short, the entire field of paint bristles with unknown quantities. When it is considered that the annual paint consumption is over $300,000,000 in the United States alone—Prof. Sabin's estimate is inadequate by a third, we have reason to believe—the value of what might be accomplished by well-directed impartial research in this field may be appreciated. The plea for research, we think, deserves general support.

Among paint users there has always existed an undercurrent of belief that paint is a field of mystery, but that paint men know all about good paint and painting; and as a result of that belief, presumably, paint men have been reluctant to admit that they themselves were puzzled by many things in their field. Such a state of affairs was not favorable to cataloging a list of the unknown quantities and framing a research program.

Prof. Sabin has made a beginning in this task, however, and it should now be easy for others to come forward and tell what things are not known or need investigating. Such a general confession would be a significant piece of progress. It would remove one of our great industries from its state of medieval mystery and put it on a plane of scientific knowledge. Whether the research that is needed should be undertaken by the United States government, and whether the study of unknown questions at large is a proper federal function, is of course another question.

## Corrosion of Reinforcement

THOSE familiar with the reinforced-concrete art of fifteen or sixteen years ago, when the Marlborough-Blenheim Hotel was built, may recall the wide interest aroused among concrete men by that undertaking, and correspondingly they will scrutinize most carefully the details of the small roof collapse investigated for *Engineering News-Record* by Lewis R. Ferguson. The case is of equal interest, however, to the entire structural engineering and architectural professions, since it is the first distinct case of a failure of reinforced concrete after the construction period, and because it thus presents anew in active form a question long ago laid on the table: whether reinforcing steel is subject to progressive corrosion. Fifteen years ago, not a few engineers shook their heads in doubt as to whether a reinforced-concrete building subject to sea-beach exposure would prove enduring. The Marlborough-Blenheim remained in satisfactory service, and other similar structures were built. Gradually, the old doubts were forgotten, but they will tend to be revived, now that a section of the roof slab has fallen.

On this score it is worth pointing out that the atmosphere of a kitchen in continuous service can hardly contain a measurable quantity of the salt spray and mist to which seashore corrosion is attributed; and in that event the present accident cannot be applied directly to the old problem. But with respect to the broader question of progressive deterioration, we have the fact that the collapse occurred under no momentary excess loading or other unusual condition, so that on the face of affairs it appears to be a clear case of progressive weakening of the slab. This impression is fully borne out by the details found by Mr. Ferguson on examining the wreckage. Corrosion of the reinforcement *did occur*, and it was the responsible cause of the collapse, Mr. Ferguson finds. Thus we are carried back to when the discovery of tension cracks in reinforced concrete was the sensation of the day in the concrete field, and when the possibility of rusting at these cracks was regarded by many as a crucial question. The question has long been considered to be laid to rest—largely by the unanswerable argument that no reinforced-concrete structure had ever failed, except during construction, and that the material is bound to grow stronger with age, not weaker. It is revived by the present collapse, which—despite the woful deficiency of steel and the very small section of the reinforcing wire, which would cause even a minute amount of corrosion to destroy the strength of the slab very rapidly—is a corrosion failure occurring after long service, the first case of the kind.

Fortunately we may feel sure that the resumed discussion of the problem will not be masked by the vague and aimless tone in which it was begun, for much has been learned about the quality and the behavior of concrete. Definite conclusions should be attainable.

## The Illinois Paved Road Test

PAVED road testing on a stupendous scale is described by Clifford Older, state highway engineer of Illinois, on p. 274. Except possibly the tests of the U. S. Bureau of Public Roads, no experiments so numerous and of such variety have previously been attempted. The testing to destruction by truck traffic of full-size pavements is unique in highway experimentation. Involving an expenditure in excess of $300,000 this traffic endurance test alone is extraordinary. It is, however, but one of a number of kinds of field tests, some of them embracing hundreds of observations and all being checked by laboratory tests nearly duplicating in number the field observations.

Viewed by itself $300,000 seems a large amount of money to be consigned to purposes of experimental destruction. With $100,000,000 to be expended in a few years in roadbuilding, however, a third of one per cent is a small investment to learn how to build roads better even by a very little. And it is certain a great deal will be learned. Although results are barely mentioned by Mr. Older in his present article, because the observations have only begun to be analyzed, it is known that they are so significant that the prediction is freely made that new principles of pavement design will be the outcome.

Even should such a revolution fail to materialize, highway engineers cannot help gain increased understanding of subgrade action and of pavement-slab strength and endurance. This should put them a long way ahead of present practice.

Not only will Illinois obtain better paved roads because of these experiments but all roadbuilding in the country will be improved. This is the promise which makes the description of the Bates Test Road worth study although it merely states the task attempted. Information on the results obtained and their lessons to engineers will be given in succeeding articles.

## Limitation of Professional Fees

IN PROFESSIONAL circles few incidents of recent years have been so significant as the decision of the board of trustees of Johns Hopkins Hospital that the maximum fee that should be charged for a surgical operation at their institution, no matter how wealthy the patient, should be $1,000, and that the physician's maximum charge for visits to the hospital should be $35 per week. Heretofore the medical profession's charges have been based on what the client could pay—particularly for surgical work. The structure is now rudely jarred. The directors of one of the foremost hospitals of the country, still conceding that there is good ground for the principle of charging what the traffic will bear, nevertheless declare for a limitation of that principle. In effect, also, they hold that there is a natural limitation to the value of the services of an individual.

While in the medical profession the Johns Hopkins step may be a shock, looked at broadly it is merely a recognition within the profession of a view widely held by the public. Question has often been raised as to the value of an individual's services. In some cases there is a ready monetary measure—as in business; in others, there is impossibility of relating the results to any material standard, as in teaching. It is to be expected, then, that the business man will, if successful, get a larger material reward for his efforts. "It is to be expected," we say, but it is not just nor beneficial to our national and social development. Witness the result in the wholesale desertion of their profession by brilliant teachers, and the consequent loss to the nation in the coming generation. But while the community *expects* to see the business man well rewarded it is by no means complacent with exorbitant emolument. Witness—whether it be a sound method or not—our income tax graduations, and the comments called forth by the payment to a steel corporation president of a bonus of $1,000,000 on a single year's operations. Nor do the comments come from radicals. They come rather from those who look beyond the present and count the loss to the public of false social standards, even though they are cognizant that under present standards the rewards are legitimate and that they are defensible on business grounds.

It is a far-cry from a steel president's bonus to large fees for surgical operations, but the hospital trustees' decision in the latter case is but the application of a principle that receives expression in the street's adverse criticism of the former. In both cases there is recognition of some natural limitation to the value of individual services.

It will be interesting to learn of the reaction in the medical profession. Viewed broadly, it is a desirable note in a time when we are sobering up from an era of too much emphasis on material returns from personal service.

## Ideals for a Medical Career

WHEN the preceding comment on "Limitations of Professional Fees" was written there was no information at hand other than the restrictive decision of the hospital's trustees. Later, however, in a communication to the New York *Times* Dean Williams of the Johns Hopkins Medical School, with which the hospital is integrally connected, stated that the fundamental reason for the decision was the desire to impress upon medical students that their profession was of an altruistic nature and that they should think "as little as possible" of the financial returns. "Naturally," he says, "it is realized that the laborer is worthy of his hire, and that most students take up medicine for the purpose of earning a living, but at the same time it was felt that it was the educational duty of the institution to teach by precept and example that the ideal medical man is no respector of persons, and is justified only in looking forward to a relatively modest financial return, and should early learn that medicine is not a career for those who hope to become rich."

This, at first blush, would seem to put quite a different aspect on the decision. Yet we are not moved to change the comment of the preceding editorial. Whatever the conscious purposes, the other factors were probably unconsciously operative. In any event, the decision does have the tendency to set a limitation on the value of individual service and the decision will operate to strengthen that principle, even though that was not one of the conscious objects of the hospital's trustees.

In trying to impress upon medical students the proper ideals for a medical career the trustees deserve the public's thanks. Deterioration in the ideals of the professions has a serious influence on general social and business standards.

# Cincinnati Builds Belt-Line Rapid-Transit Railway

## Low-Cost Route Developed by Utilizing Old Canal Right-of-Way — Concrete Subway, Concrete Elevated Railway and Standard-Gage Surface Lines

By Frank L. Raschig
Assistant Chief Engineer, Cincinnati Rapid Transit Commission

A RAPID-TRANSIT railway remarkable for its low construction cost and for its unusual plant—a belt line surrounding the residential part of the city and traversing the heart of the business district—is under construction at Cincinnati, Ohio. Both the belt plan and the low cost are due in large part to the existance of the abandoned Miami & Erie Canal, whose right-of-way for city transportation purposes was granted by the state. However, independently of the existence of the canal, it is believed that the belt line is best suited to the conditions in Cincinnati and will prove influential in developing and guiding the future growth of the city.

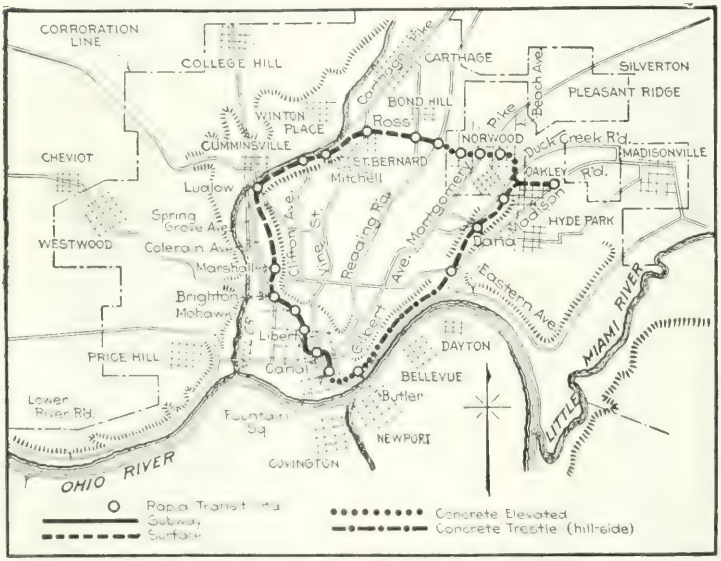



FIG. 1. BELT LINE RAPID-TRANSIT RAILWAY AT CINCINNATI

Construction is in progress on four sections of the subway portion of the line; two more sections may be placed under contract this year. By the end of 1923 about 11 miles of the system, which is 16½ miles long, will probably be ready for operation. In order to construct the remaining 5½ miles it will be necessary for the people to vote additional money.

*Route and Mileage.*—As indicated by the map, Fig. 1, the line begins at Fountain Square, and extends north in subway in Walnut St., to the canal and thence west in subway in the canal, or Central Parkway as it is now called to Plum St. The line in the Parkway is shown by Fig. 2. On this section and centering at about Race St. a combined rapid-transit and interurban terminal station, Fig. 3, will be located. At present only the center portion of the station, to be used as a combined interurban and rapid-transit station, will be built. If the station in the future becomes inadequate, the rapid-transit tracks will be put on the outside of the present structure, which will then be used exclusively as an interurban station.

From Canal and Plum Sts. the line extends north in subway to Brighton. From Brighton around the circle to the starting point, the line except for a short tunnel will be in the open, either of standard-gage surface construction or reinforced-concrete elevated railway. The map indicates the different types of structures. The total length of the loop is about 16.45 miles, consisting of 2.45 miles of subway; 9 miles in the open, with bridges or subways at intersecting streets; 0.2 miles of tunnel; 3.4 miles of concrete trestle, and 1.4 miles of concrete elevated structure.

*Topographical and Transit Conditions.*— The original location of the city, and now the business portion, is a small plateau lying east of the mouth of Mill Creek. Above this plateau bluffs rise to a height of 300 ft. or more. Beyond the top of these bluffs the ground is very broken and undulating. Owing to this rugged topography, the avenues of easy entrance to the business section are limited in number. They have been preëmpted by the city street car lines. While these lines provide sufficient service for some of the territory within the loop, they are not available for rapid-transit lines to the suburbs. Also since the main business district of the city is at Fountain Square, almost the extreme end of the city, all traffic must traverse practically the entire city to reach this district.

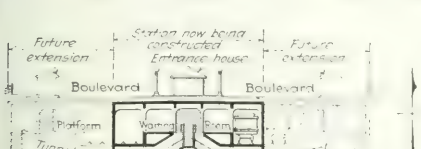
The whole plan of rapid transit developed from an effort to pick up the interurban lines in the suburbs by a rapid-transit terminal system which would send the cars rapidly to the heart of the business section. As this problem was discussed and general plans made, it became evident that the local rapid-transit problem could not be solved by the solution of the interurban problem. In fact the local rapid-transit problem became eventually more important than the interurban problem. In the last few years nearly all the interurban lines entering Cincinnati have become bankrupt. Some have been discontinued and sold for junk. Others are in receivers' hands, and several that have been reorganized are awaiting the completion of the loop to get a better entrance into the city. One of the reasons, in fact the chief reason, that the interurban lines are in such poor condition is that they have not had an

entrance into the city which would insure rapid transit within the city limits. When the rapid-transit system is completed some of these interurban roads may be revived and reorganized.

The first plan worked out in detail provided that the interurbans should not enter the city but would merely touch the rapid-transit system; that is, the interurban cars would draw up to a platform at one of the stations and transfer passengers directly to the cars running on the loop. It was felt, however, that for some time the traffic on the loop would not be so great as to necessitate cutting off the interurban lines at the loop, and the plan was revised so that the interurban cars would come to the heart of the city over the loop until such time as local traffic would become so heavy that it would be necessary to restrict the loop to its service.

At first the topographic conditions of Cincinnati and its environs seemed to present a problem much more few, there are few sewer and water pipes to be replaced (except on Walnut St. from Canal to Pearl St.), and a private right-of-way insuring speedy and direct entrance for interurban and suburban cars is easily obtainable. Finally, the line runs through the heart of the business district and should have the effect of spreading this district from the southern part of the city where it is now very congested. This is especially true on Canal St., where the combined interurban and loop station is located; this street, 150 ft. wide and twelve blocks long, is to be made into a wide boulevard and should develop rapidly.

*Line and Station Structures.*—The rapid-transit railway will be a double-track line of standard gage (4 ft. 8½ in.). The gage of the Cincinnati street railways is 5 ft. 2½ in., but due to complication produced by the use of two gages and the desirability of keeping surface cars (except fast suburban and interurban cars)



Cross-Section through Center of Station

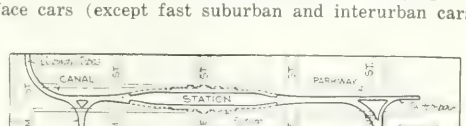


FIG. 2. CANAL STREET SECTION OF SUBWAY

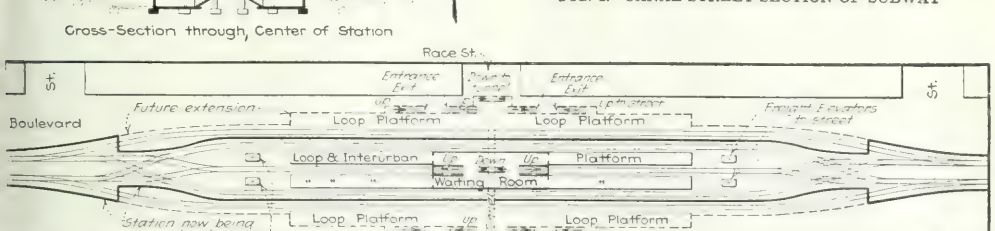


FIG. 3. RAPID-TRANSIT AND INTERURBAN TERMINAL AT RACE STREET

ifficult of solution than would have been the case in ore level cities such as Columbus, Indianapolis, and hicago. But these very topographic difficulties have ffered a natural plan which will give at once excellent nterurban and suburban rapid-transit facilities, and his, too, at a comparatively low cost. In the first place ne Miami & Erie Canal right-of-way already acquired y the city offers a direct and almost level entrance to he business district through thickly settled portions f the old city and the newer manufacturing and subrban districts, north and northwest; it provides an nmediate north-and-south route for traction lines fro ne north; it offers an invitation for direct connection ith the traction lines from the west at Brighton. In ne second place, ravines, as for example at Torrence oad and Duck Creek Road, in which houses have not een built furnish what are in effect open cuts for gress from the northeast. Third, there is a stretch f open country from Norwood to St. Bernard through ond Hill which has been almost encircled by the city's rowth northward and which will develop rapidly with roper transportation facilities.

To summarize, the conditions which seemed, upon perficial observation, to present unusual difficulties, reality simplified the solution; for the right-of-way be acquired is cheap, the streets to be crossed are out of the system only one gage is to be used. The maximum grade, except in one instance where a grade of 3.5 per cent is required, is 2 per cent. There will be no grade crossings; power will be transmitted from a third rail, and the cars will be designed to maintain a speed of 45 min. per hr. The capacity of the system at a 1-min. 9-sec. spacing of cars and with four-car trains is 110,000 people per hour. All the latest safety appliances are contemplated: block system, ventilating openings, emergency exits, separation of lighting and power ducts, and use of reinforced-concrete construction for all structures.

As indicated by Fig. 4, the subway portion of the system is a double-tube structure of reinforced concrete. Single-track tubes are used to get the piston action of the cars and thus secure better ventilation. The tubes are 13 ft. wide and have a clearance of 14 ft. 9 in. over top of rail. This height was adopted to admit standard freight cars, as it is possible that movement of freight may be permitted at night time.

It was determined to use reinforced-concrete structure, Fig. 5, for the elevated part of the line. Wherever the elevated lies on private right-of-way, a trestle form of construction, Fig. 6, will be used and especially on the hillside along Eastern Ave., where it is impossible to build on the surface due to the sliding nature

of the ground. In streets, the same longitudinal beam construction will be used as on the concrete trestle, but the beams will be supported by cross-girders and the girders by columns placed inside the curbs. The surface-line construction will be standard railroad construction using stone ballast and creosoted ties.

At all stations, except the station on Canal St., the platforms are being constructed to accommodate four-car trains, each car being 70 ft. long. The platforms will be at the height of the car floors. The stations will be equipped with all modern conveniences and the latest methods for handling passengers will be used. The station at Canal St. will be a combined interurban and rapid-transit station. The through tracks will be on the outside, while a third track from each end of the station, ending at the waiting room, will provide lay-over tracks for interurban cars. At each end of this station there will be Y tail-switching arrangements for the interurban cars.

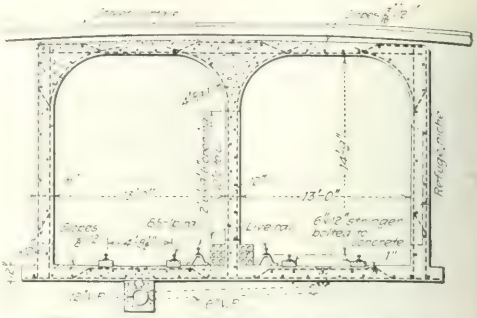
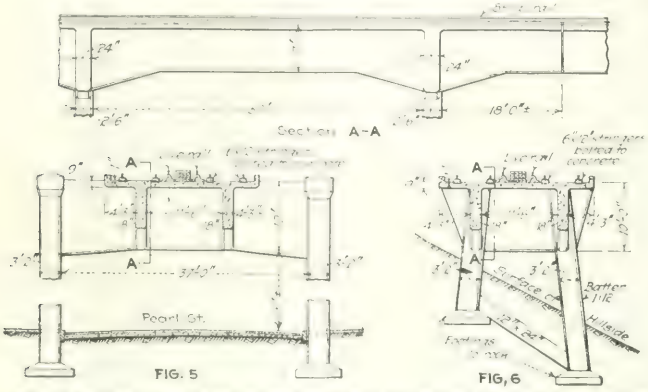


FIG. 4. DOUBLE-TUBE SUBWAY DOWNTOWN




FIGS. 5 AND 6. CONCRETE ELEVATED RAILWAY AND HILLSIDE TRESTLE

*Construction Methods.*—Construction presents no difficult problem. The structure is large but it is not complex, and the subway portion is constructed in open cut, without sheeting, in sandy loam and gravel carrying almost no water. Fig. 8 shows the old canal bed location, Fig. 9 shows the clean dry cut, and Fig. 7 shows the subway structure being built by chuting and wheeling from portable mixers on the bank. The floor is concreted first, then the wall and roof forms are erected and the superstructure concreted in sections. On two sections steel forms, shifted by travelers, are being used, and steel forms are also planned for the fourth section. On the other contract, wood forms supported by staging are used. Four sections are under construction, respectively 2,100 ft., 2,450 ft., 2,850 ft., and 2,260 ft. long. The contract prices are $524,000, $498,540, $556,905 and $493,094.

FIG. 7. DOUBLE-TUBE SUBWAY UNDER CONSTRUCTION

FIG. 8. OLD CANAL-BED RIGHT-OF-WAY

In the four sections there are about 350,000 cu.yd. of excavation and 58,400 cu.yd. of concrete with 3,000 tons of reinforcing steel. The contractor for Section 1 is D. P. Foley, Cincinnati; for Sections 2 and 3, Hickey Bros., Columbus; and for Section 4, Fred R. Jones Co., Chicago.

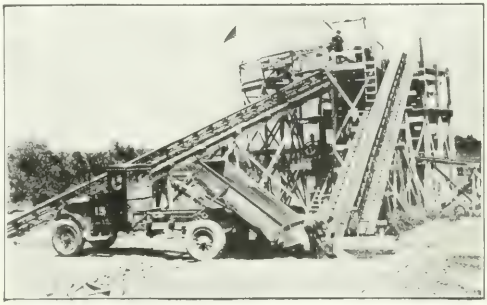
*Cost and Operation.*—The total estimated cost of the system in 1915 was $6,000,000 and this is the amount authorized for construction by vote in April, 1916. Due to intervention of the war and the higher cost of construction, this amount will not be sufficient to complete the system at the present time or in the near future, and it will be necessary to have the people authorize an additional bond issue of between $4,000,000 and $5,000,000. Until that time it is probable that a divergence may be made from Beech Ave. to Madison Road in Oakley. The portion of the line from this point to Canal and Walnut Sts. can be constructed for the $6,000,000 authorized. This is the most important part of the line and is about 11 miles of the total of 16.45 miles. It runs through the suburbs of Oakley, Norwood, Bond Hill, St. Bernard and Cumminsville and could be operated profitably before the entire system is completed.

Several years ago, the franchise of the local traction company was revised and included a provision for operating the loop. The courts, however, declared this franchise to be illegal. Due to the unsettled condition of traction matters in this city, the Board of Rapid Transit Commissioners has deemed it not advisable to take up the matter in definite form at present. Of course, the ideal method of operation would be to combine the rapid-transit system with the local street-railway system. By throwing as much traffic to the loop as possible, the street-railway traffic would be relieved, especially on long hauls to the suburbs, which are at present very unprofitable. By throwing most of the traffic from the suburbs into the loop there would be a saving in cost of operation to the surface system but there would also be a great saving of time to the people using the loop. The surface system should act as a feeder to the loop wherever possible, and as the loop encircles the entire city it would provide contact at all important transfer points, so that a great many surface lines running through the congested parts of the city could be cut off at the loop.

FIG. 9. OPEN-CUT EXCAVATION FOR SUBWAY

## Portable Conveyor Fitted to Central Mixing Plant

BELT conveyors, 75 ft. long, constructed by adding 36 ft. of standard sections to each of two 39-ft. portable belt conveyors are operating successfully at the central mixing plant for the Mt. Vernon concrete road near Cedar Rapids, Iowa. The illustration shows the arrangement of the conveyors. They deliver into the sand and gravel bins from hoppers in the ground. Each hopper has a capacity of 6 cu.yd., and is charged directly by 3-yd. trucks hauling from the railway and also from adjacent stockpiles accumulated ahead of construction. A wagon loader at the stockpile loads into a truck with a dump body, and the truck takes the material to the hoppers. The 4-bag mixer is located under the bins and high enough to dump into other trucks which haul the wet batch an average of two miles to the subgrade. The contractor is the Henry W. Horst Co., Rock Island, Ill. The conveyors and loader were furnished by the Barber-Greene Co., Aurora, Ill.



BIN LOADERS MADE FROM BELT CONVEYORS

### Alum in Illinois

Alum used at 22 of the water purification plants in Illinois during 1920 amounted to 2,300 tons, ranging from 5 tons at some of the smaller plants to about 780 tons at the largest plant. The cost ranged from $24 to $160 a ton. Analyses made at some of the plants show $Al_2O_3$, 17 to 17.25 per cent, insoluble matter 0.1 to 0.2 per cent, Fe, 0.5 to 0.75 per cent.

# Features of San Francisco Bay Bridge Report

SINCE presentation of the report made by J. Vipond Davies and Ralph Modjeski to the general bridge committee of San Francisco, Alameda and San Mateo Counties, a joint conference committee, composed of representatives of various bay cities, and an engineering subcommittee have been meeting frequently and giving consideration to various phases of the project, including the exact location of terminals and approaches, the question of financing the $150,000 preliminary surveys and means of securing sanction from the War Department. A news note on the report appeared in *Engineering News-Record*, July 14, 1921, p. 81. The chief features are presented somewhat more in detail in the following abstract:

Any high bridge between Yerba Buena Island and San Francisco would naturally land on Telegragh Hill. It would not only involve very long and costly spans, even if piers were permitted in the channel, but would land the traffic in a section of the city already quite congested, and from which a proper distribution would be impracticable. Any tunnel on this location would have to be constructed at great depth in an unknown rock formation, as the water depth is too great for tunneling under air pressure, and the length would consequently be so great as to involve an extremely difficult problem in ventilation for vehicular traffic. We there fore consider this plan as impracticable. Any continuous tunnel across the bay, on any location, while practicable for purely electrically operated railroad traffic, would involve most serious ventilation problems for vehicular traffic, and enormous expense if constructed for all classes of traffic.

The location recommended as suitable and feasible for the crossing commences at any convenient point between Mission Rock and Potrero Point in San Francisco and extends thence due east to the line between the counties of San Francisco and Alameda, the location in the proposed naval base to be whatever would be satisfactory to the naval authorities. The committee believes that a highway connection with San Francisco would be of great value to the naval station.

The location in San Francisco was so selected that the through traffic will not add to, but will tend to relieve the traffic in the heavily congested streets and the distribution of rail and highway traffic can advantageously be arranged. Under no condition should the passengers from the rapid transit suburban traffic be discharged at the bridge terminals proper, but they should be carried beyond those points to more central distribution centers where connection could be made with existing systems of surface railroads. It is therefore recommended that the project be not considered solely a crossing of the bay alone but the extension of the railroad tracks either by subway or elevated structure to points of general distribution with a few well-located intermediate stations.

The air-line distance between the city halls of San Francisco and Oakland is approximately 8.13 miles while the driving distance between these two points via the location selected for the bridge is approximately 9.38 miles, so the deviation from the shortest distance is comparatively small.

### Type of Structure

The width and capacity of the structure must be great to provide necessary roadway width, and consequently any high-level bridge with long spans would involve such enormous expense as to be economically prohibitive; and for the same reasons and on account of ventilation a very long tunnel for those classes of traffic is also impracticable. As all navigation is adjacent to the west shore of the bay, the location of the open channel at that point affords every facility for the passage of general traffic. The tunnel approach to this submerged or open-channel section would be such as to afford 40 ft. of water at low tide on the pierhead line, maintaining this depth for a distance of 1,500 ft.; rising thence to a water depth of 20 ft. at the far side of a 2,500-ft. open channel beyond which the tunnels rise above the level of the water and cross on bridge and fill to the Alameda shore. Under this plan the entire deep-water portion of the bay south of the bridge location could be used without interference and to its absolute limit of capacity for fleet or commercial uses.

### Traffic

Although separate in political entities, the population around San Francisco Bay is unquestionably one in its interest. The exact distribution of its population is immaterial to this project. The important aspect is that there is in the district tributary to the bridge approximately one million persons. The present vehicular traffic carried on ferries, amounting to about 725,000 vehicles last year, appears to be no criterion as to what may be anticipated if a suitable bridge is provided.

The two classes of transportation to be provided for of the most vital importance to the population on both sides of the bay are the suburban passenger and vehicular traffic. The present total passenger ferriage appears to be in excess of 40,000,000 per annum and increasing. If the prosposed structure is built, however, it is most unlikely that all the traffic would be diverted from the present route, so that allowing for increase in the growth and the better service rendered and for the diversion of the greater proportion, it is probable that not over 50,000,000 passengers per annum would use the new route for many years to come.

Allowing an operating speed of 10 miles per hour, a single 20-ft. roadway in both directions would permit passage of mixed motor vehicles at the rate of 1,260 per hour, 15,400 per day, or, approximately 5,250,000 per year. For crossing the open channel in tunnel the single 20-ft. roadway for vehicular traffic would be adequate for the business offered for a good many years, particularly as the length from grade point to grade point would be only approximately 1½ miles. The bridge trestle and fill on the remainder of the crossing should be made in the first instance the full width of 40 ft. and when the point of actual design of the structure is reached, arrangements should be made so as to permit, in the future, a second vehicular tunnel being built under the waterway gap. This is advisable in keeping the initial cost down to a minimum. The open channel or tunnel section constitutes the greatest element of expense in the project.

### Further Details Needed

Pending more accurate data on the bay bottom it cannot be stated definitely whether the tunnel section should be constructed as a shield-driven steel tube lined with reinforced concrete, or as a box type of structure sunk in sections in a previously excavated trench. Either method of construction should provide for two railroad tunnels of size large enough for all classes of railroad equipment and one vehicle tunnel with a roadway width of 20 ft. between curbs. The transverse application of ventilation should be used; that is, fresh air should be blown in at roadway level all along the tunnel section and foul air removed through continuous openings at the roof, or the reverse.

The further investigations necessary will require triangulation surveys and borings, both ashore and at numerous points across the bay, after which it would be possible to prepare specifications and working plans upon which bids could be called for. All of the further surveys, borings and studies necessary could be made for an amount probably less than $150,000, and could be completed in a period of about eight months.

### Justification for the Project

A study of traffic figures and cost estimates leads to the conclusion that this project would likely not yield net returns during the early years of operation fully equal to the amount of the fixed charges on the investment; nevertheless it appears reasonably certain that after those early lean years the communities will obtain full returns either from adequate toll charges or by general advantage accruing from reduction in the toll charges. There can be little doubt

that the completion of the work contemplated will tend to closer relations and interchange and consequently to the more uniform growth and development of the metropolitan district as a whole.

The total cost of the project is estimated at $40,000,000. The fixed charges at 6 per cent would be $2,400,000; maintenance, depreciation, etc., would involve an aggregate annual charge of $650,000. The net earnings necessary to pay full interest charges on bonded capital would be $3,050,000 per annum. Gross earnings in the first year after completion are estimated at $1,592,500, increasing steadily until, in the fifth year, the earnings would be $3,630,000 per annum.

The recommendation is that whether the project is financed by private enterprise and private capital or not, it should, without question, be ultimately acquired, owned and controlled by the people of the bay cities.

## Some Paint Definitions

DEFINITIONS of some basic terms used in connection with paints and varnishes reported by the committee on Preservative Coatings for Structural Materials of the American Society for Testing Materials were as follows:

*Size.*—In the painting art a size is a liquid material, the principal vehicle of which is water, and one which contains as a necessary ingredient a fairly large proportion of water soluble binder with or without pigment. A size is used to prepare a surface for further treatment and is not regarded as a finishing material.

*Varnish*—A liquid coating material, containing no pigment, which flows out to a smooth coat when applied, and dries to a smooth glossy, relatively hard, permanent solid when exposed to the air in thin films.

(Some varnish, while possessing the other characteristics, dries without the usual gloss. Such varnish is usually called "flat varnish.")

*Enamel*—A special form of paint which, when spread in a thin film, flows out to a smooth coat and dries to a smooth, glossy, relatively hard, permanent solid when exposed to the air. An enamel always contains pigment and has considerable hiding power and color. Some enamels dry to a flat or eggshell finish instead of a gloss finish.

*Filler*—A special kind of paint designed to be used for filling pores or other small breaks in the continuity of a surface preparatory to further treatment. When applied and exposed to the air, a filler should dry to a relatively hard, permanent, solid capable of properly supporting subsequent coats.

*Toner*—An organic pigment which does not contain inorganic pigment or an inorganic carrying base.

*Lake*—A special type of pigment consisting essentially of an organic soluble coloring matter combined more or less definitely with an inorganic base or carrier, both together forming an insoluble pigment characterized generally by a bright color and a more or less pronounced translucency when made into an oil paint.

(A more specific definition requires more extended description of the two and perhaps three types of pigment now generally classified as lakes. It would include (*a*) the older original type composed of hydrate of alumina dyed with a solution of the natural organic color, and (*b*) the more modern and far more extensive type made by precipitating from solution various coal tar colors by means of a metallic salt, tannin, or other suitable reagent, upon a base or carrier either previously prepared or coincidentally formed. A number of lakes, combining both types in varying degree, might be regarded as a third class.)

*Drying Oil*—One which possesses to a marked degree the property of readily taking up oxygen from the air and changing to a relatively hard, tough, elastic substance when exposed to the air in thin films.

*Semi-Drying Oil*—A semi-drying oil possesses the characteristics of a drying oil but to a lesser degree. There is no definite line of demarcation between drying and semi-drying oils.

*Non-Drying Oils*—A non-drying oil does not of itself possess to a perceptible degree the power to take up oxygen from the air and lose its liquid characteristics.

# Powder-Post Damage to Timber and Wood Products

### Burrowing Grubs Reduce Wood to Powder—Remedy and Prevention—Structural Timber and Manufactures Attacked

By A. D. Hopkins and T. E. Snyder
Bureau of Entomology, U. S. Department of Agriculture

EXTENSIVE injury to seasoned hardwood material of all kinds, finished and unfinished, is caused by grubs which are the larvae or young of small beetles known as powder-post beetles. These grubs, yellowish-white in color and from $\frac{1}{8}$ to $\frac{1}{4}$-in. long, burrow through the wood in all directions and convert it into powder, finally boring to the surface for the escape of the beetles. Damage of this kind is distributed widely throughout the world, many species of these beetles being carried from one country to another in the commercial products which they infect. To prevent infection of this kind and to check further damage in infected timber are two important points in the economics of the timber industry.

This powder posting damage to lumber is fairly well known in the lumber industry and we have received

FIG. 1. INFESTED IMPLEMENT HANDLES

during this fiscal year over 40 requests for information on prevention and remedy of this damage to both crude and manufactured seasoned wood products, including woodwork of buildings. Some of these cases were important, the injury being done to stored material of the army and navy and the Aircraft Board. It is not generally realized, however, that much of the damage can be prevented by the adoption of a system of inspection, classification and prompt utilization, such as is noted later in regard to methods of control.

Infested wood may be detected by the fine powder found on or beneath piled products of seasoned hardwood. During the first year of attack the powder comes from exceedingly minute holes, but after the second year the small holes from which the beetles have emerged are more or less conspicuous (See Fig. 1). When the wood is cut or split the interior may be found converted into a mass of closely packed powdery material which has been held together by an outer thin shell and intervening fibers of sound wood. The grubs burrow in all directions and pack their burrows with the pulverized wood. The white ash board shown in Fig. 2 is from a closely piled stack of shipbuilding lumber through which the larvae had burrowed.

Seasoned heartwood and sapwood of both hardwood and softwood trees are attached by different kinds of

these beetles, but by far the larger proportion of this kind of trouble is caused to the seasoned sapwood of hardwood by species of the genus Lyctus. Second growth sapwood of the best quality which has seasoned for a year or more and has been stored in one place for two years or more is specially liable to attack, the loss amounting sometimes to from 10 to 20 per cent of stored material which has been neglected. Seasoned wood is attacked because the chemical changes in the process of seasoning render the nutritive substances, such as sugar and starch, especially suitable as food for the grubs. Wood seasoned for less than eight to ten months will not be attacked. With beetles of the genus Lyctus, the burrowing is confined to the sap-

FIG. 2. POWDER-POSTED WHITE ASH SHOWING BURROWS OF LARVAE AND EXIT HOLES OF BEETLES

wood, except that the heartwood is sometimes penetrated when the mature beetles are emerging.

Structural timbers, car and shipbuilding lumber, veneer and plywood for airplanes, farming machinery and wheel stock, tool handles, furniture, flooring, interior finish and ornamental woodwork are among the articles affected. Hickory, ash and oak are the most liable to injury, but other woods attacked include osage orange, black walnut, butternut, maple, elm, locust, poplar, sycamore, eucalyptus and bamboo. On the other hand, chestnut and dogwood appear to be immune. As the wood is not attacked until after it has seasoned for a year or more the loss due to the "powder post" injury does not affect the producer but falls upon the dealer, manufacturer and consumer. Quartered-oak flooring is frequently infested and there may be controversy between the manufacturer and the builder as to whether the wood was infested before or after being laid.

*Habits of Powder-Post Beetles.*—The Lyctus beetles are small, slender, somewhat flat and from brownish to nearly black in color. Upon emerging from the wood they fly or crawl about in search of suitable material in which to deposit their eggs, the eggs being deposited by the female soon after its emergence from the wood. Each female deposits many eggs from which the larvae or white worms are hatched, and the burrowing of these numerous worms in quest of food results in the complete destruction of the interior wood fiber. After the continual attacks from successive generations nothing will be left but a thin outer shell.

Infestation of wood stored in cold places may escape notice, since at low temperatures the larvæ are dormant, but they become active when the wood is removed to the dry kiln or other warm place. At Washington, D. C., the beetles are active or flying from about March 1 to July 31, but the period varies with the species of insect, the temperature of the storerooms and the geographical location.

### Methods of Control

Prevention of the injury and loss caused by these insects includes the destruction of the insects in infected timber and the prevention of attack in clean timber.

*Reclaiming Infested Wood.*—All infested material, including sap edges of lumber, and all refuse sapwood in which the insects might breed, should be sorted out and disposed of by burning or otherwise. Material showing the slightest evidence of powder-post damage should be destroyed, except possibly such articles as may be tested for the required strength and found to be of sufficient value for use after treatment. In partially damaged material, such as the sap edges of lumber and parts too valuable to be destroyed, the infested parts should be cut away and burned.

This work should be done between October and March in storehouses and before April in the open air. If it is done thoroughly and supplemented by annual inspection, it will eliminate the trouble, unless there is a continued introduction in lumber and material received. To avoid such new infection all material should be carefully inspected before shipment, or at least before it is placed in the yards or storehouses.

For the more valuable stock, or where it is not practicable to remove the infested parts, the wood should be treated for the destruction of the insects between October and March. The objection to treatment is that wood once infested may be so damaged as to be unsafe for use. Pure kerosene oil may be applied liberally with a brush or saturated rag, or the wood may be immersed in kerosene. The only objection is the fire risk, but as kerosene soon evaporates the treated material is not long near the danger point. Kerosene does not affect the application of shellac or varnish, but makes it more difficult to stain treated sapwood to match the rest. Hot mixtures of creosote and kerosene oil 3 to 1 (or 1 to 3 for deeper penetration) and 1 to 3 creosote and naphtha have been used successfully, applied by immersion or brushing.

Thorough steaming of the infested wood in the dry kiln is effective, the seasoned wood being heated to temperatures up to 200 deg. F. for a short period after the usual kiln drying operation. As steaming under pressure weakens and discolors the wood, it should not be applied where fine finish or great strength are required. Fumigation of infested wood with sulphur fumes in tightly closed drying rooms at the time of the emergence of the beetles is recommended only for killing the beetles and preventing egg laying.

In the case of powder-post damage to the woodwork of buildings, a prompt examination should be made. When it has been determined where the insects are burrowing, the wood may be drenched with kerosene oil, using a saturated rag, care being taken that the work is not done near a fire. Several applications of oil may be necessary and careful watch should be made after the treatment to determine whether it has been successful. If the borers are too deep or if the wood is structurally weakened or rendered unsightly, it should be replaced with heartwood or softwood.

A system of inspection, classification and prompt utilization of timber is really more important than

FIG. 3. EGG OF LYCTUS BEETLE IN PORE OF WOOD (HIGHLY MAGNIFIED)

chemical treatment alone, since by proper methods of management it enables large manufacturers and lumber companies to keep their yards free from this pest. The instructions given in the pamphlet on these insects, issued by the U. S. Department of Agriculture, are as follows:

Inspect material in yards and storehouses annually, preferably in November and February, and sort out and burn material showing evidence of powder post. Burn all refuse and useless sapwood material.

Classify seasoned hardwood stock into: (A) hickory, ash, oak, etc.; (B) heartwood, pure sapwood, and part sapwood; and (C) according to the number of years seasoned.

Utilize or sell oldest stock first. Inspect all new stock to prevent introduction of powder-posted material. Use only heartwood piling sticks in lumber piles.

To prevent attack treat the more valuable material, between October and March, with boiled linseed oil. Varnish or paraffin the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture.

*Preventive Measures*—Stock which has been seasoned longer than eight months and is to be held in storage, may be rendered immune by applying two coats of hot boiled linseed oil, or immersing it in hot oil. This treatment should be given between October and March. The boiled oil will dry more rapidly than raw linseed oil, especially if kerosene is added to the hot oil. Linseed oil has an advantage in that it can be applied profitably to unseasoned timber, since it will prevent checking in seasoning. It stains the wood slightly yellow. Creosote can be used effectively when the brown stain will not be detrimental. The hot creosote should be applied by dipping or brushing. For finished products, any substance which closes the pores of the wood may be applied, such as varnish or paraffin wax, to prevent the beetles from depositing the eggs in these pores.

The use of chemicals for the prevention of the damage is based on the recent discovery that the eggs are hidden within the pores of the wood. Fig. 3 is a highly magnified view of the egg in a pore of wood on radial section of ash stock for ladder rungs. Although the insects and their damage to lumber have been known for many years it is only recently that the peculiar egg of Lyctus was discovered.

### Transport Minister's Power Under Roads Act

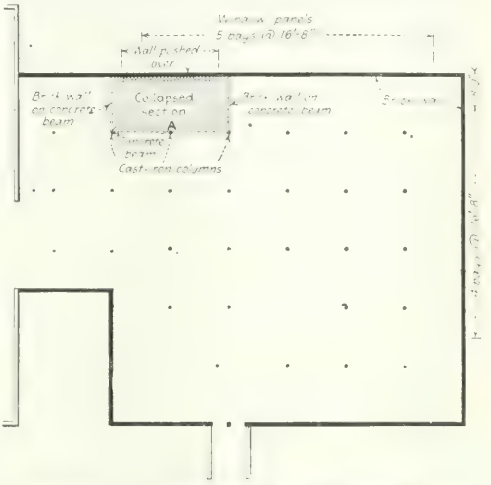
Though this regulation has not yet been enforced, under the Roads Act of 1920, the British Minister of Transport is empowered to prohibit the use of any specific type of vehicle on any particular highway if that class of vehicle cannot be driven on that highway without endangering the public or the occupants of the vehicle, or if the highway is considered unsuitable for such a type. It is considered unlikely that this power will be invoked in London or any other large cities

# Small Concrete Roof-Slab Failure in Seashore Hotel

## Reinforcing Wires at Break Weakened by Corrosion by Intrusion of Moisture Through Bottom of Slab

By Lewis R. Ferguson
of Wig, Hollister & Ferguson, Engineers, Philadelphia

FAILURE of a small section of reinforced-concrete roof over the kitchen annex of the Marlborough-Blenheim Hotel at Atlantic City, N. J., on Aug. 9, is of exceptional interest because corrosion of the reinforcing mesh appears to be responsible. This concrete hotel, built about 15 years ago, was one of the first, if not the first, structure of its kind erected along the sea coast. Exhaustive investigations made by R. J. Wig and the writer a few years ago to determine the effect of sea water upon concrete, subsequently described in a series of articles in *Engineering News-Record*, led to the conclusion that steel embedded in good




LOCATION OF COLLAPSE, HOTEL KITCHEN ANNEX

concrete, even to a considerable depth, is subject to corrosion above the water line when subjected to moist sea air. It was found that the rapidity of corrosion, with resulting cracking of the concrete member, was apparently governed by a number of conditions, but that the seriousness of the situation should be recognized by engineers who are entrusted with the design of concrete structures near our sea coasts. While the condition of many reinforced wharves, piers and bridges was described in support of the theory advanced, as far as the authors could learn no enclosed reinforced-concrete building exhibited signs of corroding reinforcing in its interior members. It is for this reason the failure of the reinforced roof slab of the Marlborough-Blenheim is worthy of unusual study.

The roof, a section of which collapsed suddenly, without any warning, shortly after 1 p.m. on August 9, covered a two-story annex used as a kitchen, pantry and storeroom. Both floors of this annex are of concrete, the first resting directly on the sand and the second being a reinforced slab in which hollow terracotta tile were embedded; the roof is also of concrete. A sketch herewith indicates the extent of the collapse.

The collapsed section of slab was supported on one side by a concrete beam and on the other side by a 9-in. brick wall, about 15 ft. apart in the clear, while the ends were supported upon brick walls resting upon concrete beams, about 33 ft. apart. The slab, 8 in. thick, was of cinder concrete of good quality, and the upper surface was covered with a bituminous coating for waterproofing purposes. Over a part of the collapsed section a granolithic walkway had been laid. The reinforcing consisted of galvanized wire mesh of about 0.105 in. diameter, whose wires were spaced 5 in. apart one way, and 4 in. apart the other; the wires of 4 in. spacing apparently spanned the short way of the slab. These wires were embedded variable depths in the concrete; in some cases the covering was over 1 in. thick, but in other places the wires were less than ½ in. from the bottom of the slab. There was no other reinforcement.

Evidently the slab collapsed through the formation of a longitudinal crack near the center, for a section about one-half as wide as the slab seems to have swung down toward the inside of the building; it broke away and came to rest in an inclined position against the cast-iron column marked "A" in the sketch. The wire reinforcing strands protruding from the lower edge of this section resting on the floor, are near the surface and many of them are badly corroded; they have the appearance of having failed from diminution of cross-section. Other reinforcing wires, near those found corroded, exhibited all the signs of normal failure under tension. They are slightly necked down and the fracture is cupped. Evidently they were subjected to excessive tension.

When the slab collapsed the outside brick wall was pushed out and fell, together with a considerable portion of the roof, into the court below; there was no evidence that the wall was responsible for the failure.

The surprising thing about this roof is that it stood for 15 years without any evidence of weakness. From dead load alone the reinforcing wires were subjected to a stress which, according to our present knowledge, was beyond the limit of safety (figured on 15 ft. simple span, with dead load taken at only 60 lb. per sq.ft., the unit-stress would appear to exceed 100,000 lb. per sq.in.!). Since this building was erected we have learned much about reinforced concrete. An examination of the edge of the slab where apparently the first break occurred shows that the rusting of the reinforcing at this point was caused by the intrusion of moisture through the under side of the slab. When this corrosion decreased the strength of the wires to a sufficient extent they broke; adjacent wires were called upon to bear an additional load they were unable to sustain, they failed, and the section collapsed.

Failure was caused primarily by the corrosion of the reinforcing of the slab. The collapse was hastened by the lack of adequate reinforcing and the nearness of the metal to the surface of the slab.

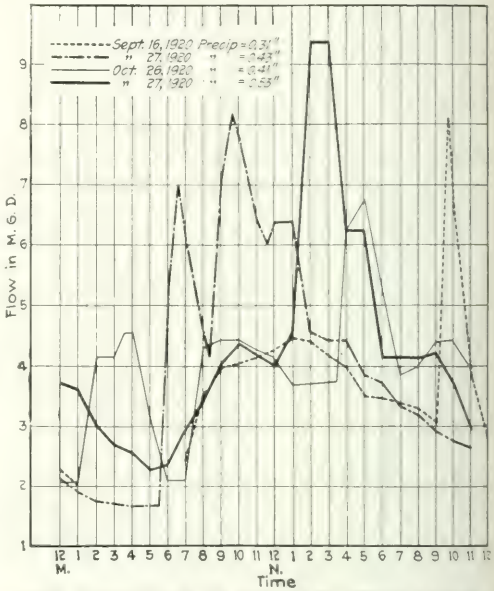
We are still in the dark as to the condition of well reinforced enclosed concrete buildings along our sea coasts, for this concrete slab that failed certainly cannot be considered typical. Some incidental but very interesting evidence of a reassuring nature was noted in connection with this failure. When the roof fell the reinforced-concrete floor of the second story was called upon to sustain a severe impact, probably causing stresses of much greater intensity than it was designed to bear. The fact that only two comparatively small holes were punched in this floor and that the remainder apparently suffered no injury indicates that if corrosion of the reinforcing is occurring, it is progressing at a very slow rate.

## Sewage Disposal Studies at Flint, Mich.

By J. R. Pollock
Sanitary Engineer, City Engineers' Department, Flint, Mich.

A RECENT study of the sewage disposal requirements of Flint, Mich., showed conditions typical of many other Middle West communities that have become intensely industrial in a short time. A year ago a study of the sewerage system and of the Flint River to find the proper form of disposal was undertaken by the writer.

During the last 20 years Flint increased in population from 13,103 to 91,599. Formerly a carriage factory




ROOF CONNECTIONS TO SANITARY SEWERS TRIPLE FLOW IN WEST SIDE INTERCEPTER

city, its chief industry now is the manufacture of automobiles, the output being 1,000 cars daily. As the demand for water from the Flint River as a water supply increases the volume to assist in carrying off wastes becomes less. The records for 1920 show a minimum dry-weather flow of 55 sec.-ft. and earlier records give a flood flow of 6,000 sec.-ft. The nuisance caused by the city's sewage at Flushing, a village of 1,000 located 10 miles below the city, is accentuated by a power dam in the village. It is no uncommon occurrance for an acre of floating sludge or scum to accumulate in front of the dam in 24 hours.

Studies of the effects of the sewage on the river for 36 miles below Flint since July, 1920, by sampling and observation trips at 8-day intervals, indicate that there is little oxygen in the river between Flint and Flushing, but five miles and farther below a high oxygen content was always obtained, due largely to algae.

One feature learned in the study of representative districts, but for which no practical remedy has been found, is that the roof connections to the sanitary sewers may more than triple the volume of flow to be provided for. The West Side intercepter drains 2,200 acres and has a tributary population of 35,000 people. What proportion of rain leaders are connected was not ascertained.

Experimental work on industrial wastes carried on for two months has indicated a way to treat the gas plant wastes. Oil from the various factories completely covers the river for days at a time. Its recovery is a logical procedure but what to do with the waste from one of the motor factories which imparts an orange color to the river for a mile downstream is a problem. The general plan is to demonstrate if possible to each industry some solution of its own waste problem.

Eventually the flow from 18 sanitary sewers discharging into the river will be collected by an intercepter and carried to a disposal plant which will probably be located four miles below the center of the city. In the program for intercepters and sewage-works recently submitted to E. C. Shoecraft, city engineer, it is proposed to install a sewage testing station in 1922, but it is not likely that sewage-works can be put into operation before 1925.

## English Devices for Rail Renewals

LABOR SAVING appliances are being given much more attention than formerly by English railway engineers, owing to the increasing cost of labor, and two such appliances used in renewing rails on the London Northwestern Ry. have been described in the *Railway Gazette*, London, from which the following particulars are taken. Both of these devices were invented by men in the maintenance-of-way department.

*Rail Distribution*—For stringing rails along the roadbed, ready for removal, a pair of trolleys are used. Each

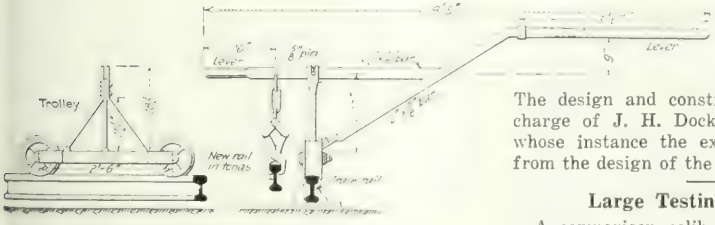



FIG. 1. TROLLEY FOR DISTRIBUTING RAILS

trolley has grooved wheels to ride on the track rail, a cross arm carrying rail tongs and a long lever on which one or two men bear to balance the weight of the rail in the tongs, as in Fig. 1. From four to eight men with the two trolleys can handle rails up to 60 ft. long. Each trolley complete weighs only about 115 lb. and its levers are easily disconnected. Two men with one trolley can shift heavy tools such as rail benders or jacks.

*Rail Laying*—For lifting out the old rail and placing the new one, there is the light portable gantry shown in Fig. 2. A timber beam 8 x 2½ in. is carried in A-frames or horses and has an iron strap on top with a ½-in. bar as the track for a trolley which carries a long lever set slightly diagonal to the track and beam. To the short end of the lever is attached a rail tong. When the splices are unbolted and the rail is free it is raised by two of the gantries, shifted outside the track and

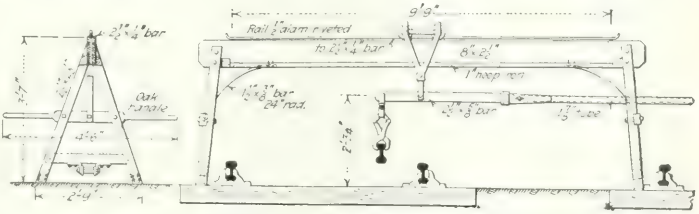



FIG. 2. GANTRY FOR REMOVING AND PLACING RAILS

lowered upon the roadbed. A new rail is then picked up by the pair of tongs, shifted into position and lowered upon the chairs or ties. The device complete weighs about 220 lb., so that it is easily placed on or removed from the track. Six or eight men with two gantries can handle heavy rails readily.

## 550-Ft. Concrete Warehouse Without Joints

A SEVEN-STORY concrete building, 550 ft. long and 100 ft. wide, has been completed in Los Angeles as the third unit in the Los Angeles Union Terminal. The other two buildings are of the same general plan and are 600 ft. in length. Differing from the other units in a few particulars, the recently completed structure has no expansion joints. This feature very considerably reduces the number of columns because where expansion joints were put in at 200-ft. intervals in the other structures twin columns were required, a set on each side of the joints on each floor. Observations will be made to see what difference there is in the action of the buildings with and without expansion joints. Graduated brass gages have been set at the top of the four corners of each building in prolongation of the side walls and these will be read with a transit from time to time to note any change in position. Measurement of the movement of adjoining sections at the expansion joints will also be made. The design and construction of the building was in charge of J. H. Dockweiller, consulting engineer, at whose instance the expansion joints were eliminated from the design of the new unit.

### Large Testing Machine Calibrated

A comparison calibration of the 2,000,000-lb. chain testing machine of the Boston Navy Yard was carried out by the Bureau of Standards recently, using a 5¼-in. nickel steel calibration bar. The deformation of this bar was measured by a special extensometer in the large Emery machine at the bureau, measurements being made for 10,000-lb. increments of load. The bar and extensometer were then taken to the chain testing machine at Boston and six loadings to 1,000,000 lb. were made on a similar schedule. Comparison of the results showed that the chain testing machine was reading about 3.4 per cent higher than the large Emery machine.

# Illinois Begins Traffic Endurance Test

## Two-Mile Road With 63 Different Kinds of Pavement Will Be Tested to Destruction by Progressively Increasing Truck Loads

By Clifford Older
Chief Highway Engineer, Springfield, Ill.

In 1919 heavy truck traffic caused the partial destruction of a well-built concrete road in Cook County, Illinois. Inasmuch as at that time Illinois had arranged for funds approximating $100,000,000 for road construction, a contemplation of the expenditure of such a sum without knowing positively how to design a pavement to resist such traffic was disconcerting. An outline of the probable research work necessary to supply conclusive data on which a rational pavement design might be based was prepared. It immediately appeared probable that the complex problems involved would require much time for solution and in the meantime miles of pavements would be built in accordance with doubtful "rule-of-thumb" designs.

In order as quickly as possible to obtain more exact empirical data on which to base rural pavement designs, S. E. Bradt, state superintendent of highways, proposed that a test road be built in which should be included all commonly accepted types of pavement. It was proposed that the series of test sections for each type begin with a section obviously too thin and weak for heavy truck traffic and by progressive stages reach a section that in all probability would be strong enough to support without failure the heaviest trucks in common use, the road when completed to be subjected to truck traffic beginning with light loads and ending with loads about 50 per cent in excess of the limits provided by the Illinois statutes.

The plan was approved in 1920 by the state administration, funds provided and the co-operation of the U. S. Bureau of Public Roads secured. Construction was started in 1920, but owing to a late start, difficulties in securing materials and the painstaking care needed in the construction of each section, the road was not finished until the middle of June, 1921.

Tables I and II give an outline of the various sections as constructed. After much study the site selected was chosen because, throughout the length of the road, the soil, gradient, alignment and drainage conditions were as nearly uniform and representative of average Illinois conditions as possible. It being a relocation, public traffic will be prohibited until the test is completed.

### Pavement Designs

The series of test sections of each type are expected to cover all reasonable variations in strength that might be required for roads carrying light, heavy or intermediate truck traffic. Each series begins with a section roughly estimated to be equivalent in strength to 4 in. of concrete and increases to the approximate equivalent of 9 in. of concrete. In comparing the strength of concrete pavements with other types, the following assumptions were made:

1. That the strength of a brick pavement constructed monolithic or semi-monolithic with concrete base is equal to that of a concrete pavement of the same thickness and of the same quality of concrete as that used in the base.

2. That the strength of a pavement consisting of bituminous-filled brick on a concrete base is equal to that of concrete slab of the same mix and having a thickness equal to that of the base plus one-half of the thickness of the brick surface.

3. That the strength of a pavement consisting of a bituminous wearing surface, either 2 or 3 in. thick, on a concrete base is equal to that of a concrete slab having the same mix but 1 in. thicker than the base.

TABLE I. BATES ROAD TEST SECTIONS OF BRICK AND ASPHALT ROADS

*Lug and Lugless Brick with Bituminous Filler—Macadam Base*

| No. of Section | Length, Ft. | Thickness of Brick, In. | Cushion, In. | Base* Thickness In. | Total Thickness, In. |
|---|---|---|---|---|---|
| 1-A | 100 | 3 lug | 2 sand | 4 | 9 |
| 1-B | 100 | 3 lugless | 2 sand | 4 | 9 |
| 2 | 100 | 4 lug | 2 sand | 4 | 10 |
| 3 | 100 | 4 lugless | 2 sand | 4 | 10 |
| 4 | 100 | 4 lug | 1 mastic | 8 | 13 |
| 5 | 100 | 3 lugless | 2 mastic | 8 | 13 |
| Total.. | 600 | | | | |

* Crushed limestone

*Asphalt Wearing Course—Macadam or Novaculite Base*

| Numbered Section | Length, Ft. | Wearing Course, In | Base Course, In. | Total Thickness, In. |
|---|---|---|---|---|
| 6 | 200 | 2 Topeka | 10 macadam | 12 |
| 7 | 200 | 2 Topeka | 8 macadam | 10 |
| 8 | 200 | 1½ Topeka<br>1½ Binder | 5 macadam | 8 |
| 9 | 200 | 2 Topeka | 6 macadam | 8 |
| 10 | 200 | 2 Topeka | 4 Novaculite | 6 |
| 11 | 200 | 2 Topeka | 4 Macadam | 6 |

The coarse aggregate for the macadam base is crushed limestone.

*Asphalt Wearing Course—Concrete Base—6-in. Curbs*

| No. of Section | Length, Ft. | Wearing Course In. | Base Course — Thickness, In. | Mix | Total Thickness, In. |
|---|---|---|---|---|---|
| 12-A | 200 | 2 Topeka | 4 | 1:3:5 | 6 |
| 12-B | 25 | 2 Topeka | 5 | 1:3:5 | 7 |
| 13 | 200 | 1½ Topeka | 4 | 1:3:5 | 7 |
| 14 | 200 | 2 Topeka | 4 | 1 2 3½ | 6 |
| 15 | 200 | 1½ Topeka | 4 | 1:2:3½ | 7 |
| 16 | 200 | 2 Topeka | 5 | 1:3:5 | 7 |
| 17 | 200 | 2 Topeka | 5 | 1 2 3½ | 7 |
| 18 | 200 | 1½ Topeka<br>1½ Bind | 5 | 1:2:3½ | 8 |
| 19 | 200 | 2 Topeka | 6 | 1:3:5 | 8 |
| 20 | 200 | 2 Topeka | 6 | 1:2:3½ | 8 |
| 21 | 200 | 2 Topeka | 7 | 1:2:3½ | 9 |
| 22 | 200 | 1½ Bind<br>1½ Topeka | 8 | 1:2:3½ | 11 |
| Total ... | 2,225 | | | | |

Crushed limestone aggregate in base course.

*Lug and Lugless Brick—Bituminous Filler—Concrete Base (6-in. Curbs)*

| No. of Section | Length of Section, Ft. | Thickness of Brick, In. | Cushion | Base Course— Thickness, In. | Mix | Total Thickness In. |
|---|---|---|---|---|---|---|
| 23-A | 100 | 3 lug | 1 sand | 6 | 1 2 3½ | 10 |
| 23-B | 100 | 3 lugless | 1 sand | 6½ | 1:2:3½ | 10 |
| 24 | 100 | 3 lug | 1 sand | 5 | 1 2 3½ | 9 |
| 25 | 100 | 3 lugless | 1 sand | 5 | 1 2 3½ | 9 |
| 26-A | 100 | 4 lug | 1 sand | 4 | 1 2 3½ | 9 |
| 26-B | 100 | 4 lugless | 1 sand | 4 | 1:2:3½ | 9 |
| 27 | 100 | 3 lug | 1 sand | 4½ | 1 2 3½ | 8½ |
| 28 | 100 | 3 lugless | 1 sand | 4½ | 1 2 3½ | 8½ |
| 29-A | 100 | 3 lug | 1 sand | 4½ | 1 3 5 | 8½ |
| 29-B | 75 | 3 lugless | 1 sand | 4½ | 1 3 5 | 8½ |
| 30 | 125 | 3 lug | 1 sand | 3½ | 1 2 3½ | 7½ |
| 31 | 150 | 3 lugless | 1 sand | 3½ | 1 2 3½ | 7½ |
| 32-A | 100 | 3 lug | 1 sand | 3½ | 1 3 5 | 7½ |
| 32-B | 100 | 3 lugless | 1 sand | 3½ | 1 3 5 | 7½ |
| Total ... | 1,400 | | | | | |

Crushed limestone aggregate in base course.

*Monolithic, Monolithic and Semi-Monolithic Concrete Base*

| No. of Section | Length, Ft. | Thick. of Brick, In. | Type | Base Course— Thickness, In. | Mix | Total Thickness In. |
|---|---|---|---|---|---|---|
| 33 | 200 | 3 | Monolithic | 2 | 1 2 3½ | 5 |
| 34-A | 200 | 3 | Semi-monolithic | 2 | 1 2 3½ | 5½ |
| 34-B | 200 | | 10' C | Standard design | | 6 |
| 35 | 200 | 4 | Monolithic | 2 | 1 2 3½ | 6 |
| 36 | 200 | 3 | Monolithic | 3 | 1:3:5 | 6 |
| 37 | 200 | 3 | Monolithic | 2 | 1 2 3½ | 6 |
| 38 | 200 | 4 | Monolithic | 3 | 1:2:3½ | 7 |
| 39 | 200 | 4 | Monolithic | 4 | 1:3:5 | 8 |

* Hand mixed and machine laid.

All pavement sections were built 18 ft. wide. The subgrade and pavement surface were crowned 2 in. so that the thickness of each section is uniform throughout. Earth shoulders 6 ft. wide are provided on each side. The bottom of side ditches are uniformly 30 in. below the crown of the road.

### Subgrade Construction

The soil throughout is the typical Illinois corn belt "brown silt loam" which is a very uniform finely divided material. Great care was taken in preparing the subgrade under all sections so that it would have the same treatment throughout. To accomplish this end the entire subgrade was plowed to a depth of 8 in. and rerolled with a 10-ton roller a day in advance of placing the slab. The forms were then placed and the subgrade thoroughly soaked at the end of the day. In the morning the subgrade was trimmed by hand to the exact elevation required.

For the purpose of determining the uniformity of the subgrade under each of the 63 sections comprising the road, observations were made for moisture content and bearing power of soil under both static and impact loads at points 25 ft. apart along the center of the roadway. These observations were made immediately before pouring the concrete. In addition to the above, samples of the subgrade, secured from different points along the road, were sent to the U. S. Bureau of Public Roads for analysis and laboratory determination of bearing power.

A penetration machine devised by the Illinois Highway Department, and an impact machine devised by the Bureau of Public Roads, were used at each observation point. Further observations of the subgrade under the pavement slab are being made by means of the subgrade testing cylinders described in *Engineering News-Record*, June 30, 1921, p. 1116. Approximately 1,000 of these are in place in the pavement. The results of the observations made by means of these devices are thought to be of great value but are too extended to be given here.

TABLE II. BATES ROAD TEST SECTIONS OF CONCRETE

| No. of Section | Length, Ft. | Thickness, In. | Mix | Special Features |
|---|---|---|---|---|
| 40 | 200 | 9 | 1:2:3½ | None |
| 41 | 150 | 8 | 1:2:3½ | Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1). |
| 42 | 150 | 8 | 1:2:3½ | None |
| 43 | 150 | 7 | 1:2:3½ | Transverse joints every 25 ft. Longtitudinal joints full length of section. (See footnote No. 1). |
| 44 | 150 | 7 | 1:2:3½ | None |
| 45 | 100 | 6 | 1:2:3½ | Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 9-ft. sections. (See footnote No. 2). |
| 46 | 100 | 6 | 1:2:3½ | Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 16-ft. sections. Transverse rods passed through longitudinal joints. No longitudinal rods adjacent to longitudinal joints. |
| 47 | 100 | 6 | 1:2:3½ | Transverse joints every 25 ft. No longitudinal joints. (See footenote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 16-ft. sections. (See footnote No. 2). |
| 48 | 100 | 5 | 1:2:3½ | Special features same as Section 45. |
| 49 | 100 | 5 | 1:2:3½ | Special features same as Sec. 46. |
| 50 | 100 | 5 | 1:2:3½ | Special features same as Sec. 47. |
| 51 | 100 | 6 | 1:2:3½ | Wire mesh reinforcing used. (See footnote No. 3). |
| 52 | 200 | 6 | 1:2:3½ | None |
| 53 | 100 | 5 | 1:2:3½ | Wire mesh reinforcing used. (See footnote No. 3). |
| 54 | 200 | 5 | 1:2:3½ | None. |
| 55 | 200 | 5 | 1:2:3½ | None |
| 56 | 200 | 5 | 1:2:3½ | 4% calcium chloride incorporated in 125 ft. 2½% calcium chloride used in 75 ft. |
| 57 | 200 | 5 | 1:2:3½ | Cemite cement used. |
| 58 | 200 | 4 | 1:2:3½ | 4-in. rolled stone base course. |
| 59 | 200 | 4 | 1:2:3½ | Cemite cement used. |
| 60 | 200 | 4 | 1:2:3½ | 2½% calcium chloride incorporate). |
| 61A | 100 | 4 | 1:2:3½ | Hydrated lime 7½%. |
| 61B | 100 | 4 | 1:2:3½ | None. |
| 62 | 200 | 4 | 1:2:3½ | Longitudinal joint full length of section; ¾-in. deformed bars 5 ft. long and 10 ft. centers across longitudinal joint; ¾-in. plain round painted bar 6-in. from each outside edge of slab. Longitudinal bar along edge continuous through sections 62 and 63. |
| 63A | 150 | 7 | 1:2:3½ | Special features same as Section 62. |
| 63B | 50 | 7 | 1:2:3½ | |

Total.. 3,800

NOTE 1.—Transverse and longitudinal joints were formed by setting on edge strips of horizontally corrugated 16 gage galvanized iron 6 ft. long and 1 in. less in width than the thickness of the pavement. Width of corrugations 3 in.; depth 1 in.

NOTE 2.—All bar reinforcing, except in sections 62 and 63, consisted of ¾-in. round deformed bars placed 2 in. from the top of the slab and 6 in. in from the edges of the section with a 3-in. lap at intersection.

NOTE 3.—Weight of wire mesh approximately 45 lb. per 100 sq.ft. Total effective sectional area in square inches per foot parallel to center line and per foot of width was 0.087.

### Construction Details

All work was handled by force account. All materials and construction details conformed strictly with the general specifications in use by the department. Rigid laboratory control of materials was had and detailed records kept. As the comparative strength of different pavement thickness is the chief object sought, uniformity in materials, proportioning and construction methods were insisted upon. The temperature of the air, mixing water, quantity of water, and all other items thought to have any bearing were recorded. No materials were dumped upon or transported over the finished subgrade.

Extreme care was used to construct each section to the thickness specified. Excepting where a sand or mastic cushion was specified a variation of ¾-in. is rare. Except as noted the average variation from the specified thickness is $\frac{1}{16}$-in.

### Test Specimens

Nine 6 x 12-in. cylinders for compression tests and three 8 x 12 x 30-in. slabs for transverse breaking loads were made for each section involving the use of concrete. These specimens were cured in the same manner as the road. They will be broken in a calibrated testing machine to determine the strength characteristics of the concrete and the effect of age on the strength of the various sections at the time of truck loading.

### Chief Problems to Be Solved

Although the truck loading of the Bates road is expected to afford empirical data of the greatest value, it has been considered essential that all possible efforts be made to solve the fundamental problems of pavement design. With this end in view an extensive series of investigations have been planned and nearly all of them are well under way.

*Imposed loads.*—(1) The magnitude of wheel loads which must be provided for. (This probably will always be limited by law.) (2) The impact factor as determined by the degree of smoothness obtainable under practical construction conditions and with various tire, spring and wheel designs. (3) The position of wheel loads to produce maximum stress. (4) The area of distribution of wheel loads with various kinds of tires.

*Capacity to Transmit Loads to Subgrade.*—(1) How to design and manufacture pavement slabs to resist most effectively compressive, shearing and bending stresses. (2) The determination of safe working stresses for the materials commonly used for pavement slabs. This item involves a determination of the effect of repeated loads.

*Subgrade Support.*—(1) The effect of the character of the soil. (2) The effect of the moisture content of the subgrade soil. (3) The control of the moisture content of the subgrade soil. (4) The effect of repeated loads on the subgrade. (5) Means for increasing the natural supporting capacity of subgrade soils.

*Temperature Effects.*—(1) Causing direct stresses. (2) Indirect, causing stresses by affecting the condition of subgrade support.

It is believed that truck load limitations, based solely upon the economics of truck transport, including pavement maintenance costs, may never be fully determined or at least fixed by considerations of ultimate economy. Load limits are likely always to be arbitrarily fixed regardless of economic limits, because of the existence of large investments in previously constructed roads, which the public is not willing to sacrifice. It would appear, therefore, that the best we can hope for at present is to direct load limit legislation in accordance with our best judgment, while over a long period of years data on ultimate highway transport economics may be accumulated.

It is believed that refinements of construction and maintenance methods which are now being tried will result in much smoother pavements and will greatly reduce the danger from impact. It is believed, however, that it is of great importance to find a means for readily determining the value of the impact factor for actual pavements of different degrees of smoothness.

The position of wheel loads to produce maximum stress presents no difficulties when the subgrade problem has been worked out. The area of distribution of wheel load is a function of tire design and easily determined.

### Studies of Concrete

The design of concrete to produce reasonably definite abrasive, shear and compressive values is fairly well established. Professor Abrams of the Lewis Institute has undertaken the determination of the factors controlling the modulus of rupture of concrete and his bulletin may be expected shortly. It is believed that this is a matter of the utmost importance. An extended series of tests to determine the effect of repeated bending loads on plain concrete slabs is now under way in the laboratory of the Illinois Highway Department. Ultimately these factors must be determined for other types of rigid pavement slabs.

As to subgrade support, intensive research work has been under way in Illinois since October, 1920. Some 1,200 stations under pavement slabs are under observation. This investigation includes the effect of soil character, moisture content and repetition of loads, on the supporting capacity of the subgrade and means for controlling the moisture content. A repeated load subgrade bearing power determinator has recently been perfected and is now in use. Tentative conclusions are being checked by strain gage and deflection readings on actual pavement slabs subjected to both static and repeated loads.

The effect of temperature changes, as an indirect cause of stresses in a slab under load, has recently been found to be of surprising importance and is now under investigation.

It is planned to load the Bates road in the fall of 1921 if the test specimens show that the effect of the difference in age of the various sections is not great enough to lead to erroneous conclusions. The loading will be effected by passing trucks operated by trained drivers over the road. It is expected that batteries of at least ten trucks will be used for this purpose. A total of at least one thousand trips is to be made for each increment of load. It is expected that before the loading is started sufficient information will be at hand to make a reasonable prediction of the loads which will cause the first signs of failure of most of the sections.

The construction work was carried out by E. M. Fleming and R. R. Benedict, under the direction of B. H. Piepmeier, engineer of construction. The research work is under the immediate direction of H. F. Clemmer, engineer of tests, with C. A. Hogentogler, highway engineer, of the U. S. Bureau of Public Roads, co-operating.

MAIN FEATURES OF CONCRETE ROAD TEST SECTIONS

| Section | Thick., In. | Width, Ft. | Reinforcement: Longitudinal | Reinforcement: Transverse | Tons per Mi. | Subgrade | Remarks |
|---|---|---|---|---|---|---|---|
| A | 5 | 18 | ½-in. bar at center and each edge. . | ½-in. bars, 18 in. c. to c. . . . | 15 | Crushed rock, 1 ft. at center, 4 in. at sides | |
| B | 5 | 18 | ½-in. bar at center and each edge | ½-in. bars, 18 in. c. to c. | 15 | Adobe | |
| C | 6 | 18 | None | None | None | Adobe . . . . | Arizona type-section thickened to 9 in. at edges. |
| D | 8 | 20 | None | None | None | Adobe | Thickened to 1 ft., 8 in., at edge (inverted curb). |
| I | 6 | 18 | Two ½-in. bars at each edge | ½-in. bars, 7½ in. c. to c. | 69 | Adobe | Reinforcement at both top and bottom of slab |
| J | 8 | 18 | None | None | None | Adobe | |
| G | 5 | 18 | Two ½-in. bars at each edge | ½-in. bars, 7½ in. c. to c. | 69 | Adobe | Reinforcement at both top and bottom of slab (like section I) |
| H | 6 | 20 | Two ½-in. bars at each edge | ½-in. bars, 7½ in. c. to c. | 69 | Adobe | Reinforcement at both top and bottom. Slab thickened to 1 ft. 6 in. at shoulders (inverted curb). |

As to subgrade support, intensive research work has been under way in Illinois since October, 1920. Some 1,200 stations under pavement slabs are under observation. This investigation includes the effect of soil character, moisture content and repetition of loads, on the supporting capacity of the subgrade and means for controlling the moisture content. A repeated load subgrade bearing power determinator has recently been perfected and is now in use. Tentative conclusions are being checked by strain gage and deflection readings on actual pavement slabs subjected to both static and repeated loads.

The effect of temperature changes, as an indirect cause of stresses in a slab under load, has recently been found to be of surprising importance and is now under investigation.

It is planned to load the Bates road in the fall of 1921 if the test specimens show that the effect of the difference in age of the various sections is not great enough to lead to erroneous conclusions. The loading will be effected by passing trucks operated by trained drivers over the road. It is expected that batteries of at least ten trucks will be used for this purpose. A total of at least one thousand trips is to be made for each increment of load. It is expected that before the loading is started sufficient information will be at hand to make a reasonable prediction of the loads which will cause the first signs of failure of most of the sections.

The construction work was carried out by E. M. Fleming and R. R. Benedict, under the direction of B. H. Piepmeier, engineer of construction. The research work is under the immediate direction of H. F. Clemmer, engineer of tests, with C. A. Hogentogler, highway engineer, of the U. S. Bureau of Public Roads, co-operating.

## Build Concrete Pavement for Test To Destruction

### Slabs of Various Designs Included—Special Reinforcing Steel Developed—Trucks To Wear Out Pavement

A "RACE TRACK" or elliptically shaped roadway of plain and reinforced concrete is being constructed near Pittsburg, Cal., which is to be tested to destruction by operating over it motor trucks of various sizes and weights. The purpose is to determine by observation under the same conditions of wear and on the same subgrade, the relative merits of different materials and cross-section design and at the same time to develop, if possible, an improved type of plain and reinforced concrete pavement. In line with this latter purpose, two of the eight or more sections that will be laid will be reinforced with a special steel of very high tensile strength which is expected to strengthen the slab more than would be feasible even with an excessive amount of commercial grade steel.

The steel of high tensile strength was developed ex-

pressly for roadbuilding purposes by the Columbia Steel Co., of Pittsburg, Cal., which has undertaken the construction of the test pavement. In addition to the two sections in which the special steel will be used, as many other designs as possible have been sought from the state highway commission, county highway commissions, and individuals.

The appeal to popular interest has attracted much attention. Cement, sand and gravel are being contributed by interested firms, equipment for the construction has been loaned by manufacturers, a contractor has undertaken the work for the bare total of force account and expenses, all testing work is being done gratis by a local firm of testing engineers, and trucks for the test of the pavement will be operated by the Motor Car Dealers Association at their own expense.

The test is planned to develop data on the most satisfactory design of concrete pavement. The best methods of preparing and draining the subgrade were held to be matters so largely dependent on local conditions that each highway engineer will always have to solve these problems for each particular case and the proper treatment for the various soils, it was felt, should be left to the Bureau of Public Roads which is now conducting research along this line in California. The test road is being constructed on black adobe and provision is being made alternately to flood and dry out each section of the subgrade.

The test road will be 18 ft. wide on tangents and 20 ft. wide on curves, 1,370 ft. long on the center line and will comprise sections of pavement differing in design as well as in the quality and location of reinforcing. In accordance with other endeavors to secure the best concrete, the pavement is to be kept under water fourteen days and traffic will not be allowed on it for a total of forty-four days after pouring. In addition to surface inspection and tests, the flexure of the concrete slab and the tensile stress in the steel will be studied by means of instruments in four transverse tunnels built beneath the subgrade before paving was started.

At the outset of the traffic run, nothing heavier than 3½-ton trucks will be permitted. Later heavier trucks will be used and as sections of the pavement are destroyed temporary repairs will be made so the remaining sections can also be tested to destruction. It was expected that the pavement would be completed and ready for traffic tests by the end of July.

The research work is under the direction of Lloyd Aldrich, consulting highway engineer and J. B. Leonard, consulting structural engineer.

### Water-Works Publicity at Terre Haute

One of the advertisements run by the Terre Haute Water-Works Co. in the newspapers of Terre Haute on the occasion of the recent visit of the Knights of Columbus to that city was a quarter-page cut showing two curves. The first curve was of the constantly reduced typhoid fever death rate from 60 per 100,000 in 1909 to 4 in 1920. The number of consumers is shown below rising from 5,200 in 1910 to 8,200 in 1920. A note reinforcing the pictorial thought states: "As the number of city water consumers increases the typhoid death rate decreases." Another clipping from Terre Haute shows the picture of Dow R. Gwinn, president of the water company, as the eighth in a series of citizens "who are doing their part for the business progress of the city."

## Recent Developments at the University of Cincinnati

### Courses in Commercial Engineering, a Hobby Hour and the Hanging of Fine Paintings Among Innovations

AMONG engineers, as well as among educators, the University of Cincinnati is known as the home of the most important recent development in American engineering education. The co-operative system was inaugurated there by Dean Schneider fifteen years ago. The methods have been evolving year by year, and always in this period of development fresh inspiration was drawn from every visit to the university. Nor is there any change now, even though the organization and methods have been brought to a high degree of perfection. There is still the freshness of attack shown by the early experiments. What is more, the fifteen years of experience have brought a greater vision of the possibilities of the co-operative system.

The freshness of attack, the willingness to try promising proposals, is displayed in two innovations—one of a year's, and the other of two years' standing, the first being the introduction of a "Hobby Hour," and the second, the hanging in the corridors of fine examples of contemporary painting.

The broader vision is displayed by the application, beginning last September, of the co-operative method to a course in commercial engineering, and by the studies under way of proposed co-operative courses in architecture, in economic geology and in industrial management.

#### The Hobby Hour

The hobby hour is by far the more unusual and original of the two recent innovations. It grew out of Dean Schneider's constant effort to bring out the personalities of his students and to develop them into many-sided men. For fifteen years there has been close study of the aptitudes of the students and an effort to place them at work that would afford the proper stimuli for their development. Shifting of students from one type of work to an opposite type or from one course to another has been a frequent means of orienting misplaced individuals. It was therefore argued that if the students' interest could further be aroused by elevating their private hobbies to a new dignity, backward men would be brought out, individualities and personalities developed, and a valuable ally found in the effort to develop the students.

It was laid down as the basic principle that there should be leadership and assistance in the hobby, so that its value might be as great as possible. Whatever was to be done was to be well done. Every hobby was to be looked on not as a superficial activity—a means of wasting time—but as one warranting the students' best energies. In all cases, the college was to engage the instructors.

After full consideration, the idea was laid before the student body and enthusiastically adopted. It has been operative since November of last year. All activities are under the management of the Student Tribunal, which is the controlling body in the student government—a feature of many years' standing in the college.

The period from 1 to 2 is set aside every day as the Hobby Hour. The luncheon period is from 12:30 to 1, so that the noon intermission is 1½ hours.

Aside from those of an athletic character, there are, thus far, nine major Hobby-Hour groups: the Orchestra, the Glee Club, the Band, the Sketching, Camera, Literary, Wireless, Psychology, and Pekin clubs—the last a group for the study of Chinese customs and language. A group of good size is studying stenography, while among the lesser groups are the Psychology of Color, Advertising, Science of Government, and Chess clubs. Groups of two and three students are pursuing still other lines. The athletic clubs are numerous and strong, embracing football, baseball, basket ball, tennis, boxing, wrestling and swimming. Already there are plans for a Russian and an Arts and Crafts club next year. Each club meets two or three times a week so that a student can belong to more than one club. Some students were found to be without hobbies, and had to find them, in some cases shifting from club to club until they were satisfied.

Each group elects its own president and secretary. The university has engaged the leaders or instructors, sometimes from the faculty; sometimes from the town. The sketching instructor, for example, is a member of the art faculty of the university; the leader of the Pekin Club is a post-graduate Chinese; the instructor of the orchestra comes from the town.

The results have fully borne out the expectations. Backward men have been shown in a new light. Their keen interest in their hobbies has discovered their latent abilities to the faculty. Personalities have been emphasized and confidence developed. Moreover, as a result of the diversion, the students are found to be as fresh in the afternoon as in the morning.

An indication of the enthusiasm of the student body for the idea is afforded by the decision to establish next year a quarterly student magazine to be called the *Co-operative Engineer*, and to be published by the Literary, Sketch, Camera and Advertising clubs. It will be broadly representative of the college's activities and will not be a technical journal, differing in that respect from the magazine activities of most engineering colleges. It is being planned with very high standards, and the manuscripts and advertising copy already in hand give promise of a distinctive publication.

### Advertising as a University Problem

The proposed method of handling the advertising is especially worthy of mention. It was desired to get away from the charity appeal so common in soliciting advertising for college papers, and also to secure a rate that would fully support the magazine. It was decided, therefore, to attempt to give the advertiser something that he could use in his advertising in other mediums than the *Co-operative Engineer*. The "copy" will be based upon research along historical and scientific lines, done chiefly by the commercial engineering students as university problems.

As may be expected, doubt was expressed, when the Hobby-Hour idea was first proposed, as to the advisability of its adoption. As a result, however, of over seven months of operation the educational benefits have been found more than to justify the time expended. It is no longer looked upon as an experiment, but as a permanent part of the work of the college.

The second of the innovations is the establishment of the practice of hanging oil paintings of a high degree of excellence in the corridors of the college. This plan is also in pursuance of Dean Schneider's efforts to develop his students broadly. The hanging was begun about three years ago, and now there are some thirty paintings in the corridors of the college. So well have the selections been made that some of the paintings have already appreciated greatly in value.

No rule is laid down as to the subjects of the paintings. They run the whole gamut of artistic inspiration—landscapes and sea views, street scenes, character studies, and occasionally a treatment of an engineering subject. No effort is made to use them for instructional purposes, but their influence is apparent from the care with which the paintings are studied by the students. Whenever a new painting is hung it is the center of interest for months. Little groups discuss its technique, its general effect, and its shortcomings. The interest in art that has been stimulated is shown by the constant demand for the visitors' tickets sent to the college regularly by the Cincinnati Art Museum. Possibly a still better indication of the students' interest is the fact that all of the paintings, with a couple of excepions, have been presented to the college by the students themselves, through their clubs and class organizations. Only the purchase of the first few pictures was stimulated by Dean Schneider.

### Commercial Engineering

In the development of the co-operative system the most important recent step has been the introduction of a co-operative course in commercial engineering, which dates from last September, though some work had been done in this direction in the year that preceded. The new course was introduced in response to a clearly expressed demand. It was found that many of the graduates of the regular engineering co-operative courses were being drawn into executive work. Upon examining the work of these graduates and studying, broadly, the type of training that would best fit men for executive places in industries having an engineering basis, it was decided to develop a three-year commercial course resting on a foundation consisting of the standard first two years of the co-operative course. In other words, the commercial engineering students take the same work in their first two years as do the students in the usual engineering courses.

The specific purpose of the last three years is to turn out men who are prepared to aid in developing the marketing side of industry. That being the case, no courses are given in retail selling. The work is specialized in the direction of factory marketing.

The courses are built upon a study of world resources. Courses in geography, dealing with climatic and topographical conditions, minerals, and agricultural products, lead up to a study of the psychology and history of nations. Strong emphasis is laid upon the social and economic development of England and the British Empire, to a careful survey of the leading European nations since the Congress of Vienna, and of the economic and social development of the American nation. Such things as the rise and spread of democracy, the industrial revolution, the rise and spread of trade unionism, the balance of power, etc., are pursued as a necessary part of the equipment of an executive who is looking to the best possible marketing of his product, and at the same time to secure greater stability through diversification of outlet.

As part of the foundation, also, are special courses in

mathematics, including calculus and the theory of variations, terminating in a course in statistics. Preliminary to the latter, special attention is given to the interpretation of formulas and the making of slide rules.

Following these, geographical, historical, and statistical studies are the courses in accounting, economics and finance customary in collegiate business courses.

As in the regular engineering courses, the co-operative system is applied throughout the course. During the first two years the student spends half of his time in shops. Here the future commercial engineer gets a familiarity with production methods. He learns how the products he must sell are made. Then, when the regular engineering students are being graduated from the shop into the planning, design, and research departments, the commercial engineering students go into the accounting, the stock, the buying, the cost, the promotion, and the sales departments. In the first two years the alternations are by two weeks' periods. In the last three years, by monthly periods—which, by the way, is now standard also for the final three years of the regular engineering course. (Until recent years the alternation for the entire course was in bi-weekly periods).

The industries in which the co-operative commercial students work are quite as varied as those in which the regular engineering students are employed, and include packing, publishing, advertising, banking, and the manufacturing of many products, from paper cartons and soap to machine tools. The course has met with quite as hearty response from the industries of Cincinnati as has the regular engineering course. One of the most gratifying experiences has been that the banks took the initiative in asking that co-operative students be placed with them. During the discussion as to the type of training needed for banking work, the bankers insisted that no change be made in the course, for, they contended, the banker needed to know quite as much about production and marketing as he did about the intricacies of finance.

As with the other co-operative engineering students, the commercial engineers must throughout their course submit bi-weekly reports on their field work together with complete semestral summaries. Each man is given from twenty minutes to half an hour to present the semestral report, after which it is fully discussed by himself and by his fellow students. Reports examined at the university last month indicated a remarkable grasp of the industries in which the students are working.

### Other Developments

Last year 900 co-operative students were enrolled in the Engineering College of the university, and the number expected next year is 1,100. As in all previous years, applications for admission are in excess of the number that can be accommodated.

Year by year the area covered by the co-operating industries has increased. During the last year co-operative students were located in industries in Pittsburgh, while next year there will be co-operating industries in Chicago and Milwaukee as well. In general, the co-operating zone is considered to be any point that is within an overnight ride from Cincinnati, embracing, in general, Pittsburgh on the east, Chicago on the west, Cleveland on the north, and Chattanooga on the south. The students in factories at the greater distances are those in the third, fourth, and fifth years, when the alternation is in monthly periods.

The college now has under consideration the introduction of co-operative courses in architecture, economic geology, and in industrial management. The expected introduction of these courses is due to the policy of the university of regarding itself as a service department of the city. It proposes, as far as its resources allow and the demands are clear, to meet the needs of the industries which make up the life not only of the city but of the territory tributary thereto. It is this point of view that promises continued broadening of the work of the college and of the application of the co-operative idea.

### Conclusion

It was stated in the first paragraph, there is still the same inspiration to be derived from a visit to the University of Cincinnati as there was in the days when the co-operative scheme was in its infancy. The innovations and developments here set forth should indicate to the reader that this statement was fully justified.

E. J. M.

## When Water-Works Conduits Ran Wine

IN THESE dry days a tale of water-works conduits that "ran with Claret Wine" seems like a fairy tale; but it is merely a true "tale of the olden time." It was on Jan. 1, 1684, in the old city of Lincoln, England. The days of Cromwell and the Puritan Commonwealth were fading from memory. Charles II had granted the city of Lincoln a new charter under which, according to a paper by Charles Horobin, water-works engineer of Lincoln, read before the Institution of Water Engineers, the city was granted the right "to hold a fair for horses and all manner of things [note the omnibus clause] in April of each year." The charter having been brought to the city by Sir Thomas Huffey, accompanied by several "Deputy Lieutenants and other Gentlemen of Quality," the royal document and the party bearing it were met, according to the London *Gazette* of 1684,

> . . . without the City gate, by the Mayor, Aldermen and Common Council-men in their formalities, and by about 3,000 of the inhabitants of this City and liberties thereof; and from thence proceeded to the Town Hall, and trained Bands being in arms and drawn up on both sides of the streets through which they passed, the bells ringing, music playing and the people expressing their satisfaction with repeated acclamations. Being come to the Hall the Charter was read by the Town Clerk, and the Mayor, Aldermen and Sheriffs were sworn, which being done, the whole company went and drank the King's Health at the first Conduit *which ran with Claret Wine from one o'clock to six at night*, and the Gentlemen were entertained by the Mayor at a very Noble Dinner; after which they all drank the Duke's Health at *the other conduit, which likewise ran with Claret Wine during the said period;* the whole concluding with Bonfires and ringing of Bells. [Italics ours.—Editor.]

Nothing just like this has ever been recorded in American water-works history, so far as known records show, but tradition has it, and it is thought that there are those living who can attest it as a fact, that years ago, at one of the annual conventions of the American Water Works Association, there was a fountain from which there flowed, except water, every kind of drink that any reasonable man could wish.

*Practical Hints on Erection, Operation and Maintenance*

# Concrete Chuting Plants

*THERE are brought together in this article hints as to the best methods of erecting, operating and maintaining concrete chuting plants. These are the crystallization of the best experience of users and manufacturers. Information of this kind is particularly valuable now because chuting plants are no longer mere collections of odd units, but are well thought out machines, in which every part has been carefully designed for its special work. With such highly developed plants, the greatest economy can be secured only by skill and care in erection, operation and maintenance. It is with the idea of telling what has proved to be the best practice that this article has been prepared.*—EDITOR.

THERE are two types of concrete chuting outfits in use, (1) boom plants under which may be classified unit plants and (2) continuous line plants. The continuous line plant has cable-supported chutes. It is the original form, but has been perfected by including improvements developed in the boom plant.

The boom plant is used almost entirely for building work, and, it is worth noting, is probably the largest machine built commercially for handling concrete. Fig. 1 shows the various parts and the diagram, Fig. 2, indicates the variety of chute ranges. The great range—the chief advantage of the chute system—is apparent from the drawing. The unit plant differs from the boom plant in that it has no separate boom. The first section of the chute is trussed and a head line as shown by Fig. 3, is used. This type of plant is of a simpler design and as a general rule is less expensive than the boom plant, although it requires about 10 ft. more head room to maintain the proper angle for the head line.

For continuous line plants, which are best suited to bridge and dam construction and other types of extensive operations, the arrangements are more varied. The diagram, Fig. 4, is a simple example. Here counterweight chutes, developed primarily for boom plants, are added to give the chutes range beyond the line of the supporting cable.

## Plant Construction

Both steel and wood towers are used for chute plants. Although sectional steel towers are the most economical in the long run, there are still more wood towers used than steel. The life of a wood tower is limited to two or three jobs; the steel tower, with ordinary care, should be good for an indefinite number of jobs. The first cost of a steel tower is greater than that of the wood, but the steel tower effects a saving in erection and dismantling cost which pays for it on three or four jobs. Wood towers may be bolted or spiked; the salvage is greater with the bolted. A good average figure for replacement on a wood tower is 35 per cent for erection. Steel towers are built in sections of 15 or 20 ft. Each tower has a standard bottom section which contains the tilting chute and swivel sheave and a top section which contains the necessary top sheaves. It may be increased or decreased in size by adding or subtracting standard intermediate sections. All steel towers are fabricated to template so that the various parts are interchangeable.

Whether using wood or steel towers, the rule for determining the maximum height of the tower required is as follows: "Take the maximum height at which concrete is to be poured above the tower base and add to this one-third of the distance through which the concrete is to be chuted, which takes care of the necessary fall in the chute line. To this sum add 20 to 30 ft. for necessary tower head room."

There are two general types of chute sections, the half-round and the egg-shaped. Each has its particular advantages and each fills all general specifications. Any chute 12 in. or 14 in. wide and at least 8 in. deep will handle all the concrete that it is practicable to hoist into it, *under average conditions*, if placed on a slope of one vertical to three horizontal, the recommended slope for chutes.

Chutes are now used in the construction of dams and other massive structures where plum stones were formerly used, it having been found that a 1:3:6:3 mix can be thus employed and handled at a considerable saving in cement. By this mix is meant one part of cement, three parts of sand and six parts of stone passing through a 2-in. screen and three parts of stone passing through a 4-in. screen.

The standard chute made by various manufacturers in this country is, at the present time, 12 or 14 gage metal. The heavier chute means longer life and the length of life of a chute depends entirely upon the type of aggregate used in the concrete. Gravel is comparatively easy on chutes but trap rock or very sharp, hard sand shortens the life of the chute considerably. The method used for prolonging the life of a chute is relining. These reliners can be placed in the chute at the factory or later on at the job. They consist of a sheet of metal shaped to conform with the chute and of the same thickness as the chute. This reliner covers that part of the chute which comes in contact with the concrete.

It is very hard to state definitely the length of life of a chute in cubic yards of concrete as it depends upon so many different factors. As a general average, the 14-gage chute has a carrying capacity of between 8,000 and 10,000 cu.yd.

Chute connections are a very important feature of chuting equipment. They are of two kinds: one for continuous line chute where no change in direction is required nor swiveling action necessary, and one for boom, unit and continuous line plants where swiveling is a necessary requirement. The purpose of the first type of connection is to provide flexibility in the chute line. It should be easy of attachment and not change or interrupt the flow of concrete. The purpose of the second type is to provide means for swiveling so that the concrete can be poured over a considerable area from the end of the chute. This chute connection should be designed to reduce splashing to a minimum, provide a stable support to prevent the chute from tipping, and to give, as near as possible, no interference to the flow of concrete. In selecting any chute section it is advis-

able to see that the chute is so designed that either type of connection can be removed or attached at will, as the chute on one job may require a continuous line joint, and on another job, the other type.

There are certain relations between the size of mixer, size of elevator bucket, and size of tower hopper which should govern the selection of a plant. The table below gives a suggestion as to this relationship.

| | | | |
|---|---|---|---|
| Size of mixer | 11-S | 21-S | 28-S |
| Size of bucket | 14 cu.ft. | 22 cu.ft. | 28 cu.ft. |
| Size of hopper | 20 cu.ft. | 30 cu.ft. | 40 cu.ft. |

In general, the rule may be stated in this fashion. "The working capacity of the elevator bucket should correspond with the wet batch capacity of the mixer. The tower hopper should be at least 50 per cent greater in working capacity than the elevator bucket to allow for unforeseen holdups in pouring, and additional storage capacity."

### Plant Location

While the conditions are so divergent that it is impossible to lay down specific rules on plant installation, there are certain general rules which should be followed in so far as possible:

1. Since the cost of handling materials behind the mixer is of equal importance to the cost of handling the mixed concrete, the receiving and handling of cement

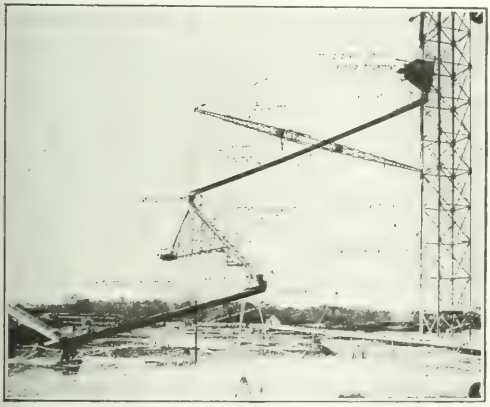


FIG. 1. A TYPICAL BOOM CHUTING PLANT SHOWING METHOD OF EXTENDING RANGE

and aggregates should be convenient to the mixing and hoisting plant.

2. It is desirable to locate the hoist tower in a central position so that the semi-circular radius of action of the boom can be utilized to full advantage.

3. The maximum efficiency of operation of boom plant equipment is confined to placing concrete within 130 to 160 ft. of the tower base. Where the reach is in excess of this distance, study is required to determine whether it would be more advantageous to chute the concrete into floor hoppers located at central points and within 130 ft. from the base of the tower and to handle it from these hoppers to the far portions of the work in buggies, or to attempt to cover the far portions of the work directly from chutes, using the more or less troublesome floor supports that would be required.

4. To warrant the installation of a steel-tower, quick-shift, counter-shift, counterweight-chute plant, the work should contain at least 4,000, or better 5,000 cu.yd. of concrete.

5. Where a building is so large that it is not possible to cover the entire work from one tower, the yardage of concrete will determine whether a two-tower plant should be installed or whether a one-tower plant should be used and buggies be employed as an auxiliary means of distribution.

6. The height of work does not offer serious difficulty as steel towers are now being constructed to heights

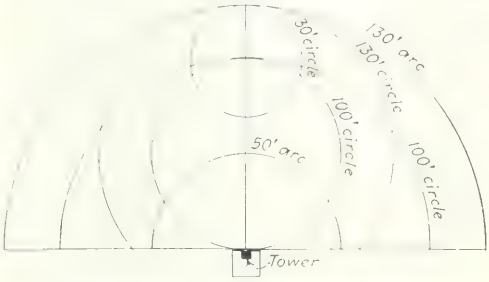



FIG. 2. DIAGRAM SHOWING VARIETY OF RANGES OF A BOOM PLANT

as great as 240 or 280 ft., this height covering the exceptional job. The ordinary building can be covered by a tower 200 ft. or less in height.

There are, of course, occasional construction operations involving the placing of large yardages of concrete which cannot be covered by general rules. In such cases it is wisdom to call into consultation experts who have had a wide experience in the handling of special work.

### Plant Erection

Towers, whether of wood or steel, should be guyed at 40-ft. intervals, these guys to run off to suitable anchorages at a slope of not less than 45 deg. with the vertical. Turnbuckles, with shackles, should be inserted at both the tower and anchorage ends of the guy lines; the turnbuckles make it possible to take up slack in the guys for the purpose of plumbing the tower and the shackles make it easy to "slip" a guy line either for the purpose of allowing a boom to swing, or for clearing some obstruction.

A crew of seven men and a foreman should erect 80 ft. of tower per day and set the guys. The dismantling of the equipment can be accomplished in approximately one-half the time required for erection.

It is always advisable to have the hoisting engine on the job before the erection of the tower is commenced so that it will not be necessary to lift the tower parts by hand. First the bottom frame of the tower is set in place and the four lower corner posts are bolted into position and held together by the required struts and diagonals. All that is necessary for handling subsequent members, as the work gets away from the ground, is a light wooden gin pole about 16 ft. long, having a heavy spike in its lower end. The spike fitting in between tower members, will provide a good swiveling support for the pole, which is set within the tower and leaned over so that the upper end is outside and in a suitable position for hoisting the tower members.

All bolting of gussets and small members should be

done on the ground so that mid-air work may be held down. Experienced iron workers will have no trouble in getting the various parts together since similar parts are interchangeable. The heaviest members are the corner posts which are 20 ft. long.

The one caution in connection with the erection of a steel tower refers to the tightening of the bolts. While all bolts should be put in place as the tower progresses in height they should not be tightened, this tightening should be postponed until the tower has been carried to its full height and plumbed, after which the erectors will go over it making sure that all bolts are properly tightened. After the tower is in place the sliding frame fixtures are put on the tower at ground level and the tower hopper is bolted into place at a convenient elevation. The boom is then erected on the ground and the sliding frame is raised sufficiently to allow the boom hinge connection to be put in at ground level. The boom is then rigged at the proper inclination and the entire plant lifted to an elevation convenient for attaching the counterweight chute, this counterweight section likewise having been completely assembled on the ground. By this method there is practically no mid-air work after the tower has been erected.

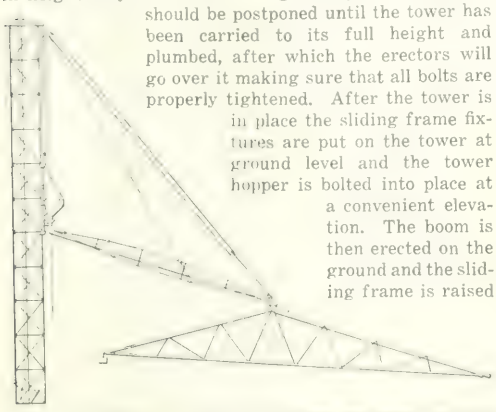


FIG. 3. TYPICAL UNIT PLANT WITH TRUSSED CHUTE REPLACING BOOM

In building a wood tower, carefully constructed templates should be made exactly in accordance with the tower drawings. These templates should contain the exact location of all bolt holes. If possible each timber should be marked with a number. In other words, the corner posts should all bear one number, the cross braces another, sway braces another, and so on. By so numbering, the workmen who are erecting the tower can signal for a certain piece of timber and be assured that when it is sent up it is the proper piece. One of the most important things in erecting a wood tower is the guying, and at the time of starting to erect the tower, the first thing that should be done is to locate the guy anchors or deadman in order that there may be no excuse for continuing the building of the tower without guys because no anchorages have been provided. When the tower has reached the height of between 35 and 40 ft. the first set of guys should be attached. If the contractor plans to use his wood tower on two or three jobs it should be of bolted construction.

Continuous line chutes are made in lengths of 10, 20 and 30 ft. A continuous line chute connection should be placed at least every 30 ft. in the line, and the chute line should be supported by manila rope from the main cable at least every 30 ft. and preferably every 20 ft. The overhead cable should be of plowsteel. The supporting ropes should be ¾-in. manila. A double 6-in. wood block and a 6-in. single wood block should be used with the manila rope for supporting the chutes. The chutes are equipped with hangers for attaching the supporting ropes.

The sketches in Fig. 5 show two methods for connecting the manila ropes to the overhead cable. The overhead cable may be firmly lashed to the top of the hoist tower at the point where it crosses the tower and the back kick of the line can be taken care of independently, or the overhead cable can be run on a set of rollers over the top of the tower into a dead man. Both methods are used in actual practice and both methods are satisfactory. The sag in the supporting cable should be from 8 to 12 per cent. The approved method of placing long lines of cable-suspended chutes, is first to put up the chute suspension cable and then to put the chutes in place at ground level, one by one, pulling the entire line up toward the tower as the line of chutes is lengthened. Standard trolleys which ride on the suspension cable can be obtained for this purpose. These trolleys are held in their proper position on the cables by a spacing line. Running the chutes up on the suspension cable rather than lifting them vertically into place, as is sometimes done, saves a considerable amount of labor.

## Plant Maintenance

Depreciation of modern steel-tower gravity-plant equipment is confined almost entirely to the chutes, there being otherwise only the rollers on the hoist bucket to wear and practically nothing on the tower, tower hopper or boom. The amount of concrete which a chute will convey before becoming worn out depends upon the aggregate. A trap-rock aggregate is more severe in its action than a gravel aggregate. As a general average, the carrying capacity of an ordinary 14-gage chute runs between 8,000 and 10,000 cu.yd. Where it is known that a given set of chutes will have to handle more than this amount of concrete on one installation, the best practice is to have interliners of like weight put in the chutes at the time of their manufacture. These liners extend up on the sides of the chutes only as far as the concrete normally piles in transit.

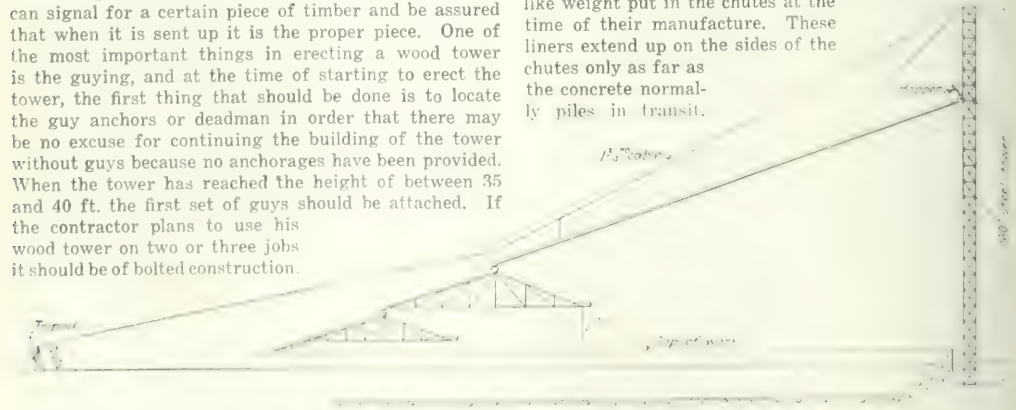


FIG. 4. ELEVATION OF A TYPICAL CONTINUOUS LINE PLANT

At a time when the original unlined chute would be worn out only the liner plates on the lined chutes will have become worn through. It is relatively simple and inexpensive to replace these plates, thus making the chute sections practically as good as new.

To hold down the depreciation of chutes, they should be handled with reasonable care so they are not dented (a high spot in a chute very soon results in a hole) and

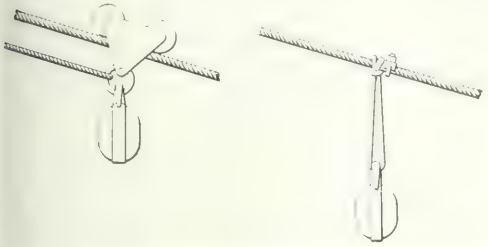


FIG. 5. HANGER CONNECTIONS TO SUSPENSION CABLE

they should be kept clean. The approved method of keeping the chute lines clean is either to run a water line to the tower hopper or to elevate water in the hoist bucket, and flush the chute line whenever operations are to cease for a period in excess of half an hour. The addition of liners of course makes the chutes stiffer and reduces the chances that they may become dented. Chutes, as they leave the manufacturer, are ordinarily painted on the outside and given a slush coat of heavy oil on the inside, it having been found disadvantageous to paint the inside because the paint, until worn off, seriously retards the flow of concrete. When equipment is to be laid up for the winter, good practice indicates that the painted parts be repainted if they have been weathered to any considerable extent, and that the inside of the chutes be covered with a slush coat of heavy oil.

## Plant Costs

Cost varies with the character and extent of the equipment. The cost of a specific installation and of a representative operation are, therefore, as truly indicative as are general figures, which have to be qualified in many ways. Any cost figures it may be repeated are merely indicative. Absolute costs cannot be given. These warnings must be kept in mind in studying the examples cited.

The cost of a 160-ft., 1-cu.yd. batch steel tower determined on a building operation in New York City in July, 1920, was:

| | | |
|---|---|---|
| Steel tower | | $2,325 |
| Blocks and cable | | 325 |
| Erection at $1.50 per ft. | 240 | |
| Dismantling at 50c. per ft. | 80 | |
| Depreciation 5 per cent on $2,650 | 133 | |
| Trucking | 50 | |
| Total fixed charge | | $3,153 |
| Total charges — 1st job | | $3,153 |

An estimate of the cost of a timber tower for the same operation is as follows:

| | | |
|---|---|---|
| Cable and block | | $325 |
| Lumber (50 bd. ft. per running ft. at $80 per M.) | 640 | |
| Framing at $1.50 per ft. | 240 | |
| Bolts and nails at $1.25 per ft. | 200 | |
| Tower before erection | | $1,080 |
| Tower erection: $1.50 per ft. | 240 | |
| Dismantling at $1 | 160 | |
| Depreciation at 50 per cent of $1,405 | 703 | |
| Trucking | 50 | |
| Fixed charges | | $1,103 |
| Total charges — 1st job | | $2,558 |

As an example of operating costs the Gardner-Lucas Building, New York City, is selected. This building was constructed in 1920. It required about 8,000 cu.yd. of concrete and the organization was as follows:

| | |
|---|---|
| 1 foreman at $1 per hour, per day | $8 00 |
| 1 hoisting engineer at $1 per hour, per day | 8 00 |
| 1 mixer engineer at $1 per hour, per day | 8 00 |
| 1 laborer on sand at 60c. per hour, per day | 4 80 |
| 1 laborer on gravel at 60c. per hour, per day | 4 80 |
| 2 laborers on cement at 60c. per hour, per day | 9 60 |
| 1 laborer on hopper at 60c. per hour, per day | 4 80 |
| 1 mixer operator at 70c. per hour, per day | 5 60 |
| 1 mixer helper at 60c. per hour, per day | 4 80 |
| 2 laborers spreading, 60c. per hour, per day | 9 60 |
| 2 chute handlers at 60c. per hour, per day | 9 60 |
| | $77 60 |

The average day's run was about 300 cu.yd., making the cost of mixing and placing about 25c. per cubic yard. The average mixing and placing cost for the entire job was 36c. per cubic yard.

A man with a buggy will average 12½ cu.yd. per hour, or 20 cu.yd. an eight-hour day. It would require fifteen laborers to place 300 cu.yd., one laborer would be required on a floor hopper, and four to move runways. So on a similar job using the buggy method, the organization would be as follows:

| | |
|---|---|
| 1 foreman at $1.00 per hour, per day | $8 00 |
| 1 hoisting engineer at $1.00 per hour, per day | 8 00 |
| 1 mixer at $1.00 per hour, per day | 8 00 |
| 1 laborer on sand at 60c. per hour, per day | 4 80 |
| 2 laborers on gravel at 60c. per hour, per day | 9 60 |
| 1 laborer on cement at 60c. per hour, per day | 4 80 |
| 1 laborer on tower hopper at 60c. per hour, per day | 4 80 |
| 1 mixer operator at 70c. per hour, per day | 5 60 |
| 1 mixer helper at 60c. per hour, per day | 4 80 |
| 15 laborers — buggies at 60c. per hour, per day | 72 00 |
| 1 laborer, floor hoppers, at 60c. per hour, per day | 4 80 |
| 4 laborers, runways, at 60c. per hour, per day | 19 20 |
| 2 laborers, spreaders, at 60c. per hour, per day | 9 60 |
| | $164.00 |

With an average day's run of 300 cu.yd., the cost per yard for mixing and placing would be 53c. by using the buggy method with necessary crew.

## Conclusion

Concrete gravity plants are machines for placing concrete at any point in a considerable horizontal area, at any elevation. Mobility and permanent construction are necessary if the machine is to be employed on several operations and this repeated use is essential to economy of plant investment. Proper installation, perfect maintenance and skillful operation are required for maximum production. These call for intelligent mechanical direction and experienced machine operators.

---

## Testing Wearing Qualities of Shovels

Tests upon the various alloyed steels in order to determine the best steel to use for the manufacture of shovels have been carried on recently by the Wood Shovel & Tool Co., Piqua, Ohio. The tests determine not only the wear on the edge of the blade, but also the wear on the surface of the blade, the strength of the weld, toughness of the steel and the durability of the straps. The testing machine was designed with a rotating axle and four arms in which the shovels were fastened. The machine is driven with a 3-hp. motor with the speed reduced to 14 r.p.m. The shovels were forced through more than 3 ft. of red granite rock. Over 125,000 revolutions through the granite rocks, or a distance of more than 75 miles, were made by some of the steel shovels without the blades breaking or straps pulling loose. Based on the tonnage of material handled per shovel, this indicates that one shovel would have handled 3,400 tons.

# Thirty Years' Engineering Service for District of Columbia

## Asa E. Phillips, Resigning as Sanitary Engineer, Reviews His Work and Outlines Recent Difficulties

IN RESIGNING, effective Aug. 16, as sanitary engineer of the District of Columbia after thirty years' of engineering service, Asa E. Phillips presented a review of his work in the design and construction of sewers and sewage disposal works for the district and adjacent territory and in supervising, of late, the underground construction work of public service corporations. At the close of his review Mr. Phillips stated some of the difficulties he had met and the heavy burden he had carried in recent years because of a limited underpaid engineering staff. At the beginning of his letter of resignation, addressed to the engineer commissioner of the District of Columbia, Mr. Phillips stated that the present is a favorable time for him to resign, because of the excellent condition of existing works, the "limited outlook for new works" and the "lack of any appropriations for the sewage disposal system," and gave the condition of his health as a specific reason for resigning. He stated that he had served under 12 of the 16 engineer commissioners of the district, and that this was a longer term than that of any other department head in the district government. Mr. Phillips' review of his services is here given in full, as follows:

1891-1894—Principally subsurface surveys and large scale map construction of the drainage system of the district. This was the first set of 50′ = 1″ maps, followed later by the preparation of similar sets for highways, water mains and electric conduits.

1894-1898—Plans and estimates for new drainage works and construction of new works.

1898-1900—Rainfall and run-off studies, hydraulic data and experiments, including what are believed to be among the earliest studies along the line of what is now called the "rational method" of drainage computation; at the same time continuing the usual current work on new plans and carrying on construction work.

1900-1908—Engineer in charge of designs, estimates and construction for the sewage disposal system including the main sewerage pumping station and its mechanical equipment and all other works except the F St. interceptor and the Tiber Creek and New Jersey Ave. high-level interceptor, begun before this period.

### Inception of Greater Sanitary District

1908-1921—Head of the sewerage division, engineer department, first as superintendent and later as sanitary engineer, including charge of underground construction of public service corporations. The work of this period has included studies and plans and partial construction of the enlarged sewage disposal system, from its original limits within the old city of Washington so as to include the entire district; and also the inception of a greater sanitary district, including those areas of Maryland which are a growing source of pollution of the park streams of the district.

It has included the expansion at the same time of the sewerage system to serve the outlying areas as far as the district line from Potomac Heights to Chesapeake Junction; this permitting the development of the many healthful and attractive suburban areas.

The supervision of underground construction of the public service corporations has been carefully organized along a systematic plan of location with accurate record sheets and mapping, under an equitable arrangement of cost construction with these corporations.

In the business and congested downtown area two important developments have been accomplished: The providing where required of deep service sewers independent of the ordinary combined storm and sanitary system, for important business structures with the cost borne entirely by the properties benefitted; and the mapping on a very large scale, from careful subsurface surveys of all underground construction, making a set of model charts whereon in appropriate colors these intricate structures are accurately set forth. In these particulars Washington has set a standard not attained, it is believed, by any other American city, and both without any additional expenditure of public funds.

The maintenance of a sewerage and drainage system in which $20,000,000 is invested is a very important work. In 1908 was first inaugurated a complete annual inspection of the interior of all trunk sewers with systematic and thorough recording of all structural defects, accompanied by a continuous inspection of the smaller lines. This work, involving the detailed examination of 700 miles of sewers, is so arranged and timed as to require only the services of the normal force by utilizing its period of seasonal winter inactivity. One of the first fruits of this new work was the detection of the impending failure of the great 30-ft. span Tiber sewer under the heavy Union Station Plaza fill and the prompt reconstruction of this great storm sewer by day labor forces working from the interior without surface excavation narrowly averted what would have been a serious disaster. Regularly these inspections are followed up with prompt repairs throughout the system.

### Division Lacks Technical Personnel

Much of the drainage system of the District of Columbia, as it now exists, is fragmentary and incomplete, the result of growing inadequacy in the allotment of funds. The work done has been carried on under great and increasing difficulties due to the impossibility of maintaining a capable personnel with the meager rates of compensation allowed for technical assistants. There was a time, years ago, when four of the six or seven major engineering colleges of the country had graduates in responsible charge of work in this division; with a number of graduates of the minor colleges also; today, the sanitary engineer does not have as assistants a single graduate from the major colleges of engineering and has only two assistants with any engineering degrees. It is not at all intended to indicate that the grade of the institution determines the capacity of the graduate, yet the situation as set forth in a work whose technical detail is of primary importance, involves a danger that should not be overlooked, and has resulted in a great and unreasonable burdening of the sanitary engineer. How great may be measured by the fact that there is not a single drawing involving any elements of engineering design on the records of this department for very many years past which covers construction work costing more than $10,000,000 and involving structures of every sort, simple and complex, which has not been worked out in detail personally by the sanitary engineer.

With his supervisory duties involved in the design, construction, maintenance and operation of a very large and somewhat complicated drainage and disposal system, to say nothing of the inception and development of projects, the preparation of estimates and the administration of sewerage appropriations, the lack of technical assistance in this tedious and time absorbing detail has been an added burden that for years past has strained him beyond reasonable limits. An example of this manifest deficiency is found in the drafting force where the highest annual salary allowed is $1,200, or a rate of about $4 per day, less than the rate allowed pick-and-shovel men in the trenches. With such rates of pay it is manifestly impossible to secure men capable of performing the services demanded by the work involved.

In conclusion I desire to express my appreciation of the earnest and sincere labors of the entire personnel under my direction; in some instances they are rendering a service unexcelled in any other like organization and entirely disproportionate to the compensation allowed them.

# Engineers Seek Data on Pressure Tunnel Construction

## Committee Appointed by Swiss Railroads Investigating Causes and Remedy for Failure at Ritom Plant

*Prof. A. Rohn of the Zurich Polytechnic College, one of the five members of a committee of engineers appointed by the Swiss Federal Railroads to investigate the failure of a pressure tunnel at the Ritom hydro-electric plant in May, 1920, has requested the "Engineering News-Record" to publish a questionnaire, and explanation, that the committee has addressed to hydro-electric plants and their engineers in various countries, regarding pressure tunnel construction. The subject will readily be recognized as important and one in which an international effort to secure information should be valuable. It is requested that replies be addressed to F. Rothpletz, Spitalgasse 24, Berne, Switzerland, chairman of the committee of experts appointed by the Swiss railways.*—EDITOR.

NEAR the St. Gothard line the Ritom hydro-electric power station was erected by the Swiss Federal Railroads, designed to supply power for electric traction on this line. In May, 1920, the pressure tunnel carrying the water from the Ritom Lake to the pressure pipe line was filled for the first time and was found to be leaking. The internal water pressure is 54 lb. per sq.in. at the upper end, 65 lb. per sq.in. at the lower end of the tunnel. Some days after it was filled several springs began to flow on the mountain slope just outside the tunnel, where water had never been previously observed. A few days later, an earth slide occurred at another section of the slope, threatening the pipe line. Where the earth slide had started, several springs appeared. When the tunnel was emptied, all the springs ceased at once to flow, and it was therefore evident that it was not tight. The tunnel and water chamber are completely lined with concrete, with a smooth, water-tight cement finish, according to the statement of the committee of experts appointed by the Swiss railroads to study the subject. A thorough inspection of both revealed a great number of very small cracks which were for the most part longitudinal.

The investigating committee has stated that the quality of the concrete used for lining the tunnel was good and that the smooth cement finish of the lining had been well applied and had set very well; that the concrete lining had been brought close to the rock and that in all places where cavities between concrete and rock could be expected the cavities had been "mostly filled with cement grout." The cracks and leakage in the tunnel and water chamber could not, therefore, be attributed to faulty construction, according to the committee, since water could have gone only through these cracks. It is concluded that there are causes leading to the formation of cracks which have not hitherto been sufficiently known, as, for instance, a certain yielding of the rock.

In order to avoid a long stop of the entire plant, all the cracks were sealed and the tunnel again put into service, but the pressure at the lower end had to be kept within 14 lb. per sq.in. From that time until the committee sent out the questionnaire no further leakage has occurred.

The pressure tunnel of the Ritom power station is about 5,800 ft. above sea level and is 2,800 ft. long on a grade of 0.7 per cent. It passes along the mountain side, but lies at least 133 ft. under the rock surface. The rock through which the tunnel is cut consists mostly of small-banked, rather soft mica schist and very micaceous gneiss. The inclination of the strata is about 45 deg. and it crosses the axis of the tunnel at an angle varying between 30 deg. and 60 deg.

In view of the fact that the Swiss Federal Railroads are constructing other similar tunnels and will have to construct more of them in the future, the general management has appointed a committee of experts, which has issued the following questionnaire addressed to engineers and others associated with the design, construction and operation of other hydraulic pressure tunnels:

1. When was the tunnel built and how long has it been in service?
2. What is the length of the tunnel or shaft?
3. What is the grade of the tunnel (give longitudinal profile if possible) and what is the highest and lowest water level?
4. What are the minimum and maximum pressures in the tunnel or shaft in pounds per square inch?
5. What is the cross-sectional area of the tunnel or shaft in square feet?
6. State method of construction and whether or not tunnel is lined with masonry. (Supply sectional drawing if possible.)
7. What is the thickness of the lining? What is the material used? How was it applied and what cement was used?
8. Has the thickness of the masonry been fixed in accordance with the internal pressure? What conditions have been assumed to exist? Has any particular assumption been made as to the yielding or the elasticity of the rock?
9. Is the masonry close to the rock or are there cavities between the rock and the lining of the tunnel, which are only filled with dry stone packing or not filled at all?
10. Have such cavities been filled with cement grout during or since construction of the tunnel? Under what pressure was this grouting done?
11. Does the tunnel penetrate earth or rock? If rock, what kind (marl, limestone, conglomerate, gneiss, granite or any other kind of stone) and condition (homogeneous, stratified, cracked, water-tight or porous)?
12. Does the tunnel follow a mountain slope or cut through a mountain range? What are the longest and shortest distances between the gallery and the rock surface, vertically and horizontally?
13. What angle does the axis of the tunnel form with the drift of the strata? What is the inclination of the strata to the horizontal plane?
14. Have influences been observed due to the position of the tunnel relative to the stratification of the rock?
15. Are there certain parts of the gallery not lined at all with masonry, and has anything been done in these parts to make the rock water-tight?

Since not only the Swiss Federal Railroads have become greatly interested in this inquiry but also all power companies engaged in the construction of such tunnels, it is hoped by the committee that other engineers will assist them by replying to the questionnaire, giving as much information as possible. The committee consists of F. Rothpletz, chairman, Spitalgasse 24, Berne, Switzerland; Prof. M. Lugeon, Department of Geology, University of Lausanne; Prof. A. Rohn, Department of Civil Engineering, Zurich Polytechnic College; J. Büchi, consulting engineer, Zurich; and Prof. E. Hugi, Department of Mineralogy, University of Berne.

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## Waddell on Bridge Economics

Reviewed by CHARLES EVAN FOWLER
Consulting Engineer, New York City

ECONOMICS OF BRIDGEWORK. A Supplement to Bridge Engineering—By J. A. L. Waddell, C.E. (Rens. Poly. Inst.); B.A. Sc., Ma.E., D.Sc. (McGill Univ.); D. E. (Univ. of Neb.); LL.D. (Univ. of Mo.); Kogakuhukushi (Doctor of Eng., Imp. Univ. of Japan.) New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 512; illustrated. $6. 30s. net.

Here is a volume which should be read by engineers connected with the design and construction of bridges not because any will necessarily agree with the findings in all respects but as a stimulus to the serious consideration of what constitutes the real economics of bridgework. Many engineers will dispute the statement that the solutions given are the real and final ones. The author decries the mathematical methods of determining the economics of bridges, but it would seem unwise to give the young engineer the idea that he can do otherwise than depend largely upon pure mathematics as the foundation for conclusions built up of his practical experience. Yet the range of the author's investigations is remarkable.

The specific cases of the economics of large bridges referred to in the second chapter may be regarded as only suggestions of the various phases that must be considered in any great bridge project, but it would perhaps have been more valuable to the engineer had it been pointed out that there are certain fundamental considerations which take precedence over elementary bridge economics. Traffic needs, foundation conditions and existing land communications are among the determining factors in the construction of long spans. The chapter on alloy steels, a review of the author's various papers, provides information in condensed form. Unfortunately, his investigations of the possibilities of alloy steels have so far been fruitless, due principally to the fact that no philanthropic steelmakers have been found who will supply such alloys at costs which will make their use possible for long-span bridges.

The findings as to the use of tunnels instead of bridges will be much criticised by those who have investigated this subject, as the decision in any particular case must usually be made upon other considerations than those of economics, namely the results to be obtained and the practicability for the particular traffic to be carried, such as automobile traffic, which certainly cannot satisfactorily nor safely be carried through long tunnels. The question of comparative cost can only be decided by actual plans and estimates for each particular location, as so many local matters must be considered which vitally affect the cost of either bridge or tunnel. Indeed, elsewhere the author frequently admits that there are reasons for entirely disregarding the question of cost economy, as is done in the very short chapter on steel versus reinforced-concrete bridges.

The economics of the various ordinary types of steel structures and of pin-connected versus riveted types, are too well understood after years of development to warrant more than the meager eight pages devoted to the subject; most engineers will decide the major problems of such ordinary spans by judgment. The subject of the economics of continuous bridges has been so well understood for many years that no surprise need be expressed as to the results in favor of such construction where the conditions are at all favorable.

Cantilever bridges for comparatively short spans may usually also be dealt with on general grounds, as they are simply special forms of the continuous truss and should often be used where the possible settlement of piers will be large, or else where falsework for erection is very expensive or impossible. However, for long spans, where we have only two types to consider, the cantilever and the suspension bridge, the question of their comparative economy is a subject of fundamental interest, and it is to be regretted that the author did not discuss the question in its broad aspect, instead of upon personal grounds.

Certainly it is not *a priori* to be conceded that unloaded backstays are always the most economical; in a recent design for an 1,800-ft. suspension span, loaded backstays were found most economical for one end and uneconomical for the other end. The span of equal cost will likely be found, in comparing cantilevers and suspension bridges for any particular case, to hover closely around 1,700 or 1,800 ft., varying somewhat with the particular designs compared; for example, a wide difference will be found for a suspension design with fixed towers and one with hinged towers. These questions must all be decided "upon the broad grounds of professional intelligence and common sense."

Chapters 15 and 16 require but little comment except to question the declaration of the author against the use of ultimate maximum live loads and high unit stresses. It is to be regretted that the American Railway Engineering Association did not have the courage of its convictions and adopt an E 80 or E 90 live load, with unit stresses approaching closely the elastic limit; such a method is apparently the only logical way to build for the future, especially in case of long-span bridges.

In connection with what the author says on the economics of steel arch bridges it is pertinent to recall that a discussion of this subject before the American Society of Civil Engineers contained a tabulation of the design elements of 100 steel arches in various countries from which was derived a composite opinion of their various designers concerning economical rise and rib depth as well as type of arch. On the basis of this table the author thereupon admitted errors in his previous conclusions; but after making some trial designs he finally admitted only a partial agreement with the composite opinion of arch designers. Inasmuch as every large arch bridge is of necessity a special problem, it would be wise for each designer to satisfy himself as to whether this composite opinion, and Prof. M. A. Howe's findings as to the economy of the various types of arches, are correct or not. Further, each designer will find it advantageous to modify the

author's diagrams of weights to agree with his own practice, not only in this case but also in the case of many other diagrams in the book.

While the writer has found it desirable to extend this system of composite opinion to other types of bridges, particularly when dealing with the questions discussed in chapters 27 to 30, such matters as wire cables *versus* eyebar cables must be decided by accurate estimates and a careful consideration of all phases of the problem for each case, especially considering the grades of wire and alloy steels obtainable. Certainly an analysis of the author's findings on these points is far from satisfying.

The incentive to thought on types of movable bridges, afforded by Chapter 31, is somewhat neutralized by the succeeding chapter on the transporter bridge, as few will concede it the importance of requiring nearly a score of pages for its consideration, and most engineers will advise its avoidance like a plague.

A proper profit-sharing contract is no doubt conducive to economy; but while many are using a method in which cost plus a fee with bonus and penalty is giving good results, few will care to overload such a method with so much detail as to make it disagreeable in operation.

The chapters on Inspection, Shopwork, Erection, and Maintenance and Repair are well worth while and will give the young engineer a large amount of valuable practical information. The chapter on military bridges is timely, and the thanks of the profession are due to Gen. Beach and to Col. Bond for its preparation.

Careful survey of the volume compels the conclusion that a treatise on bridge economics is yet to be written. Such a work would give all the principal mathematical deductions as to detail design deduced by scores of independent engineering mathematicians; the practical application of these conclusions in the many long-span bridges already designed or built; and a series of comparative designs made upon a basis truly comparable. The opening or closing chapters of such a book should give a comprehensive review of the broader aspects of bridge planning, from both the economic and artistic point of view and with regard to traffic and other practical objectives.

## British Experiments on Bridge Impact

TESTS ON RAILWAY BRIDGES IN RESPECT OF IMPACT EFFECTS. Report to British Ministry of Transport by Advisory Committee for the Revision of the Board of Trade Requirements, 1914, in Regard to the Opening of Railways. London, England: His Majesty's Stationery Office. Paper, 8 x 13 in., pp. 16, many tables, folding plates and other illustrations. 15s. net.

In revising the British Board of Trade requirements concerning railway construction, an advisory board appointed for the purpose in 1914 gave the subject of bridge impact special consideration, through a subcommittee. After taking into account American practice in making impact allowances on live load, the variation of English practice, and the recent active discussion of the subject among the engineers of the Indian railways, the committee first considered the adoption of the Pencoyd formula, but later decided to undertake a series of experiments. The results of these experiments are recorded in the present report. Twenty bridges were tested and 181 runs made, giving 362 records. The Fereday-Palmer photographic stress recorder was used, an instrument which, because of its construction, has very little inertia. The diagrams show remarkably interesting vibrations of relatively high frequency, that are neither natural vibrations of the girders nor proper motions of the recorder parts, according to the author of the report, Maj. A. Mount, Inspecting Officer of Railways. The vibrations, which show chiefly in bottom-flange records, vary in frequency from about 30 to 70 per second. They are attributed to definite variation in stress in the member due to the application of live load. On the basis of the experiments, combined with those made earlier by the American Railway Engineering Association, a new formula, similar to the old A. R. E. A. formula, with 120 in the numerator and 90 in the denominator, is recommended. A fuller abstract of the tests and conclusions will be given in *Engineering News-Record* shortly.

## Automatic Sewage Ejectors

REVIEWED BY JOHN H. GREGORY

Consulting Engineer, Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

THE EFFICIENCY OF PUMPS AND EJECTORS.—By E. C. Bowden-Smith, M. I. Mech. E., Late Egyptian Civil Service, Author of "Oil Firing for Kitchen Ranges and Steam Boilers," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 205, illustrated. $5.

If the title leads anyone to expect that this volume is a short treatise or textbook on the efficiency of pumps and ejectors he will be disappointed. To a large extent the book is a monograph on the use of the automatic sewage ejector, written apparently as the result of the author's personal experience on the main drainage ejector system of Cairo, Egypt.

The author does give some data on the efficiency of certain pumps and ejectors which have come under his personal observation, but these data are extremely meager and so presented as to be of little value to the engineer. Although English units are used largely throughout the book, yet in places units not easily grasped by the American engineer are employed. For example, the volume of sewage is sometimes given in cubic meters and costs in Egyptian pounds.

The book is clearly printed, but not well illustrated. The line sketches, which are few, are of practically no value, and but little more can be said of the diagrams, which are poorly arranged and drawn.

Notwithstanding the lack of real working data on the efficiency of pumps and ejectors, the author has written an admirable general discussion of sewage ejectors, well worth careful reading by any engineer who has under consideration the installation of such ejectors on an extensive scale.

## Railway Track Maintenance

ROADWAY AND TRACK.—By W. P. Resch, Author of "Simplified Curve and Switch Work," Formerly Supervisor on Pennsylvania Railroad. New York: Simmons-Boardman Publishing Co. Cloth; 6 x 9 in., pp. 282, illustrated. $2.

A good practical book for the supervisor and roadmaster and for the engineer who has to do with maintenance of way. To the experienced man it will give new ideas, besides refreshing his memory as to matters he should know and has forgotten. To the younger man it gives both information and instruction. The term practical is used advisedly, because there is little in regard to theory, principles or development, the book dealing mainly with present-day conditions of routine and special classes of maintenance work, which are described fully and clearly.

Omission of instructions as to turnouts, switch work and even such an important subject as superelevation on curves may be due to the treatment of

these matters in another book by the author. Not much is said about track material or tool equipment—particularly power-operated tools. As to the labor problem, the author deals with the present condition of inefficiency and independence. He advocates the modern idea of distributing track work throughout the entire year in order to maintain uniform and competent forces. An inadequate and illogical index is a marked defect for which the publisher must share the responsibility.

## Great Lakes and Niagara River Diversion

DIVERSION OF WATER FROM THE GREAT LAKES AND NIAGARA RIVER: Letter from the Secretary of War Transmitting, with a Letter from the Chief of Engineers, Reports by Col. J. G. Warren, Corps of Engineers, and the Board of Engineers for Rivers and Harbors, on Water Diversion from the Great Lakes and the Niagara River, Including Navigation, Sanitary, and Power Purposes, and the Preservation of the Scenic Beauty of Niagara Falls and the Rapids of Niagara River. Washington, D. C.: War Department. Paper; 6 x 9 in.; pp. 415; 57 plates.

Niagara Falls is a combined scenic and industrial heritage to the people of Canada and the United States. Its scenic beauties have long been foremost. Twenty years or so ago its value as an industrial asset began to be realized. We are now in the beginning of the great controversy sure to be waged in the coming generation between the two values of the Falls. In that controversy the report to the Secretary of War, noted in the above heading, should be a valuable base mark, for in it is gathered together probably for the first time the full information regarding the hydraulics of the Niagara River, the possibilities of power development upon it, the effect of the diversions from the river and from its reservoir, the Great Lakes, upon both power and scenic beauty, and finally the recommendations as to future treatment which will preserve and possibly increase the scenic beauty, and at the same time provide for greater power development.

The main part of the report consists of an investigation by Col. J. G. Warren, Corps of Engineers, U. S. A., division engineer at Buffalo, and of W. S. Richmond, U. S. assistant engineer. Their reports are abstracted at considerable length by Gen. Harry Taylor, for the Board of Engineers for Rivers and Harbors.

The reports are much too lengthy for detailed description. They do contain practically everything that the engineer need know regarding the Niagara River and its reservoirs for his information in deciding upon treatment of the river. They contain an interesting recommendation that river protection works be placed above Niagara Falls better to distribute the water over the crest and to increase the scenic effect, at the same time permitting the diversion for power purposes of a considerably greater quantity of water than has ever before been attempted. They also contain the statement, interesting and novel, we think, to most engineers, that the present treaty agreement of 36,000 sec.-ft. to Canada and 20,000 sec.-ft. to the United States apparently is not based on any rational method of apportionment, but rather was devised to take care of developments existing at the time the treaty was made. The recommendation is made, however, that if proper remedial works are installed each country could readily divert 40,000 sec.-ft. without damaging the Falls, and the hope is expressed that 100,000 to 110,000 sec.-ft. total is possible.

The dozen pages of the report in which Mr. Richmond deals with the sanitary aspects of lake diversion are mostly filled with a valuable discussion of diversion of Lake Michigan water through the Chicago Drainage Canal to dilute the sewage of the district and protect the water supply of Chicago. The conclusion is reached that the conflict over diversion should be settled in the interests of all concerned, including 13 American states, Canada, Chicago and its Sanitary District, the shipping and the water-power interests. Elements of such a settlement are outlined. The remainder of this section touches upon the Black River Canal, for the dilution of the sewage of Port Huron, Mich.; the proposed Erie & Ontario Sanitary Canal at and near Buffalo, which is disapproved; and the diversion of water for the supply of Chicago and other lake cities.

## Reinforced-Concrete Diagrams

CONCRETE DESIGNER'S MANUAL: Tables and Diagrams for the Design of Reinforced Concrete Structures—By George A. Hool, S. B., Consulting Engineer, Professor of Structural Engineering, The University of Wisconsin and Charles S. Whitney, M. C. E., Structural Engineer, Milwaukee, Wis. New York and London: McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in.; pp. 178; illustrated. $4

It has been the fortune of the reviewer to sit many years at an editorial desk over which have passed numberless articles on the design and construction of concrete. As a result of his experience he ventures to guess that every engineer who has had to design more than three structures in which reinforced concrete figures has prepared a diagram for the simplification of future design. Further than that, probably two or three of them have submitted the diagrams for publication, with the comment that these particular diagrams are the only satisfactory ones the author has ever seen, though he has inspected and tried to use many. All of which shows that Messrs. Hool and Whitney have struck a popular chord in the preparation of the diagrams in the book noted above, though they may find a persistent preference for self-made curves.

The diagrams are extensive and inclusive and cover practically every possible phase of concrete design, with the necessary variations of unit stress and modulus of elasticity ration. The subjects covered are slabs, flat slabs (according to the American Concrete Institute and New York and Chicago codes but not the old Joint Committee), rectangular beams, doubly reinforced beams, T-beams, shear reinforcement, columns, bending and direct stress and footings. Reprints are given of the 1917 Joint Committee report, the A. C. I. building law recommendations and the Chicago and New York code requirements for concrete.

Concrete design diagrams depend for their value on their constant use and for such use many different methods of arrangement are equally satisfactory. The present diagrams are no exception to this rule; in addition, they have the great value of readability and easy access as well as general application.

## Monthly Business Survey

A monthly "Survey of Current Business" is being published by the United States Department of Commerce. The data presented, according to a statement issued by Herbert Hoover, Secretary of the Department of Commerce, will consist largely of material "which the secretary and executives of the various departments find necessary to have at hand for their own use." Some of the data presented in the July "Survey" are classified under Banking and Finance, Price Index Numbers, Cost of Living, Transportation, Building Statistics, and Fuel

and Power, but there are twenty main heads altogether. The general scheme is to give index numbers for each year from 1913 to 1920 with the 1913 figures as the base. Besides these monthly averages by years, the corresponding figures are given by months for 1920 and up to and including June, 1921. In the introduction to the first "Survey", it is stated: "In comparing these figures every effort is made to secure accuracy and completeness. *On the other hand, it is realized that timeliness is often of more value than extreme accuracy.*" It is to be hoped that other government departments will note and heed the sentence we have italicized. The large percentage of government statistics published are so belated as to be of only historical interest.

## A Broad View of the Engineer

THE ENGINEER—By John Hays Hammond. New York: Charles Scribner's Sons. Cloth; 5 x 7 in.; pp. 194; $1.75.

If the claims, qualifications and opportunities for service in other vocations are as well presented as are those of the engineer in the volume before us the books in this Vocational Series will be helpful to individuals choosing a career, to the various professions or other callings and to the public at large—which suffers largely from misfits.

The plan of Mr. Hammond's book is first to outline the profession of engineering, its advantages and—note this—its shortcomings; then to consider the natural qualities of an engineer and the abilities which he may acquire, his general education, his training in the use of English, and the foundations of engineering. This brings the author to a consideration of seven classes of engineers: the mechanical, civil, mining, electrical, chemical, marine and the military. A brief summing up closes the book.

The author takes a broad view of the engineer, his educational needs and his place in the world's work. In his concluding chapter he forcibly presents the increasingly great part that the engineer will take in government—"a vast engineering undertaking, in which fitness and integrity of men are fundamental necessities." Besides being admirably adapted to serve as an aid in the choice of a vocation, Mr. Hammond's book should be of value to engineering educators and cannot fail to interest every wide awake engineer.

# PUBLICATIONS RECEIVED

AMERICAN RAILWAY MOTIVE POWER DEPARTMENT AND FUEL ORGANIZATIONS—By H. L. Cole, O.B.E., M.I.Mech.E., Locomotive Department, Indian State Railways and Secretary, Railway Board. Simla, India: Chief Engineer with the Railway Board. Paper; 8 x 13 in.; pp. 29; illustrated.

THE BRITISH CAST IRON RESEARCH ASSOCIATION: A Survey of the Scheme of Industrial and Scientific Research for the Cast Iron Foundry Industry. Birmingham, Eng.: The Association. Paper; 6 x 9 in.; pp. 24.

CHARTER, ORDINANCES AND LAWS, CITY OF WALTHAM, MASS., 1921—By Order of the City Council. Waltham, Mass.: The Council. Cloth; 6 x 9 in.; pp. 298.

THE CITY PLAN AND LIVING AND WORKING CONDITIONS—By John Ihlder, Manager, Civic Development Department, Chamber of Commerce of the U. S. Washington, D. C.: The Author. Paper; 7 x 8 in.; pp. 15.

CONCRETE PAVEMENT CONSTRUCTION IN HOT WEATHER. New York and Chicago: Portland Cement Association. Paper; 6 x 9 in.; pp. 12; illustrated.

DIENST VOOR WATERKRACHT EN ELECTRICITEIT IN NEDERLANDSCH-INDIA, 1919—Bandoeng, Java, W. I.: Address P. A. Roolofsen. Hé Hoofd von den Dienst voor Waterkracht en Electriciteit. Stiff paper; 7 x 10 in.; pp. 32; half tones and folding maps.

EIGHTH NATIONAL FOREIGN TRADE CONVENTION, CLEVELAND, 1921—New York City: The Secretary, India House, Hanover Square. Cloth; 6 x 9 in.; pp. 632; $[illegible].

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK—1921-22. Comprising England and Wales, Scotland, Ireland, Canada and Newfoundland, India, Burma, Ceylon, Australian Commonwealth, New Zealand, Africa, * * * * * and Other Dependencies and Colonies. 39th Year of Publication. London: The Sanitary Publishing Co., Ltd. Cloth; 7 x 10 in.

In three parts: (1) the directory, giving populations and the leading appointive administrative officials for the cities and lesser governmental units of all the countries in the British Empire; (2) a review, for the year 1920, of the progress and status of municipal public works and services, such as road construction, use of motor vehicles, sewerage and sewage treatment, refuse collection and disposal; housing and town planning; (3) "A Municipal Engineering and Sanitary Engineering Trades Directory." Leading officials of the government departments of Great Britain, Canada, India, etc., and the headquarters and secretaries of various municipal and technical societies are given. For easy reference the directory part would be much improved if the divisions for each country were combined in a single list, instead of being given separately under from two to a half-dozen classifications.

FIRE RESISTANCE OF CONCRETE AND REINFORCED CONCRETE—Reports of tests by a Special Commission of the British Fire Prevention Committee. Red Books of the Committee. Paper; 5 x 9 in.; Nos. 217, 219 and 221, about 32 pp. each and No. 251, 64 pp.; illustrated. London, England: H. M. Stationery Office. Postpaid, 2s. 6d. each.

No. 217: Cement Concrete Floor Slabs of Broken Stock Brick, Sand (or Stock Brick Fine Stuff) and Portland Cement in Various Proportions with Some of the Slabs Having a Protective Covering on the Soffit.

No. 219: Cement Concrete Slab Floors of Coke Breeze, Broken Stock Brick, Furnace Clinker, Sand (or Fine Coke Breeze) and Portland Cement in Various Proportions.

No. 221: Reinforced Concrete Floors of (1) Clinker and (2) Coke Breeze.

No. 251: Heat Conductivity Tests with Concrete Slags of Various Aggregates (Thames Ballast, Coke Breeze, Limestone, Granite, Gravel, Slag, Etc.) in Various Proportions.

Some of the latest detailed reports on a long series of tests made possible by a grant, early in 1917, from the Government Department of Scientific and Industrial Research to the British Fire Prevention Committee. Some thirty Red Books on these tests have been prepared. A full list may be obtained from the department just named, 16 Old Queen St., Westminster, London, S. W. 1, England, but for purchase of the reports, address H. M. Stationery Office, as above.

FORESTRY COMMISSIONERS OF UNITED KINGDOM—Report for 1919-20. London, England: H. M. Stationery Office. Paper; 6 x 10 in.; diagrams. 9d. net.

Reviews the history of forestry in the United Kingdom and details beginnings of state forestry under the Forestry Act, 1919. The commission has acquired 103,100 acres of land, of which 68,100 are plantable; planted 1,585 acres in the eight months ended Sept. 30, 1920; made out a program for 1920-21 to plant 8,000 acres; has established nurseries; and has arranged for educational work in forestry.

GAUGE WEIRS FOR STREAMS—By H. J. F. Gourley, M. Eng., Assoc. M.Inst. C. E., F.G.S. Read and Discussed at the Institution of Water Engineers, June, 1921. London: The Institution. Paper; 6 x 9 in.; pp. 10; illustrated.

HYDROMETRIC SURVEYS: Provinces of Alberta and Saskatchewan, 1919—Ottawa, Can.: Department of the Interior. Paper; 7 x 10 in.; pp. 391.

MERCHANT VESSELS—By Robert Riegel, Ph.D., Professor of Insurance and Statistics in the University of Pennsylvania. (Shipping Series.) New York: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 257; illustrated. $4 net.

An economic presentation of the subject for the student and business man. Types of vessels and of construction, together with means of propulsion, are considered in Part I; Part II is devoted to ship measurement. The treatment is concise. Useful reference lists are appended to each chapter.

NATIONAL CONFERENCE ON CITY PLANNING—Proceedings for 1920. Boston: Flavell Shurtleff, Secretary, 60 State St. Cloth; 6 x 9 in.; pp. 165.

Contains papers on city planning work in St. Louis, Detroit, Dallas, Rochester, Cleveland, Cincinnati, and on zoning and other subjects.

NEW JERSEY DEPARTMENT OF HEALTH: Report, 1920—Trenton, N. J.: The Department. Cloth; 6 x 9 in.; pp. 381.

OSSERVAZIONI PLUVIOMETRICHE: Raccolte Nel Bacini Con Foce Al Litorale Della Compania, 1916-17; pp. 76: Raccolte Nella Sicilia, 1916-17; pp. 100. Rome, Italy: Ministero Dei Lavori Pubblici. Paper; 13 x 9 in.

RESURFACING AN OLD PAVEMENT WITH CONCRETE, South Seventh Street Road, Vigo County, Terre Haute, Ind.—New York and Chicago: Portland Cement Association. Paper; 6 x 9 in.; pp. 7; illustrated.

SEWERS AND SEWERAGE: Sewage Estimates and Sewerage Requirements, The Components and Operation of Sewers, The Design and Execution of Sewerage Schemes—By H. Gilbert Whyatt, Member of the Institution of Civil Engineers; Member of the Royal Sanitary Institute; Member of the Institute of Municipal and County Engineers, etc. New York and London: Isaac Pitman & Sons. Cloth; 4 x 6 in.; pp. 118; illustrated. $1. Brief outline of the elements of the subject, from the British viewpoint.

THE STORY OF ENGLISH PUBLIC HEALTH—By Sir Malcolm Morris, K.C.V.O., Member of the Royal Commission on Venereal Diseases, and of the Executive Committee of the National Council for Combating Venereal Diseases; President of the Institute of Hygiene; Fellow of the Royal Sanitary Institute, etc. New York: Funk & Wagnalls Co. Cloth; 5 x 8 in.; pp. 166. $1.50.

THE USE OF POWDERED FUEL UNDER STEAM BOILERS: Presented Before American Iron and Steel Institute, May 27, 1921, by H. D. Savage, M.A.S.M.E., A.I.M.E. New York: Combustion Engineering Corp. Paper; 6 x 9 in.; pp. 41; illustrated.

WHO'S WHO IN ENGINEERING—Edited by John Ed. Sears, C.B.E., M.A., Assoc.M.Inst.C.E., 1920-21. London: The Compendium Publishing Co. Cloth; 7 x 10 in.; pp. 156. Over British engineers, societies, schools, journals and manufacturers.

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## Views on American and European Bridge Construction

Sir—I have received your letter asking my opinion on the article by P. H. Chen, Engineer Chinese Government Railways, on certain tests alleged to have been made by him on steel bridges in China, published in your issue of July 14, p. 58. I have also read your editorial thereon. The article reminds me of the story about the discussion by some savants of the proposition: Why does a bowl brimful of water, into which a goldfish is dropped, not overflow? After some learned explanations all around, a hardheaded Scotchman finally opinioned "I dut the fact."

I would suggest that Mr. Chen first produce some proof of the remarkable differences in deflection in bridges, which he reports in your journal. G. LINDENTHAL.

New York City, July 19.

Sir—The paper by P. H. Chen in your issue of July 14 brings up an interesting subject for consideration. The statement about the effect produced on bridges by American rolling stock is based on one test which was made with admittedly crude instruments. Nothing is said about the condition of the engines used in the test. Defective rolling stock with loose brasses, flat wheels and similar defects could easily increase the vibration and account for the observed differences.

Two errors are noted in the paper: The lateral vibration given for engine 153 as 11.5 m.m. does not agree with the description [it should read 1.5 mm.—ED.] The bridge diagram shows a length of 154 ft. and the table states 114 ft. span [the latter is in error.—ED.]

The paper might have contained valuable data about the two bridge accidents mentioned. Were the bridges overloaded? Had there been any settlement to produce unusual stress? Evidence of this kind is desirable before blaming the failure on the use of American locomotives.

It seems unfortunate that *Engineering News-Record* did not investigate the subject thoroughly before making editorial comment. Communication with the special committees of the American Society of Civil Engineers on bridge design and railroad track stresses would have furnished better data upon which to base an opinion. An editorial from a generally accepted authority like *Engineering News-Record* may produce an unfortunate effect on the casual or hasty reader and will doubtless prove serious to our export business. Imagine an American locomotive exporter confronted by the following quotation from the editorial when trying to make a sale in a foreign country: "An experiment is reorded which shows that an American locomotive set up lateral vibrations in a bridge several times as violent as those set up by a European locomotive."

Should such statements be published without first carefully investigating the causes and the accuracy of the deductions? ROBERT A. MARSHALL,

New York City, July 20. D. P. Robinson & Co.

Sir—The comparison of European and American bridges and loadings is very interesting, but the conditions found are susceptible of easy explanation. The European type of bridge shown in cross-section would hardly be called good engineering in any country, as it leaves the wind stresses and other lateral forces or vibrations a chance only to "shin down" the posts. The reason for the slight changes in European designs is the fact that there has been no such increase in locomotives and train weights as has occurred in America.

The usual depth of our bridge trusses years ago, with the light loads then existing, was about one-seventh of the span length, but with the advent of modern train loads we quickly changed to depths of about one-sixth, for stiffness and economy. The table given by Mr. Chen is quite remarkable in that he found practically no increase in impact for increase of speed, as is sure to occur up to the critical speed, and such results are undoubtedly due to the use of crude instruments.

What the author notes as "severe shaking" was probably a combination of deflection and lateral vibration, giving a cork screw motion, which is sure to be found in too shallow trusses having insufficient portal and cross-section bracing.

Detroit, July 21. CHARLES EVAN FOWLER.

Sir—The article "Railway Bridge Construction and Service by American and European Standards" is very interesting, and it is to be hoped that he will follow it with the results of the further investigations he promises, as he is in a better position to make comparisons than any of the contestants.

The author's tests show greater impact effects with the American locomotive than with the German, but the maximum of 31 per cent recorded is well within the limit of 46 per cent for which this span would be designed under American practice. It must also be borne in mind that the impact effects from derailed wheels, for which provision must be made, might exceed those caused in normal operation.

Impact effects and lateral vibrations are caused primarily by the unbalanced revolving parts of the locomotive together with slight additions for unevenness of track and defective wheels. The writer has run an electric train with balanced revolving elements over a 50-ft. span at all speeds up to 45 mi. per hr. without being able to detect any measurable effects of impact.

American bridges are designed to cover all conditions that can reasonably be anticipated. Bridges are destroyed by derailed trains, collisions on them, or something falling from the train. It is, therefore, obvious that the floor system, which must receive the initial shock, should be as heavy as practicable so that its mass will act as an anvil to cushion the blow. This accounts for the lower stresses used in designing such parts. The writer has built 100-ft. spans with three panels of 33⅓ ft. in order that a large part of the weight might be massed in the floor.

Our early designers failed to anticipate the great and rapid increase in the live load, and most bridges have been replaced when only a third of their normal life had elapsed on this account. The weight of the locomotive doubled in a period of about ten years. Now that the limit of weight has nearly been reached through the limit of space, future increase does not need to be provided for in the same measure, and higher stresses are being adopted and greater uniformity in the practice of different countries will result.

With regard to bracing, the vulnerable parts are the compression members. In these, sag or deflection is incipient failure, and liability to destruction by blows an especial source of danger, and the bracing necessary to protect them is a small percentage of the total weight of the bridge.

Bridge design is of such economic importance to the public, that the national government should provide investigations and tests similar to those by which armaments are developed, with the advantage that the results would be far less costly and of more permanent value.

New York City, July 22. GEO. H. PEGRAM.

Sir—Referring to the article by P. H. Chen, which I have read with considerable interest: It appears to me that the article has many general statements. It is hard to analyze and answer his questions.

A detailed study should be made of European bridge practice and American bridge practice. To say that a European-built bridge failed under an American locomotive which was lighter than the European locomotive does not mean much until all of the details of design and the character of the locomotives are known.

The American locomotive has outside cylinders, which make it diffcult to counterbalance, and consequently there is considerable nosing. This nosing means comparatively

large lateral forces compared with European locomotives with cylinders inside of the frame. The American locomotive, however, has many advantages in that it has its reciprocating parts on the outside. The whole question at last resolves itself into the basic problem of railroad engineering. Who hauls freight at the lowest cost per ton-mile, the Chinaman or the American? Bridgebuilding is a small item in economical freight handling.

B. R. LEFFLER,
Engineer of Bridges, New York Central R.R. Co.
Cleveland, July 30.

---

Sir—Mr. Chen's article in *Engineering News-Record* of July 14 should be taken as a timely hint by Americans interested in exporting fabricated steel for bridges. It concerns fabricators and steel producers as well as designers.

American railway bridges are generally designed for typical loads and impact at maximum speed, with unit stresses so low that live loads about 50 per cent greater than the design load may be safely carried without restriction of traffic. In other words, if maintenance of physical condition has been good, we expect E50 bridges to remain in service, on lines of average density of traffic, until live loads approximately to E75 are introduced. If E75 loading were used for design, with unit stresses of about 21,000 lb. per sq.in., and the bridges designated as E75, questions concerning ultimate working loads would be simplified. Moreover, the web members, and particularly the counterbracing, would be more rationally proportioned.

Except for long spans, American practice has come to use mild steel exclusively, as it is more readily obtainable and makes for a standard commercial article. It is also better adapted to American shop practice, and the extra weight involved has been more than offset by low unit prices. In the early days of structural steel in America "medium" and "high" steel were frequently specified, sometimes three grades being used in one structure. For some export work, where freight and erection costs are comparatively high, with a consequent incentive to keep weights down, the writer believes that high-carbon and perhaps alloy steel should prove economical. He does not believe that impact is a serious factor in selecting the grade of steel; shop practice really determines it. There is some evidence that high-carbon steel, if not punished in fabrication, may stand impact better than low-carbon steel. When we have shops equipped to handle all-drilled work as economically as European shops are reported to do, then we can safely use high-carbon steel with a large saving in weights and, for many export jobs where freight and erection are high, considerable reduction in costs. Fabricators and steelmakers who are looking for foreign markets may find this point worth some consideration.

Nearly thirty years ago the late George S. Morison proposed, in outline, a four-cylinder balanced compound locomotive, designed to reduce impact to the minimum. The suggestion seems to have received little consideration from locomotive designers. The writer is not equipped to discuss its merits nor the point raised by Mr. Chen regarding the comparative impact effects of European and American locomotives, except to say that, if impact could be reduced as much as Mr. Chen's experiment indicates, an average saving of from 8 to 10 per cent in weight of bridges might be realized. As a general mechanical principle, it would seem to one without experience in locomotive design that impact and lateral forces, so destructive to track and structures, represent lost energy, and that the most efficient machine should be that in which the minimum percentage of the total power developed is expended in ineffective and destructive work—the smoothest running machine. The answer to this question from motive-power experts will be awaited with interest.

For overseas export work, pony trusses and latticed girders may often be used to advantage for span lengths which would be designed as plate girders for domestic use.

The "standard" cross-sections of 150-ft. spans shown in Fig. 2 of Mr. Chen's article are hardly a fair comparison. The American example given is hardly "standard" practice here; the top strut is much deeper than common and the truss depth is rather an extreme example than an average one. On the other hand, the European example only gives, apparently, about 18 ft. headroom, and the top laterals are much too slender for compression. A mean between the two would fairly conform to good practice. It looks as if the opposite extremes were being compared instead of average European and American practice. Although American bridge designs have tended, in recent years, towards quite rigid bracing, one would hardly suppose that we had gone beyond the English practice in this respect.

Finally, referring to Mr. Chen's specific questions, the following remarks may be made:

1. Have European bridges, generally, been subject to as rapid increases in live loads as have American bridges?

2. For American conditions, including the necessity for anticipating great and rapid increases in loads and low unit costs for fabrications and erection, American designers cannot justly be accused of wasting money, notwithstanding their bridges are comparatively heavy.

3. Chinese practice should be fixed for Chinese conditions, including costs of material, freights and erection, anticipated traffic and loads, maintenance conditions and other factors affecting the problem.

A. W. BUEL.
New York City, Aug. 10.

---

## A Plea for Research in Paint and Wood

Sir—Some months ago I was asked for advice as to the best treatment (by the maker) for automobile wood wheels to prevent absorption of moisture and subsequent shrinkage. No material help was to be had from the Forest Products Laboratory; and inquiry developed the fact that no agreement of opinion exists among the makers of wagons and trucks as to the most desirable moisture-content, the treatment with oil, either raw or boiled (linseed oil), character and amount of paint, temperature during such treatment, or anything else. This seems to be a matter deserving investigation by some government agency; especially, it seems to me, by the Forest Products Laboratory or possibly the Bureau of Standards, or both in co-operation.

But really this is only a particular case of the general problem of preservation of wood after it has been converted into structures, by painting, varnishing and the like. Most of the paint and varnish made in this country, which probably amounts annually to two hundred millions of dollars or more in value, is used on wood, and most of the people in the United States live in wooden houses, which depend on paint to resist decay and the action of the weather. Wood is itself practically imperishable. Mummy-cases two to three thousand years old exist; and in my own how town, Flushing, N. Y., there is a Friends' meeting-house, built in 1695, still in weekly use, and as good as ever, built of wood grown in the vicinity; and an excellent and valuable dwelling house, the Bowne house, also of wood, built in 1661. If a wooden house can be preserved two hundred and sixty years and still be as good, apparently, as when it was built, we are warranted in maintaining that a wooden house should be a permanent structure; and the present shortage of houses, with the high cost of materials and labor, justifies every reasonable effort for their preservation.

Not long ago the chief chemist of the Pennsylvania R.R. asked my opinion as to the cause of failure of some paint, prepared according to the specification of a well-known and highly recommended writer on the subject; and if the Pennsylvania R.R. cannot protect itself in this matter, what chance has the ordinary citizen with no special knowledge nor access to technical literature, but who wishes to preserve his homestead, representing probably the savings of years? About all he can learn is in the advertising matter of someone who simply desires to sell him a paint which will yield a good profit to the maker and the retailer.

Some of the paint manufacturers know a good deal about paint, but very little about wood. The Forest Products Laboratory knows a great deal about wood, but nothing about paint. With their knowledge of the structure and nature of different kinds of wood, and their natural and

professional interest in its preservation, the forestry people ought to be the ones to undertake this investigation and carry it on, with no commercial bias, for a term of many years. The only thing that hinders them, so they say, is the lack of money; they agree that they ought to do it and they wish to do it.

They think they can make a beginning with $6,000 a year; my own opinion is that they can, with probably some co-operation from the Bureau of Standards, but that after a year or two the amount will need to be a half more, and finally about double the specified sum. This should be public money, or at any rate not from a source which might imply an advertising value in the results; we have enough of that kind of research now. The Forest Service organization has done a great deal of good. It has always been above suspicion; let us keep it so. Those who are to be benefited are the whole people, not only of this country but the world. And whatever may be the necessity for economy in these days of housing shortage we ought not to refuse this small amount for a service which may eventually double the whole value of the forestry work. Will those who read this and approve do something about it?

Flushing, N. Y., Aug. 5. A. H. SABIN.

## Fire Resistance of Columns

Sir—R. E. Wilson's digest of the test investigation of the fire resistance of building columns conducted at the Underwriters' Laboratories emphasizes the excellence of this series of tests and sets forth some fundamental data on the fire resistance of different types of column protectives. In this latest contribution to the art of fire-resistive construction, some discrepancies have developed from existing practice based on the results of actual fires and previous test investigations made for supervising building authorities.

The Bureau of Buildings of New York was the pioneer in establishing requirements for fire-resistive construction, based on actual test investigation on floor and partition construction and column protection. As far back as 1903, tests were made on some nine different types of column protection by Rudolph P. Miller, then chief engineer of the Bureau of Buildings, Borough of Manhattan. These tests were not made to establish relative values, but to determine the minimum requirements for a protective coating on structural columns which would insure safety for a reasonable length of time against the action of fire. The test specifications then established required the coating to withstand the action of a 1,700-degree F. fire for a period of 2 hr., without permitting the temperature of the structural shaft to rise over 550 degrees F. This specification was adopted and incorporated in the city building code on Oct. 6, 1915. Several column constructions were also tested from time to time in conjunction with standard fire, water and load tests on new types of fireproof floor fillings. Among other materials, it was found that both gypsum and cinder concrete, although somewhat deficient in structural strength, gave excellent fire protection to steel and cast-iron columns, and both of these types of protection have been accepted and are approved for column protection under the building code of New York in so-called fireproof buildings when applied in 2-in. thickness.

From the ratings based on the underwriters' tests it will be noted that a 2-in. gypsum protection would not meet the 2-hr. requirement. Furthermore, a 2-in. protection of hard-coal cinder concrete is grouped with granite and sandstone concretes, with a maximum rating of 2½ hr. In the New York tests cinder concrete has always shown superior heat insulating properties and less tendency to crack and spall under expansion and contraction than most other concretes, and gypsum gave the lowest temperature of conduction of all the protective coatings.

The lower rating of these materials in the underwriters' tests can, possibly, be traced to the construction of the test specimens. In these tests the protective coating on the steel or cast-iron shaft was required to support a portion of the load, the head of the column shaft being subjected to direct compression on the total area of the finished column with the covering. This detail is not followed in ordinary practice, where the coating is simply a protection to the structural shaft, except in the case of reinforced-concrete construction, where shaft and covering are cast monolithic. The load is ordinarily applied to steel or cast-iron columns through the medium of cast or riveted brackets supporting the ends of the girders. In the underwriters' tests, as the metal of the column became heated, a constantly increasing proportion of the load was transferred to the covering. As gypsum and cinder concrete, for example, possess lower compressive strengths than other coatings, the duration of time to failure of the column shaft would naturally be decreased, not considering the other factors of expansion, spalling and heat conductivity.

The average compressive strengths at one month of the various protective materials are given in the appendix to the complete report of the underwriters' tests as follows:

| Protective Material | Compressive Strength Lb. per Sq.In. |
|---|---|
| 1:2:4 siliceous gravel concrete | 1,807 |
| 1:2:4 sandstone concrete | 1,633 |
| 1:2:4 limestone concrete | 1,588 |
| 1:2:4 calcareous gravel concrete | 1,505 |
| 1:2:4 trap-rock concrete | 1,497 |
| 1:2:4 granite concrete | 1,263 |
| 1:1½:4½ cinder concrete | 989 |
| 1:2:5 cinder concrete | 771 |
| Gypsum blocks on edge | 468 |

The excellent results obtained with the unprotected timber columns were to be expected. Although the area of the shaft was reduced from 25 to 55 per cent the tests did not develop the full resistance of the column shaft to the action of fire. Failure was due to the metal cap bearings, through conduction of the heat in the metal flanges and the metal bearing plates. By the introduction of properly protected caps, or such reinforced-concrete caps as are now being developed by the National Lumber Manufacturers' Association, the superiority of the timber column for slow-burning construction will be assured. With the commonly accepted cap details now in use, the unprotected timber column is rated 2½ times superior to unprotected steel. The fire resistance of heavy timber construction is constantly demonstrated in practice. On April 9, 1921, fire occurred in the lumber dry-kilns of the Camp Mfg. Co., at Wallace, N. C. Seven of the kilns at this plant were covered with a 6-in. laminated wood roof, and two kilns with an arched hollow-tile roof. The laminated roofs burned very slowly and assisted in keeping the fire within the kilns. The arched tile roofs collapsed in from one to two hours.

Compressive strength tests on specimens of the timber cut from the tested columns compared to similar specimens of unburnt timber show no loss in unit strength of the material after it has cooled off.

GEO. E. STREHAN,
New York City, Aug. 8. Consulting Engineer.

## Simplified Methods of Plotting Traverses

Sir—The old adage, "There is nothing new under the sun," is peculiarly applicable to the article in *Engineering News-Record*, July 28, 1921, p. 160, entitled "Simplied Method of Plotting Transit and Stadia Traverses," by Herbert N. Bradstreet. In the bygone days of railroad building this system was in universal vogue, and I have plotted many hundreds of miles of surveys by a slightly better modification, which consisted in fastening a large paper protractor on the sheets of drawing paper and pricking off with pencil points in opposite sides the calculated courses of the survey, and then by means of a large parallel ruler transferring their courses, instead of using large triangles and the rather slower method of laying off deflections from a transferred meridian. It seems to me that the once familiar parallel ruler has become obsolete.

I have also used sheets on which the protractor was printed in a light color, yellow or green, which did not obscure the mapping work.

Buffalo, N. Y., Aug. 2. EMILE LOW.

# HINTS FOR THE CONTRACTOR

## Grouting Sewer Tunnel Cavity from Test Pits Avoids Building Settlement

BY LEO G. HALL
Onekama, Michigan

DURING the preliminary grading for the large factory of the Willys Corporation at Elizabeth, N. J., the surface of the ground in one place dropped in, leaving a hole about 15 ft. in diameter and 10 ft. deep. The hole was directly under one of the principal buildings, a four-story concrete structure whose piers were designed for a load of 200 tons each.

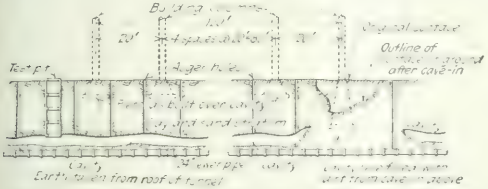



FIG. 1. LONGITUDINAL SECTION OF SEWER SHOWING CAVITY, AUGER HOLES, BUILDING COLUMNS, ETC.

Investigation disclosed that a 24-in. sewer had been laid there about 20 ft. underground in a former street some 40 years previously, and that it had been laid in a poorly backfilled tunnel. The tunnel timbers had rotted out, and the vibration of the shovel operations together with heavy rains caused the top to cave in. A test pit which was sunk to the level of the old sewer disclosed this rotted timber work, and an irregular cavity lying along the length of the sewer averaging 3 ft. x 5 ft. in section. The tunnel itself was in a gravel stratum immediately under a clay stratum; and the gravel had fallen away, leaving the clay arch roof.

After some experimenting, it was decided to fill the cavity with a 1:2:4 lime-and-cement-sand grout, mixed very wet. This mixture was found to run a great distance horizontally along the cavity without settling.

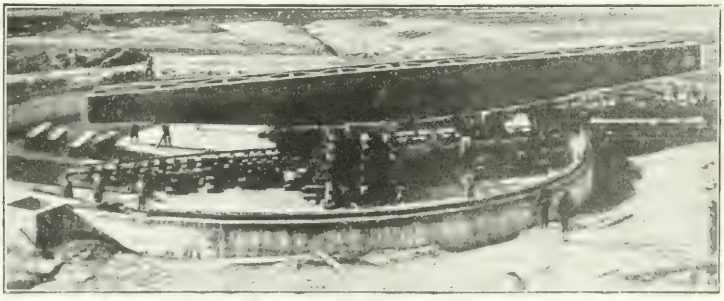
We were able to fill about 20 ft. of the cavity from the test pit. We then secured some 8-in. post-hole augers, fitted them with extensible pipe shanks, and tapped the cavity with them at intervals of 10 ft. We then poured into each hole, successively, as much grout as they would hold. During pouring grout could be seen with the aid of a flashlight, flowing under holes 20 ft. away from where pouring was taking place.

When the pouring was finished a couple of men were kept busy for several days boring holes in the vicinity, to determine whether the grout had penetrated all of the cavity. The grout was found to have stopped up completely every crevice to a distance of several feet from the sewer. A tunnel subsequently dug just outside the building showed that the grout had also compacted the loose fallen earth, and a trip made by the writer into the old sewer showed that it had stopped up several leaky joints.

## Placing a 100-Ft. Turntable by Cribbing and Jacks: M., K. & T. Ry.

IN PLACING the 100-ft. turntable for the new engine terminal of the Missouri, Kansas & Texas Ry. at Oklahoma City, Okla., jacks, cribbing and a wrecking crane were employed. The turntable as shipped complete, but without end trucks or center bearing, weighed about 67 tons and was mounted on three flat cars, the ends being supported by blocking on the two outer cars.

The concrete pit, about 8 ft. deep and having a lightly reinforced floor, had been completed about ten days before the girders were placed, 3 x 10-in. timbers being laid along the floor for a width of 18 ft. as a support for the cribbing of an incline track and to distribute the load over a wide area. When the track was ready the front car was removed and the car on which the turntable rested was pushed into the pit by a locomotive attached to the rear car. When the turntable had been spotted into position, cribbing was built up on each side of the car to carry jacks under timbers extending across the bottom of the turntable girders. By a slight lift of the jacks the table was raised clear of the car, which was then removed, leaving the table supported in an inclined position on the center crib



TURNTABLE PLACED IN PIT BY CRIBBING AND JACKS UNLOADED FROM CAR

At the low end of the table, blocking was then built on the bench for the circle rail, and by raising the high end slightly with a wrecking crane it was possible to remove the center cribbing and lower the turntable to a horizontal position. In this position it rested upon two cribs on the floor, ready to have the end trucks and center bearing placed, the final adjustment being by jacks on the cribbing.

This work was in charge of R. M. Stubbs, bridge engineer. The design and construction of the new terminal are under the direction of F. Ringer, chief engineer of the Missouri, Kansas & Texas Ry.

# NEWS OF THE WEEK

New York, August 18, 1921

## Bill to Commission Engineers in Public Health Service

**Engineering Bodies Endorse Measure—Would Attract Able Sanitary Engineers to Public Service**

A bill providing that the sanitary engineers of the United States Public Health Service shall be commissioned in the regular corps of the Service by the President, the same as the medical officers in the Service, and that the sanitary engineers will have equivalent rank, pay, allowances and status as commissioned medical officers of the Service, has been introduced in the House of Representatives and referred to the Committee on Interstate and Foreign Commerce, of which Samuel E. Winslow, of Massachusetts, is chairman. Under the terms of the bill, no commission to sanitary engineers would be granted until after they had passed "a satisfactory examination in the several branches of sanitary engineering and public sanitation before a board of commissioned officers of the said Service." Similar examinations are required of candidates for commissions in the medical branches of the Public Health Service.

The movement for securing legislation of the kind proposed has received considerable support from engineers and others. A committee to consider the subject has been appointed by George S. Webster, president, American Society of Civil Engineers. This committee has as chairman George G. Anderson, Los Angeles, Cal., and as its two other members Prof. A. N. Talbot, of the University of Illinois, and John C. Hoyt, of Washington. The movement has been endorsed by the Committee on Public Affairs of the Federal American Engineering Societies and by the American Engineering Council. Efforts on the part of the American Association of Engineers in behalf of the bill are in charge of A. T. Koehler, manager, Federal Department, A. A. E., Washington, D. C. The Surgeon-General of the American Public Health Service has expressed himself in favor of the bill. Ewing Laport, assistant secretary of the Treasury (of which the Public Health Service is a bureau), has stated in a letter to E. G. Sheibley, Los Angeles, that the Treasury Department "fully appreciates the great value of the service performed by sanitary engineers in public health work" and that legislation making it possible to commission sanitary engineers in the Public Health Service "on the same status as medical officers would benefit public health work and attract competent sanitary engineers who wish to make a public health career their life work."

## Campaign Begun in California for State Development of Power

An initiative campaign just launched in California has as its object the placing on the ballot at the election in November, 1922, of an amendment to the state constitution providing for the development and distribution of hydro-electric energy, under a state agency for the benefit of cities, irrigation and reclamation districts or other community organizations. This result would be accomplished by the creation of a water and power board, consisting of five members, with power to contract for the construction and operation of hydro-electric systems. The board would issue and sell bonds to the extent of the funds required, the state lending its credit in such issues to a limit of $500,000,000. Four of the board members would be appointed by the governor and the director of the newly-created state department of public works would serve as the fifth member.

The League of California Municipalities has taken a prominent part in launching the new plan. Individuals mentioned as having part in drafting the proposed amendment are Clyde Seavy, City Manager of Sacramento; Louis Bartlett, Mayor of Berkeley; W. B. Mathews, attorney for the Los Angeles board of public works; Dr. Horace Porter, Mayor of Riverside; Rudolph Spreckels, of San Francisco and William Kent, ex-Congressman from California.

## To Encourage Military Invention

Announcement is made that it is the policy of the War Department to encourage the development of military inventions by officers, enlisted men and civil employees. In consideration of assistance to be given by the department in the issue of patents, it will require of inventors no more than a license to manufacture and use their inventions for government purposes, thereby reserving to the patentee complete freedom and ownership of the patent in commercial application. In special cases of inventions of great military importance, however, provision is made for exclusive government ownership and the utmost secrecy.

## Zone Commission for Chicago

Under an ordinance passed about a year ago the mayor of Chicago has recently appointed a zoning commission, with Charles Bostrum, building commissioner, as chairman. Most of the twenty members are aldermen or city officials; the others include C. P. Wacker, chairman of the Chicago Plan Commission; Wm. Artingstall and Charles B. Duke, civil engineers, and E. R. Graham, architect.

## Fatal Concrete Roof Failure In Atlantic City Hotel

**Two Panels Fall After 15 Years' Service — Inspector Blames Defect in Concrete**

The fall of a section of reinforced-concrete slab roof over the kitchen of the Marlborough-Blenheim Hotel in Atlantic City on August 9 caused the death of a waitress and the injury of several other persons. The collapse, which occurred just after 1 p.m., involved two panels of roof along one of the exterior walls, an area about 15 x 33 ft., and occurred in a kitchen annex separate from but connected with the main hotel building. Much of the wall in front of the two panels fell with the slab. The structure had been standing for 15 years, having been built in 1906. No official explanation of the cause has been made up to the present time. The roof was a cinder-concrete slab 8 in. thick, reinforced with wire mesh, carried on concrete beams supported by cast-iron columns 16 ft. 8 in. on centers both ways. The walls here were brick with the slab supported directly on them.

THEORIES AS TO FAILURE

Building Inspector Peterson of Atlantic City in an interview directly after the failure suggested that a bubble in the concrete was responsible for the failure. Reporting to the mayor on the following day he stated that the slab had insufficient reinforcement and also said: "This slab had a fracture alongside the structural girder and within an inch and a half of the under side which shows that the water had been getting through it for some time and caused it to rot. As there was no reinforcement there was nothing to hold slab up and in my opinion the construction of the entire roof is poor."

J. J. White, president of the hotel company, stated after the collapse: "As far as we can determine a portion of the west wall of our separate two-story kitchen building about 25 ft. long and extending about 12 ft. to the ceiling or roof, buckled out and fell into the outside courtyard. One section of concrete roof about 15 ft. wide and of like length, which rested upon the wall, fell to the kitchen floor. We have not as yet been able to ascertain the cause."

Later Mr. White made the following statement to *Engineering News-Record:* "We are unable to tell at the present time whether it was the slab or the wall which failed. If the latter it was probably due at least partially to the defective workmanship in the placing of the wire mesh reinforcement in this particular roof slab so that it was almost on the under surface of the slab instead of being an inch above the under surface as it should have been."

Investigation of the collapse made for *Engineering News-Record* by Lewis R. Ferguson, of Wig, Hollister & Ferguson, Philadelphia, indicates that some of the wires of the reinforcing mesh corroded because of access of moisture and others were ruptured through excessive tension, presumably after the failure of the corroded wires through additional load on them. Mr. Ferguson's report is given on page 271 of this issue.

The Marlborough-Blenheim was the first large reinforced-concrete building on the sea coast, and aroused wide interest at the time of its construction in 1905-6.

The building was described in *Engineering Record* of Dec. 23 and 30, 1905, pp. 719 and 743, and in *Engineering News* of Mar. 8, 1906, p. 251.

## Williams Not a Candidate for Highway Commission

In *Engineering News-Record* of June 30 a news item stated that S. M. Williams, chairman of the Federal Highway Council, was being talked of as a probable candidate for the Federal Highway Commission, proposed in the highway bill now before the Senate. The item having come to the attention of Mr. Williams, he has disclaimed any desire to be a candidate. He says in a letter under date of Aug. 12:

"May I say definitely that I am not a candidate nor could I conscientiously consider the appointment if tendered, because I could not afford to accept a position, having assisted in the promotion of legislation for its creation. Unfortunately, we have too many examples where efforts for legislation have been prompted by desire for the job and I do not want to be included in that class.

"My effort for the creation of a Federal Highway Commission has been with the same motive which always prompted my contributing much time and effort for the past ten years, in the development of highways and transportation, namely the public need.

"I sincerely believe that three capable men can and should be found who have had no direct participation in promoting the legislation for the creation of the Commission if it is authorized by Congress, and to those men I will pledge my loyal coöperation."

## Wood Preservers Will Establish Service Bureau

For the purpose of furnishing information concerning the uses of treated timber, the American Wood Preservers' Association is establishing a service bureau at 10 S. La Salle St., Chicago. P. R. Hicks, engineer, Forest Products Laboratory, Madison, Wis., has been appointed secretary-manager. The bureau will be prepared to answer inquiries regarding the use of treated and untreated timber and various methods of treatment.

## Revised Townsend Highway Bill Goes to Senate

The Townsend highway bill, revised so as to make possible a unanimous report from the Committee on Post-offices and Post Roads, was presented formally to the Senate on Aug. 15, with the urgent recommendation from the committee that it be passed promptly. It was Senator Townsend's intention to move to take up the bill on Aug. 16 or Aug. 17. He expresses the hope that the Senate will pass the measure so as to allow the conferees of the two houses to adjust the differences between the Townsend bill and the bill passed by the House. An effort will be made to reach an agreement and secure the approval of the conference report prior to the congressional recess.

The Townsend bill, as reported, provides for a federal highway commission to be composed of three members. The state highway departments are to be allowed an important part in the administration of the act but federal aid is to be limited to 7 per cent of the total rural highway mileage in each state. Three-sevenths of this mileage must be composed of interstate highways while all of the remaining mileage must consist of roads which connect with interstate highways.

The states are required to maintain all highways in proper condition.

The bill carries an appropriation of $100,000,000 for the current fiscal year. Half of that amount is to be available immediately and half six months after the passage of the act.

## Surplus Road Equipment Charges Unfounded, Says MacDonald

*Washington Correspondence*

Ever since the federal government has been distributing surplus equipment to the states for use in highway construction there have been frequent allegations that this property was being disposed of illegally by some of the state highway commissions. On several occasions investigations have been made by the U. S. Bureau of Public Roads. In each case the reports have been proved erroneous. With the possible exception of irregularities in connection with the Arkansas muddle, Thomas H. MacDonald, chief of the bureau, is positive that no state highway department has disposed of federal equipment so long as it was serviceable for highway work.

Mr. MacDonald calls attention to the fact that more than $100,000,000 worth of surplus property has been distributed among the states through his bureau. In this way, he declares, the public has been able to get the maximum return on its investment in this material. In quarters other than the Bureau of Public Roads, it is believed that these sporadic charges against the state highway commissions have had their origin with those having selfish interests in the sale of government surplus property

## Street Cleaning Officials Meet in Chicago

**Society Well Launched Changes Name—Whole Two-Day Program Consists of Round Table Talks**

Methods of street cleaning and the disposal of refuse were the main topics discussed Aug. 10 and 11 in Chicago at the second annual conference of the International Association of Street Cleaning Officials. The organization now has a membership of 85, of which 61 are active members—officials—and 24 are associates. Most of the large cities are represented. The membership is distributed over 27 American states and three Canadian provinces. At the opening session 45 were in attendance. Unlike most programs, no papers were scheduled, but the officers had arranged six subjects for discussion, which took the form mainly of recitations of experiences in the home town of the official speaking.

Three amendments to the constitution were made: 1. The name was changed to International Association of Street Sanitation Officials to make the organization more comprehensive. 2. Three vice-presidents instead of one are now included in the list of officers. 3. Associate membership is extended to engineers and publishers.

### Garbage Disposal

The disposal methods described referred mainly to incinerators. Abram Swan, engineer of streets, Trenton, N. J., detailed the successful burning of 70 tons daily of garbage in the summer and 30 tons in the winter. In two years 225 tons of coal have been used. Despite the large foreign element householders have been educated to drain and wrap all garbage. The collection cost is $2.35 per ton and incineration 33c. Common workmen receive $30 per week and drivers $31. Adolph P. Schuck, Baltimore, spoke of the failure, after 16 months' operation, of a hog-feeding company which spent $60,000 for equipping a 127-acre farm rented from the city. Unknown causes killed 15 to 50 pigs per day. At present the garbage is loaded on scows and sold to farmers, but an injunction operative Sept. 1 will compel a change. A committee visited 35 cities but found none satisfied with its present method. The city decided to let the disposal out by contract and recently awarded a 10-year contract to a reduction company for $2.70 per ton.

W. F. Tallman, Winnipeg, said 90 to 95 tons daily were collected. Domestic garbage, wrapped, is collected twice a week and burned without use of any other fuel than rubbish. Incineration costs are 50 to 70c. per ton. Disposal of ashes is a problem because of the flatness of the country. A "mountain" on the prairie 25 ft. high is being built.

P. H. Connolly, city engineer, Racine, Wis., stated that 20 to 30 tons of wrapped garbage is incinerated without complaint in the center of the city at a cost of $1 per ton. Collection costs

$2.48 per ton. East St. Louis gets $1.80 per ton for garbage sold to piggeries. The St. Paul collection system, reported by H. C. Wenzel, consists of 50 farmers' routes and 30 municipal routes. The cost is $44,000 for 80,000 tons. It is planned to save $10,000 yearly by motorizing the system. E. F. Murphy, Boston, said bids for a 10-year contract for the disposal of garbage, ashes and rubbish, would be opened Sept. 1.

Much discussion was given to flushers, the double-unit type apparently being in most favor. Although admitting the damage done to pavements, particularly apshalt, the consensus of opinion was that the results justified flushing. It was considered the best means of handling fine dust. No one spoke of vacuum systems. W. J. Galligan stated that the use of power flushers was started in Chicago two or three years ago. He expects to add five to eight each year until the department has fifty. He is of the opinion that the danger to pavements is small if the stream is properly directed.

Snow removal received some attention. Motion pictures of two new devices were shown, a snow loader and a rotary broom sweeper suspended from a motor truck and operated by a power plant carried on the truck.

The officers elected for the ensuing year are as follows: President, W. J. Galligan; vice-presidents, Abram Swan, E. F. Murphy and J. S. Miller; secretary, A. M. Anderson, Old Colony Building, Chicago; treasurer, R. W. Waddell.

## Tentative Valuations Issued

Additional tentative valuations covering the properties of twenty-three companies have been issued by the Interstate Commerce Commission. They include the St. Louis Southwestern, the Green Bay & Western, and the Wichita Union Terminal Co. All include single sums as "final value" and a statement of the present cost of condemnation and damages of acquiring lands in excess of "present values." A comparison with other quantities of sums given as final value is indicated for ten of the properties in the accompanying table.

TENTATIVE VALUATIONS ISSUED BY INTERSTATE COMMERCE COMMISSION

| | Final | Cost of Reproduction | Cost of Reproduction Less Depreciation | Investment in Road and Equipment | Capitalization |
|---|---|---|---|---|---|
| [illegible] | $26,[illegible]74 | $18,424,505 | $14,588,870 | $67,430,327 | $16,356,100 |
| [illegible] | 1,82[illegible]00 | 1,269,676 | 1,040,280 | 1,844,633 | 500,000 |
| Paragould Southeastern | 424,000 | 526,000 | 466,000 | 518,148 | 100,000 |
| [illegible] | 686,000 | 691,261 | 518,003 | 1,070,182 | 150,000 |
| [illegible] | 5,298,582 | 5,203,425 | 4,098,052 | 10,279,343 | 10,100,000 |
| [illegible] | 1,289,193 | 1,005,960 | 889,[illegible] | 1,279,512 | 664,950 |
| [illegible] | [illegible] | 679,299 | 552,114 | 978,437 | 439,500 |
| [illegible] | 1,[illegible]00 | 1,937,229 | 1,513,484 | 1,[illegible]10 | 894,800 |
| W[illegible] | 2,070,911 | 1,[illegible]43 | 1,144,[illegible]15 | 1,999,827 | 100,000 |
| [illegible] | 1,187,810 | 384,874 | 360,2[illegible]8 | 946,979 | [illegible] |
| [illegible] | | | | | |

Original cost of lands of the St. Louis Southwestern wholly owned by the carrier and devoted partly to carrier and partly to non-carrier purposes is found to be $1,374,440. The present cost of condemnation and damages in excess of "present value" of lands owned is reported as $1,713,252.

## Ontario Commission Against Hydro-Electric Line

An adverse report on the project for constructing and operating a number of electric railways by the Ontario Hydro-electric Commission, through an issue of bonds guaranteed by the government, has been made by the commission appointed by the provincial government to investigate the matter. Decision against the construction of additional lines and development of the "radial" system is based on the present financial situation in the electric railroad industry generally, possible competition with the Canadian National Railways by paralleling lines and the desirability of testing the effect of highway development before undertaking electric line building.

It was generally anticipated that the majority report would oppose the plan. The reasons cited are as follows:

The financial condition of electric railways in Ontario and the United States has been precarious and unsatisfactory and the outlook discouraging; the evidence submitted indicates that the proposed electric railways would not be self-supporting. Their construction paralleling and competing with the Canadian National Railways system would be economically unsound, and a serious blow to the success of government ownership. Until the Chippawa power scheme, estimated to cost $60,000,000 or upward, is completed and shown to be self-supporting, the government would not be justified in endorsing the construction of an electric railway system at an initial estimated cost of $15,000,000. The endorsement of bonds by the province for extension of electric railways at the instance of the municipalities concerned is held highly dangerous and likely to lead the province into great financial difficulties, as it would give rise to demands for like accommodation from other localities which it would be hard to refuse. The expenditure of $25,000,000 on public highways in the province having been begun, it would be unwise to commence the construction of electric railways until the effect of highway improvement has been ascertained and the use of them by motor cars and trucks made clearly apparent. The rapidly increasing debts and financial commitments of the Dominion, Province and municipalities have aroused well-founded apprehension, and are a cogent reason against the embarkation in the construction of the contemplated electric railways.

The report is signed by four of five members of the commission: Judge Sutherland, the chairman; General C. H. Mitchell, W. A. Amos and A. F. Macallum, C. E. The minority report by Frederick Bancroft, labor representative, controverts most of the conclusions arrived at in the majority report, recommending that the government should adopt the principle of publicly owned and operated electric railways. He states that unemployment conditions would be considerably relieved through the hydro-radial development.

## Refuses Roads Maintenance Costs for "Labor Inefficiency"

In a decision made public Aug. 6, 1921, the Interstate Commerce Commission refused to include allowances to the railroads, in maintenance accounts for the six months' guarantee period, for "labor inefficiency" or the decrease in the effectiveness of railroad labor due to the National Agreements and other causes. Three commissioners dissented from the opinion, one not participating.

The controversy has hinged on the construction to be placed on the term "cost of labor." The Transportation Act, in providing for the six months' guarantee of earnings, limits the amounts to be charged in operating expenses for maintenance accounts, to sums to be fixed by the commission, with due regard to usage and differences in "the cost of labor and materials" as in comparison to the three-year test period previous to federal control.

The railroads contended that cost of labor is the cost of performing work and should not be construed as price of labor as reflected by wage scales, claiming that the National Agreements had resulted in a decrease in the effectiveness of labor irrespective of wage rates. The commission held such allowances to be inadmissible largely through lack of proper determination.

## Crown of Full Gas Holder Ruptured by Unknown Cause

A 3,000,000-cu.ft. gas holder of the Consolidated Gas Co., New York, located at 15th St. and Ave. C, failed in a remarkable manner on Aug. 12, while in normal service. The holder was nearly full at the time. A rupture developed suddenly at the junction between the crown and the shell of the upper section, opening a large hole through which gas was forced out. The gas fortunately did not become ignited, and the holder sank as the contained gas escaped, aided by pumping to transfer gas from the ruptured holder to others nearby, until fully down in its tank. The steel tank is unaffected, and so far as known none of the lower holder sections are damaged.

Pending the pumping out of the tank to permit full examination of the break the nature of the accident remains unknown. The top course of the upper holder section, a curb course of plate about ⅜ in. thick, is broken through on a vertical line and thrown or rolled back. The thin crown plating is ripped and crumpled fifteen or twenty feet back, apparently by a force at the curb. The shell course below the curb is also damaged, but the extent of this damage is less definitely known.

The holder has been in service 30 years. It was built by the Continental Iron Works. Recently it was painted, and with regard to drying of the paint on the lower sections it was kept nearly full. More definite facts concerning the rupture are expected to be available after the damaged parts have been exposed and examined.

## William C. Robinson

William Colin Robinson, vice-president and chief engineer of the Underwriters' Laboratories, died on July 31 from an acute attack of illness after a notable career of nearly 30 years in the development of fire protection by the aid of testing. He was only 53 years old at the time of his death, but had spent his entire professional life in the service of fire protection, and had attained a position of countrywide authority in many phases of the art.

Testing of materials affecting fire hazard was begun by W. H. Merrill and Mr. Robinson about 1893, in connection with the Chicago Board of Fire Underwriters, and two years later this work was organized in the form of the Underwriters' Laboratories, an institution with which both men have remained continuously associated since that time. Electrical testing was among the first lines of work carried on, and the importance of this investigative and test work is generally known. However, the scope of the Laboratories' research and test work grew in the course of a few years to cover a remarkably wide range.

Of the earlier work with which Mr. Robinson was intimately connected the development of standards and methods of test for fire doors, wire glass and metal-frame windows and fire extinguishers was prominent. Mr. Robinson was a leading authority in these fields and in all matters relating to sprinkler equipment. Later work dealt with a great variety of building materials and construction systems, including brick and tile, wall boards, roofing, and floor and partition constructions. The investigation of fire protection of building columns, recently completed, was one of the most elaborate of these researches, and here Mr. Robinson's ability in planning pre-test equipment was of determining influence. Investigations of large scope yet uncompleted at the time of his death related to cast-iron pipe, to safes, to roofing, to pressed steel construction and other subjects.

Mr. Robinson was distinguished for high ingenuity in devising and applying testing methods and apparatus to the particular service in which he was engaged. He is largely responsible for establishing the view that fire-protection testing must be done in full size, to bring out the true conditions arising in severe building fires. He improved the testing of partitions and similar structures by introducing restraint by a surrounding frame or its equivalent. He contributed materially to the introduction of the standard time-temperature curve for fire tests. Shortly before his death, he took the initiative in a step of fundamental importance, namely the study of time of fire exposure for different kinds of occupancy, a study which, when completed, will for the first time place fire-resistive construction on a plane of sound engineering design.

He was distinguished also for his care and caution in interpreting test results, being notably reluctant to issue reports on investigations made until their conclusions were incontrovertibly grounded, and correspondingly dependable in his opinions. His conclusions on fire protection questions were rarely questioned. Integrity, practical sense and a conscientious objective attitude were characteristic of the man.

## Denies Certificate for Cleveland Public Square Station

Issuance of a certificate of public convenience to the four carrier applicants for the construction of a union passenger station at the public square at Cleveland, Ohio, has been denied in a report by Division 4 of the Interstate Commerce Commission in a decision made public August 15. The applications of the New York Central, the Big Four, and the Nickel Plate have been pending since hearings were first initiated last February. A re-hearing was held in Washington August 2 before the Commission as a whole. The applicants had applied for a certificate of public convenience and necessity to permit the construction of a new passenger terminal at the public square through contract with the Cleveland Union Terminals Co. The applications were strenuously opposed by Peter Witt, former transit commissioner of Cleveland under the Johnson administration, who appeared in all of the hearings before the commission.

The majority opinion of the commission holds that the Cleveland terminal problem has received inadequate consideration and that the commission is "not persuaded by the evidence now before it" that the plan is compatible with public interest or that sanction should be given to the enormous expenditure of capital which the plan involves. "Possibly the presentation of further evidence or the modification of the plan in various particulars," says the opinion, "might make possible a different conclusion." It is stated that dismissal of application need not involve delay in terminal improvement at Cleveland since the railroads feel that as now situated the consummation of such a large project would not be practicable.

In a dissenting opinion Commissioner Potter of Division 4. states that it is clear that new passenger facilities and relief from existing freight congestion are necessary at Cleveland, stating that the public square plan seems to be justified and preferable to the site on the Mall. "While the expenditure involved in the proposed improvement is large," says Commissioner Potter, "I cannot see that public interest forbids it. . . . It seems to me that the city of Cleveland, the travelling public and shippers who will use the improved facilities are entitled to have the improvement made even though the new investment increases the burden on the public generally." The "strong support" that the public square station project has received in Cleveland is also cited.

## Huge Bridge Program in Bond Issue for Pittsburgh

Bridge construction to the amount of about $25,000,000 is provided for in a bond issue to be voted on by Allegheny County (Pittsburgh) on Sept. 20, according to a resolution just passed by the county commissioners. In addition to this sum, about $2,000,000 for the purchase of the three last remaining toll bridges over the Allegheny River will be included in the vote. The entire vote — about $41,000,000 — will include $10,000,000 for roads and $2,000,000 for buildings and other purposes.

Two of the Allegheny River bridges requiring reconstruction in accordance with the order of the War Department for raising and increasing the spans of bridges are provided for in the proposed bond issue: the Fortieth St. bridge, for which plans have been prepared by B. Janssen, architect, with C. S. Davis as engineer, and the Thirtieth St. bridge, which was destroyed by fire a month ago. Funds for construction of the Sixteenth St. bridge were provided by a prior bond issue; this structure was designed by Warren & Wetmore, with H. G. Balcom as engineer. A separate item in the vote provides $3,500,000 for reconstructing 6th, 7th, and 9th St. bridges.

### Bridges Proposed

Four very large bridges over the Monongahela and one over the Ohio River are also included. The largest of these are the Liberty Bridge, to connect the north portal of the Liberty Tunnels with the main part of the city ($4,000,000), and the proposed bridge from McKees Rocks to Woods Run ($6,600,000). The full bridge schedule of the bond issue includes the purchase of Monongahela River bridges at Rankin and Glenwood ($1,000,000 and $700,000) and the Neville Island bridge over the back channel of the Ohio ($250,000); the construction of three bridges over the Allegheny, at 30th St., 40th St. and Natrona ($1,500,000, $2,800,000 and $280,000); bridges over the Monongahela at Wilson, Homestead, Riverton and South 3rd. St. ($1,200,000, $2,500,000, $2,000,000 and $4,000,000); a bridge over the Ohio at McKees Rocks ($6,600,000); and bridges over East St. and Jacks Run ($320,000 and $850,000). A separate item of $3,500,000 for the raising of the 6th, 7th and 9th St. bridges brings the total up to $27,500,000.

J. G. Chalfant, county engineer, advises that the costs have in all cases been estimated large enough to permit first-class design for the heaviest type of highway traffic, and, in a number of cases, designs monumental in character. Some of the estimates are based on only preliminary sketches. The figures were computed on the basis of steel erected at 10c. per lb., concrete above foundations, $12 to $15 per yd., and in river foundations, $40; excavation and fill $2 per yd. for earth and $10 for rock; lumber, $80 per M; wood block pavement, $4 per sq.yd. laid.

### Form Transportation Division of Farm Inquiry Commission

Formation of the division of transportation of the Joint Congressional Commission on Agricultural Inquiry was announced Aug. 2. Donald D. Conn, First National-Soo Line Bank Building, Minneapolis, has been appointed in charge of the division. One of the six subjects which the joint commission is to investigate under congressional resolution is "The marketing and transportation facilities of the country." The division of transportation, according to the announcement, will be charged with making a thorough analysis of rate and car service problems as affecting prices of commodities produced and utilized by agriculturists. Sidney Anderson is chairman of the commission.

### Reduce Highway Crossing Grades

Under a new law for the protection of grade crossings in Michigan not only are signs to be placed 500 to 600 ft. from each crossing, but the highway for 25 ft. on each side of the tracks must be level or with a grade not exceeding 3 per cent. It is reported that at a meeting of county road commissioners and the public utility commission it was decided to leave the enforcement of the law to the local authorities, but that where they fail to act the commission will undertake the work. About 20 per cent of the crossings are to be improved each year.

### Full Municipal Street Cleaning Service at Philadelphia

In furtherance of the plan for complete municipal instead of contract service in street cleaning and in the collection of garbage, rubbish and ashes at Philadelphia, the City Council has passed and Mayor Moore has signed ordinances providing $1,250,000 for the purchase of sites and equipment for the work. Bids for a large incinerator are to be received on Aug. 26, as noted in this section Aug. 11. The city took over the reduction plant some months ago. It has been cleaning the streets in a considerable section of the city since Jan. 1 of this year. On Jan. 1, 1922, it expects to put its entire program of direct city work in this field into effect. Fred C. Dunlap is chief and J. H. Neeson deputy chief of the Bureau of Highways and Frank H. Caven is director of the Department of Public Works.

### To Extend Rock Creek Park

Lieut.-Col. C. O. Sherrill, the engineer officer in charge of public buildings and grounds at Washington, has announced the completion of preliminary plans for the extension of Rock Creek park so that it will connect with Potomac park. The lower end of the Rock Creek valley, now particularly unsightly as contrasted with the upper reaches of the stream, is to be improved with a drive near the creek level along with a full complement of walks, bridle paths and shrubbery.

## Personal Notes

CHARLES A. MAY, a former employee of the U. S. Reclamation Service, and for the last two years assistant highway engineer of New Mexico, has been appointed state engineer of New Mexico.

ASA E. PHILLIPS, after more than thirty years' continuous service with the District of Columbia, has resigned, effective Aug. 16, as sanitary engineer. He has served under 12 of the 16 engineer commissioners of the district. During the early years of his service he was engaged on mapping the drainage system, plans and estimates for new drainage works, rainfall and run-off studies, hydraulic data and experiments. From 1900 to 1908 he was engineer in charge of designs, estimates and construction of the sewage disposal system, and from 1908 to 1921 he was head of the sewerage division, Engineer Department, first as superintendent and later as sanitary engineer, and had charge of the underground construction work of public service corporations.

HERMAN H. SMITH, formerly chief engineer, Bureau of Highways, Borough of Brooklyn, N. Y., was appointed, Aug. 2, deputy chief engineer of the New York Board of Estimate and Apportionment in accordance with the recommendation of Arthur S. Tuttle, chief engineer of the board. Mr. Smith was a graduate of the Massachusetts Institute of Technology, class of 1899, and after serving four years in the engineering department of the Long Island R.R., joined the staff of the Brooklyn highway bureau as engineering assistant in 1903. He was subsequently promoted in 1907 to become assistant engineer in charge of maintenance and four years later became chief engineer of the bureau.

F. C. FINKLE, consulting engineer, Los Angeles, Cal., has been selected as consulting engineer for the Fruitvale Mutual Water Co. of San Jacinto, Cal., organized during the last few months and which has acquired the irrigation system of the Citizens Water Co., which formerly, as a public utility, served over 3,000 acres. The Fruitvale Mutual Water Co. is planning to serve 5,000 additional acres.

W. S. RICHMOND, formerly employed by the Larner-Johnson Valve & Engineering Co., Philadelphia, Pa., and for about a year in private consulting engineering practice in Detroit, Mich., in connection with hydro-electric power plants and general hydraulic problems, has moved to Buffalo, N. Y., where he will continue in engineering practice.

W. G. BLACK, of Black & Griffin, consulting engineers, Mandan, N. D., has been elected a member of the Park Commission of Mandan for a term of five years.

FREDERICK R. MILLER, civil engineer, has been appointed a member of the Ontario Hydro-Electric Power Commission to succeed Hon. I. B. Lucas, who will retire. Mr. Miller was in charge of the Imperial Munitions Board plant at Toronto, Ont., during the World War and is vice-president of Roger Miller & Sons, Toronto, formerly munitions manufacturers and at present engaged in harbor improvement works for the Canadian government.

C. F. CONVERT, formerly assistant bridge engineer of the North Dakota Highway Commission, has entered the employ of Black & Griffin, consulting engineers, Mandan, N. D.

A. L. FERVER, superintendent of the plant department, Southwestern Shipbuilding Co., has been appointed Director of public service and ex-officio city engineer of Long Beach, Cal.

B. B. BORTNER has recently entered into partnership with C. Ross Lindemuth, consulting and practical civil engineer, Fort Wayne, Ind.

MURRAY SULLIVAN, formerly acting chief engineer of the Chuchow-Chinchow Line and the Chouchiakou-Hsiangyang Line, Chinese Government Rys., is now general manager of the Chinese Engineering & Development Co., with headquarters at Peking.

## Obituary

C. E. POWELL, general inspector of bridges, Chesapeake & Ohio Ry., died July 26 in Covington, Ky. He was 45 years old and had been connected with the above railroad for about 20 years.

SAMUEL A. FORTNER, construction engineer, died August 3 in Springdale, Pa. He was born in Marysville, Kan., and was graduated, with the degree of B.S. in Civil Engineering, from the University of Kansas in 1908. In 1908 he became assistant division engineer in charge of construction of the west half of North Gooding Tract of Idaho Irrigation Co.'s project north of Gooding, Idaho. He also was resident engineer and late construction engineer on the Willow River Land & Irrigation Co.'s Dam No. 3, near Brogan, Ore. During the World War he directed the construction of naval buildings along the coast in France. At the time of his death he was in Springdale, Pa., supervising the erection of an electrical plant.

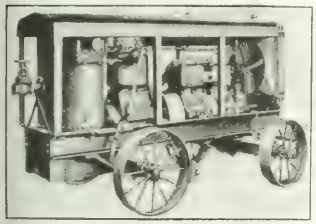
JOHN I. COCHRANE, statistician for many years of the United States Bureau of Mines, died in Cleveland, Aug. 3. Mr. Cochrane's death came suddenly following his gradual recuperation from a paralytic stroke which occurred in January. The deceased had been in the federal service in Washington for 14 years, first with the Technologic Branch of the United States Geological Survey, and later with the

Bureau of Mines. In the protracted effort to obtain Congressional enactment for the establishment of the Bureau of Mines, Mr. Cochrane rendered great assistance to the late Dr. Joseph A. Holmes, who was made the first Director of the bureau. Since the creation of the Bureau in 1910, he had been in charge of the publication work of the organization, and, through the dissemination of safety information and literature, had played an important role in the work of the Bureau in reducing death and accident rate in the mining industry. Mr. Cochrane was co-author of a bulletin of the United States Geological Survey on "The Fire Tax and Waste of Structural Materials in the United States." He contributed to the technical press a large number of articles on mine-safety and mineral conservation on topics. Before entering the federal service Mr. Cochrane had been engaged in newspaper work in various cities oin Ohio. He occupied editorial positions on the Cleveland *Leader* and the Cincinnati *Commercial-Tribune*, and was for a time city editor of the Washington *Post*. Mr. Cochrane was born in Dundee, Scotland, 49 years ago. He came to the United States when eight years old.

# NEW EQUIPMENT

## Portable Air Compressor

In designing its new class P2-DGL type of gasoline-driven portable air compressors, the Chicago Pneumatic Tool Co. endeavored to secure a lightweight outfit of large capacity. The



compressor has a capacity of 128 cu.ft. of air per minute, at a pressure of 100 lb. per sq.in. The weight of the outfit complete is 4,500 lb.

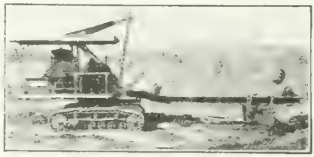
The compressor is of the two-cylinder, single-acting, vertical type, with the cylinders cast en bloc and entirely water-jacketed. The engine is of the tractor-marine, four-cycle, four-cylinder type. The compressor and engine shafts are connected by a flexible coupling which also serves as a flywheel.

A pneumatic throttle working automatically with the engine governor and the differential unloader of the compressor throttles down the speed of the engine when the compressor is running unloaded, thus effecting economies in the use of fuel and lubricant.

The unit is provided with a removable steel cover which may be locked in place.

## Skimmer Scoop Attachment

The Skimmer Scoop. has been designed for tearing up old roads, grading new roads, and for other types of shallow excavation. It is built by the Pawling & Harnischfeger Co., of Milwaukee, for attachment to either its No. 205 or No. 206 excavator crane.



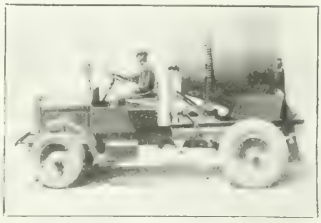
The scoop loads by being run out from the machine. When the bucket is filled the boom is raised, swung over the wagon and the load released. The under side of the bucket is hinged at the forward end and is released, for dumping, by a line from the cab.

The boom is interchangeable with the standard boom for this type of crane, and the new device can be installed within a few hours. The shovel attachment, brought out by the company earlier in the year, is likewise interchangeable, so that at relatively small additional investment the contractor may have a steam shovel, a skimmer scoop, or a standard crane, the latter with all of the flexibility of that type of equipment.

In a recent contract on Hawley Road, near Milwaukee, William Datka, the contractor, made a comparison between the cost of grading with the use of a Skimmer Scoop as against plows and wheelers. His figures showed a saving of $83.44 per day by use of the machine.

## Truckmixer for Road Work

A mixer mounted on a motor truck and operated by power from the truck engine is illustrated by the accompanying cut. In this outfit the ordinary



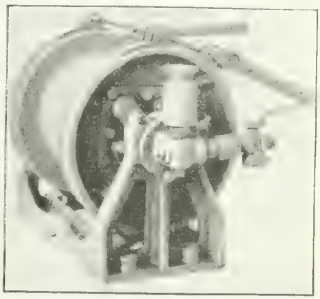
truck body, with its hoist, is replaced with a specially constructed frame which fastens onto the chassis and supports a rotably mounted concrete mixing drum. The power formerly used to operate the hoist is transferred to the drum, making a direct and efficient drive.

The entire mixer, with its mechanism, has fewer parts than the ordinary dump body and hydraulic hoist. Stone, sand and water are put into the drum direct from bins, and the required amount of cement is added at the cement shed or car. Mixing is preferably done on the final stretch, just before discharging, but the drum can also be rotated at the beginning of a haul, and then given a final re-mix action when in place to discharge. When it arrives at the place of laying the concrete, the truck is turned and backed up and the mixed batch is discharged by gravity into a chute which delivers the material to the rear of the truck, and as it moves forward, the chute spreads the concrete.

A fleet of these trucks is to be tried out on a Wisconsin concrete road contract recently awarded. The device is manufactured by The Truckmixer Co., Milwaukee, Wis.

## Compact Air Hoist

The Turbinair Hoist, built by the Sullivan Machinery Co., Chicago, is a compact portable air-driven hoisting engine which may be set on a base or mounted



on a column and used for handling drill steel, structural steel, timbers, etc., or for pulling cars, piling lumber, or any odd jobs of hoisting and hauling. It weighs 285 lb. and the drum will carry 500 ft. of ⅝-in. wire rope. Its capacity is 2,000 lb. lifted vertically at a speed of 110 ft. per minute under 75-air pressure.

The machine consists essentially of a cylindrical drum, mounted on a steel frame and completely inclosing the operating mechanism. The motor has two cylindrical rotors, provided with right- and left-hand helical flutes or vanes converging to a spur tooth in the center.

These two rotors mesh together as they revolve under the influence of the incoming air. The air is admitted at the axis of the drum through a hollow shaft and the motor revolves with the drum. The engine develops a high starting torque and is economical of power.

The hoist is provided with a friction clutch and brake. When both are released the rope may be pulled freely from the drum. The friction clutch may be locked in position and the load raised or lowered, controlled entirely by the throttle valve.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Federal Report on Alleged Price Fixing Association Due Soon

According to advices from Washington the reports of the staffs in the Department of Justice and the Department of Commerce engaged on investigation of alleged price-fixing combinations are soon to be ready. Following the submission of these reports, a definite outline of policy toward price-fixing associations will be announced. Several conferences on the matter have been held by the two cabinet members. It is the statement of Attorney General Daugherty that no interference with legitimate activities will be made, that a great many business associations are of great benefit to the nation, the majority not only desiring to do the right thing, but actually operating in a perfectly legal way. Some are under the ban and some in the guise of trade associations are contravening the law, says Attorney General Daugherty, and are fixing prices in an illegitimate fashion.

It is the assertion of Attorney General Daugherty that the action filed against the so-called cement trust in New York City by federal authorities recently has had a salutary effect upon other industrial organizations who might possibly become the subject of a federal investigation. He says that many of these associations have sent representatives to the Department of Justice for conferences as to the validity of their activities.

## Cincinnati Voters Defeat Canal Boulevard Bond Issue

By a vote of almost 2 to 1, the voters of Cincinnati recently defeated a bond issue calling for the authorization of $4,500,000 in bonds for the construction of a boulevard above the rapid transit loop on the site of the old Miami and Erie Canal. In all 36,339 votes were cast on the bond issue, 8,609 votes more than were cast for both the Republican and Democratic candidates for mayor, a fact which indicated the liveliness of the canal boulevard proposition. The bond issue was defeated on the ground that the city now carries about all the bonds of this character it is able to, and because a great many municipal improvements are of more pressing character than the canal boulevard.

## Injunction Holds Up Road Job

Strenuous objection on the part of farmers in Butler County to the construction of a stretch of 4½ miles of brick road at $70,000 per mile has resulted in an injunction being granted against the three county commissioners and Leon C. Herrick, Ohio highway commissioner, from paving the road from West Middletown to Jacksonburg.

## Car Movements

Due principally to the increased demand for grain cars in the Central West, a reduction of 28,991 in the number of freight cars temporarily out of service on July 31, because of the business depression, was shown by reports just received by the car service division of the American Railway Association. On that day, the total was 526,177 compared with 555,168 on July 23.

Of the total, 321,781 were serviceable freight cars in excess of current freight requirements, while the remaining 204,396 were freight cars in need of repairs. On July 23, serviceable cars totaled 350,772. Surplus box cars in good repair at the end of the month numbered 100,207, compared with 119,442 on the earlier date, or a reduction within that period of 19,235 cars. Reports showed 161,723 surplus coal cars in good order, which was a reduction of 6,845 cars in a little more than a week. A reduction of 1,830 was reported in the number of surplus stock cars, bringing the total on July 31 to 14,467.

## Lake Cushman Power Project Reported Upon

In a report on the Lake Cushman power project, Superintendent of Light Llewellyn Evans of Tacoma, Wash., stated recently that the city light department has a surplus of about $800,000 in cash and bonds which it can apply toward the development. It will require a utility bond issue of about $4,700,000, exclusive of the $400,000 already issued for the purchase of the site, for the completion of the first unit. Superintendent Evans explained that by damming the canyon of the north fork of the Skokomish, a lake 8 miles long would be formed, giving a continuous flow of 710 sec.ft., capable of generating 75,000 hp. on a 50 per cent load-factor basis, and warranting a 100,000 hp. machinery installation. He expressed the opinion that it will be a year, or more before actual construction is started, and that it will take at least three years to complete the project.

## Highway Toll Bridge Over Columbia River Assured

Pledges made by various corporations in Seattle have been sufficient to assure the financing of the construction of the steel highway toll bridge over the Columbia River between Kennewick and Pasco on the Yellowstone trail. Seattle's quota of $40,000 toward the total cost of $400,000, has been nearly all pledged. The proposed bridge will close an important gap in the system of highways throughout the state, and will provide rapid communication between the eastern and western districts of the state.

## Time to Build—When Costs Lack Deflated Expense

**A. G. C. General Manager Discusses Downward Trend and Deflation—Normal Level Mythical, He Finds**

When steel, cement, brick and lumber prices register anywhere between 48 and 20 per cent above 1914 prices, any possible variation between these points will not be so great as to delay necessary construction, is the view of R. C. Marshall, Jr., general manager of the Associated General Contractors of America. Mr. Marshall includes that assertion in a discussion of the general construction situation which will appear in the September issue of the A.G.C. *Bulletin*.

"To a manufacturer who has a promising production program on his hands," asserts Mr. Marshall, "a problem of a 15-point difference in this interval is insignificant. Likewise the prospective builder of a home may, by this limitation, be enabled to build. Unless the prospective builder desires to wait a number of years he can then doubtless proceed with the confidence that no rapid change in prices will depreciate the value of his structure."

### Normal Level a Myth

It is Mr. Marshall's assertion that there is no such ideal condition as a normal price level, commonly taken as the level of prices existing in either 1913 or 1914. He asserts that the arbitary choice of a "normal," which was only a point in a slowly but constantly changing trend of prices, has created in the minds of laymen an idea that any price above 100 in the index is unreasonably inflated and conversely that anything below the 100 index is abnormally low. Such conclusions, as shown by the history of wholesale prices, he believes erroneous. They fail to consider the slow upward trend of prices during the past generation which made the era, on the whole, a period of business prosperity. Mr. Marshall finds that for twenty years prior to the World War prices were steadily increasing at about 2½ per cent a year. This increase except for the war, in all probability, would have reached the so-called normal of 1921 and which is now designated as 120 on the scale of indexes. Therefore, he says that "to say that prices must drop to the 1914 level before the normal conditions have arrived is to ignore the rising trend of the preceding twenty years."

By studying price trends before and after the war of 1812 and the Civil War, Mr. Marshall finds that after each there was a downward trend for thirty years. If this situation is any criterion of what is to happen again, he asserts.

there will be slow downward trend similar to that under which our grandfathers worked. Therefore, Mr. Marshall makes the conclusion: "The man who is determined to wait the return of 1914 prices may be obliged to turn his prospects over to another generation."

Mr. Marshall asserts that whether wages "now paid labor in the building trades must be reduced remains to be seen, but it is significant that since 1820 the trend of wages has been steadily upward in spite of the fluctuation in wholesale prices. This means in part that mechanics have been enabled by improved methods and machines to turn out sufficient work to pay their higher wages. In other words, the standard of living of the working class has steadily risen. This is as it should be, and if the building mechanic can increase his production enough to justify his wages, no one will object."

Prospective owners Mr. Marshall finds are not especially concerned with the daily wage of mechanics, but want assurance that such wages in combination with material and management costs will build a structure containing no inflated expense. This assurance, he asserts, the contractors must provide.

## Brazil to Provide Water Storage for Semi-Arid States

In connection with plans for the reclamation of its semi-arid states, the Brazilian government has retained Dwight P. Robinson & Co., Inc., engineers and constructors, New York, to supervise a large amount of the construction work involved. Other work has been let to two British firms. The work to be undertaken by the American firm is located in the states of Ceara and Parahyba and will include the construction of five large dams, involving nearly 1,000,000 cu.yd. of concrete, to create storage reservoirs, some of which, it is said, are to be larger than any artificial reservoirs now existing. Two of the dams are to be some 60 ft. in height and the other three from 160 to 200 ft.

In these semi-arid states of Brazil there is an average annual rainfall of about 30 in., practically all of which falls during the rainy season from January to April, followed by a long dry season. The purpose of the water storage works will be to provide against the dry season since the rainfall, properly distributed, is considered sufficient to produce moderate crops.

Dwight P. Robinson & Co. have already sent one detachment of seventeen men to Brazil and about fourteen more are to sail soon. Ira W. McConnell, vice-president of the firm, expects to sail within a short time to remain in Brazil indefinitely. The work is under the direct control of the Inspectoria de Obras Contra as Seccas which is a department of the Ministry of Viacao e Obras Publicas. The inspector general in charge of the work is Dr. Miguel Arrojado Lisboa. Dr. Pires do Rio is the minister of Viacao e Obras Publicas.

## West Coast Lumber Production and Movement

For the week ended July 30, 107 mills in western Oregon and western Washington report production at 54,395,454 ft. b.m., which is 29 per cent below normal. New business totaled 53,804,283 ft. b.m., and shipments totaled 68,395,532 ft. b.m.

For delivery by rail, new business included 1,204 cars; rail shipments 1,238 cars. Unshipped balance in the rail trade was 2,770 cars. Local business totaled 4,236,237 ft. b.m.

In the cargo trade, domestic orders totaled 6,987,046 ft. b.m.; export 6,461,000 ft. b.m., and coastwise and intercoastal cargo shipments totaled 21,325,910 ft. b.m. Export shipments were 5,693,385 ft. b.m.

## Production of Southern Pine

For the week ended Friday, Aug. 5, 136 mills, members of the Southern Pine Association, reported a total production of 68,510,563 ft. b.m., which represents 75 per cent of the normal production. Shipments were 2 per cent above production for the week and orders 1.5 per cent below production for the week. There was a slight depletion in orders on hand, due to the excess of shipments over orders. The production for the week is the largest average per mill production that has been recorded since the week ended June 10.

## Engineering Advertisers Promote Conference Plan

The Engineering Advertisers Association of Chicago, led by Keith J. Evans of the Joseph T. Ryerson Co., has adopted resolutions supporting an industrial advertising conference plan to be held at the Associated Advertising Clubs' Convention in Milwaukee in 1922. The Engineering Advertisers Association of Chicago suggests as a tentative program subjects as follows: Organization and management of industrial advertising departments; direct advertising and its relation to the movement of goods from industry to industry; the use of business papers in advertising industrial products; the general mediums', newspapers', and magazines' practical use for the industrial advertiser; the agency and its service in the industrial field; and other topics. The movement is gaining ground. The Associated Advertising Clubs of the World have no industrial program at the present time, but have agreed to co-operate in every way.

## Worcester Unemployed to Engage in Public Works Construction

According to an arrangement recently made at a conference between the mayor of Worcester, Mass., and heads of city departments, 1,000 of the unemployed men in Worcester were placed at work last Monday on municipal improvements. The men are to work in two week shifts of 250 each on the new reservoir and on an extension of the sewage purification plant.

## Newark Settles Wage Dispute

Another dispute in the building industry was settled recently when the arbitrator for masons, bricklayers and plasterers, of Newark, N. J., decided that the existing wage of $10 per day was to be paid these trades until Jan. 1, 1922, providing that New York City's wage scale for these trades shall not be lowered before that time. The Newark scale after January 1 has not been decided. The proximity of Newark to New York and the possibilities of building trade labor being pulled away from that city by the latter were reasons given by the arbitrator why no reductions should be made. The arbitrator advocated holding of conferences between employers and employees in September to determine upon the scale and working conditions which would be operative from Jan. 1, 1922.

In Providence, R. I., the electricians' union has sent copies of a new working agreement to the employers asking for a wage of $1 an hour instead of $1.15 under which they are now working to take effect when the present agreement expires September 1. The same working conditions and hours of employment as are in effect now are asked for in the proposed contract. According to press reports the employers have not accepted the agreement but have made counter offers embodying changes in conditions, and wage scales ranging around 82½c. an hour. Employers also suggest conferences with the unions but the unions refuse to discuss anything under the rate named in their agreement.

## Building in Representative Cities, 1914-1920

From data collected by the Bureau of Labor Statistics building operations as indicated by building permits issued involved a greater expenditure of actual money in 1920 than in the previous six years. The data were collected for 1919 and the previous five years by the United States Geological Survey and during 1920 by the Bureau of Labor Statistics. For most of the cities the information for 1920 was obtained from building inspectors of the different cities by correspondence. In a number of instances, however, the agents of the bureau obtained the information in person either from tabulated records kept in the building inspector's office or direct from the building permits.

The total value of building as revealed in building permits for 1920 was $1,318,992,872 as against $1,235,548,397 in 1919. For the previoous five years the figures were as follows: 1914, $736,758,492; 1915, $764,149,180; 1916, $963,384,664; 1917, $636,919,123; and 1918, $395,016,535.

In this tabulation 126 cities were included for 1919 and 1920, Greater New York being considered as one city. Of this number seventy-seven showed an increase in the cost of buildings as shown in the permits, and forty-nine a decrease. The greatest relative increase in cost of construction in 1920 over

1919 was in Charleston, S. C., where 251 per cent was recorded, while the greatest relative decrease was in Dubuque, Iowa, where 67 per cent was recorded. Of the ten largest cities in the United States, New York, Cleveland, Boston, Baltimore, Pittsburgh and Los Angeles showed a gain over 1919, while Chicago, Philadelphia, Detroit and St. Louis showed a loss. According to the information gathered by the agents of the Bureau of Labor Statistics, building inspectors in most of the cities covered say there is a pressing need of more dwelling houses and that 1921 will be a record year for building operations of all kinds.

The greatest need, it is believed, is for housing construction, with public works a close second.

## Specifications on Pumps and Motors for South Africa

Blue prints and specifications covering the contract for the supply and erection at Vereeniging, Transvaal Province, South Africa, of two vertical and two horizontal spindle centrifugal pumps and motors, with all accessories, and one 10-ton traveling crane have been received by the Bureau of Foreign and Domestic Commerce from Consul Fred D. Fisher, of Johannesburg. This material is for use in connection with the Vaal River scheme. The specifications may be examined by interested persons at the bureau's New York office, 734 customhouse, or will be made available at any district or co-operative office, says *Commerce Reports*.

## Employment Drops 2 Per Cent During July

According to the report recently made public by the state industrial commission, working forces in factories in New York State were further reduced by 2 per cent during the month of July. Since March, 1920, there has been a total decline in factory employment of approximately 30 per cent, or about 450,000 workers.

## Contracts Total $20,000,000

Contracts let during the past week, as reported in *Engineering News-Record*, totalled more than $20,000,000. Highway contracts were in excess of $6,500,000, and miscellaneous structures, about $10,000,000.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 4, the next on September 1

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.88 | $3.50 | —$4.20 | —$2.88 | $3.16 | $4.10 | $3.70 | +$4.10 | $5.00 |
| Structural rivets, 100 lb. | 4.40 | 5.25 | 5.75 | —3.88 | 5.20 | 4.25 | 5.50 | —5.25 | 8.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2.78 | 3.20 | 3.50 | —2.78 | 3.18 | 3.97½ | 2.35 | —3.75 | 4.25 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 52.65–5% | 45% | —53½% | 53.9–5% | 36% | 46.25% | 47½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 48.30 | 43.33 | 57.50 | —46.10 | 52.80 | 57.50 | 60.00 | 63.00 | 75.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@2.70(del.) | 2.75 | 2.80 | 2.17 | 2.41 | 3.10 | 3.09 | 3.10 | 2.75 |
| Gravel, ¾ in., cu.yd | 2.25 | 2.25 | 3.00 | —1.80 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.50 | —1.80 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.90 to 2.00 | 2.25 | 2.80 | —2.00 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | —47.00 | 38.00 | 35.00 | —49.00 | —34.00 | 47.00 | 27.00 | 21.00 | 120.00 |
| Lime, finishing, hydrated, ton | 19.00 | 19.60 | 25.00 | 20.00 | 29.00 | 32.00 | 25.40 | 24.00 | 28.00 |
| Lime common, lump, per bbl. | 3.00 | 1.50 | 2.75 | 1.65 | 1.50 | 3.10 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | 10.00 | 12.65 | —11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 18.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .13 | —.0926 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | —.1005 | .14 | .13 | .07410 | .092 | .10 | .14½ | .12 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | .80 | +.86 | .97 | —.84 | —.90 | —.96 | —.96 | .79 | .84 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 1.00 | .50 | .50@.63½ | .81½ | .75 | ..... |
| Common labor, non-union, hour | ..... | .20@.25 | .35@.45 | .40 | .50 | .37½@.50 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe the prevailing discount from list price is given: 45 5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tile, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime, white is $1.80 for Kelly Island and $1.60 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per cu. yd. instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

## Changes Since Last Week

The steel situation is practically the same as last week, except that there seems to be less deviation from the official Pittsburgh schedule of $1.85 per 100 lb. for structural shapes, $1.75 for bars. Dallas reports a 10c. reduction on shapes in warehouse, mill delivery price being $3.10. Rivets and reinforcing bars are down 25c. per 100 lb. in Seattle, present quotations being $5.25 and $3.75, respectively. Chicago prices now compare with those in New York, with the black steel base for lap-welded pipe 53½ as against 58½ per cent.

Price changes in concreting materials are not numerous, but Chicago reports rather abrupt declines in sand, gravel and crushed stone. Trade in crushed stone is reported to have bettered considerably in New York, recently; a price lowering is promised as soon as towing charges are reduced.

The wholesale base price of lumber in New York is now $42 per 1,000 ft. bm., with the price to contractors about $5 higher. The Chicago base is $49, as against $55. Douglas fir is down $1 in Minneapolis, to $34. Direct mill shipments of long leaf yellow pine, New York, are: 6-in., 20 ft. and under, $40; 10-in., $44; 12-in., $46. So far as logging and mill conditions are concerned, the cutting of the last 30 days is no greater than that of the month preceding, with demand negligible. Mill stocks are satisfactory, and labor is plentiful, reasonable and efficient. The simple fact is that with lumber, as with steel, there is practically no market.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 87 — NEW YORK, AUGUST 25, 1921 — Number 8

## Bulk Cement for Buildings

FOR some years the use of cement in bulk to reduce handling costs and the nuisance of bag disposal has been advocated by some of the cement companies. The practice, however, has never been widely used, mainly because it involves so radical a departure from current methods. Where it has been used, too, there have arisen at times unexpected difficulties which seriously impeded progress. Nevertheless, the elimination of the bag, with its almost imperative man handling and its dust and storage complications, should be most desirable if it can be economically and effectively accomplished. For that reason the Turner Construction Company's study of the problem as it is applied to buildings, which is reprinted on another page, deserves careful reading and discussion. Any practical experiences in the use of bulk cement, particularly those in amplification of the points brought out in the article, will be welcomed as additions to an interesting phase of contracting economics.

## Gravel-Road Economics

WE ARE FAR from knowing when we reach the limit of economic use of secondary types of road surfacings, such as gravel and sand-clay. Experiences vary in different parts of the country and only where the types have been under observation for a long time is any fairly safe determination of this matter possible. For that reason, the study which the Bureau of Public Roads has begun of gravel and of sand-clay roads should prove very valuable. It is undertaking, with the help of various state agencies, to determine the maximum traffic which roads of these types will carry economically. Included in the study is an inquiry into the characteristics of their behavior when they get near their maximum traffic carrying capacity limit, with a view to determining what can be done to increase this maximum carrying capacity. It is just information of this sort that will gradually put our road practice on sounder and sounder grounds.

## The Large Pipe Problem

APPROXIMATE analysis is the great tool of practical engineering. Rightly handled, and backed by a sound understanding of the physical actions concerned, it solves a great number of problems that are not susceptible of exact solution within reasonable limits of time and effort. But there are some practical problems in which it fails, where approximation shoots so wide of the mark that exact analysis is indispensable unless absurdly large margin of ignorance is allowed, or unless empirical trial-and-error development is relied upon. The design of large horizontal pipes carrying water is a problem of this kind. Practical designing fails in attempting to deal with it, as failures of pipes attest. Theoretical analysis such as is given by Capt. T. B. Parker in this issue is necessary. For the particular case of saddle or pier support the formulas and tables of this article represent design data of great value. A problem of more general kind is confronted in the case of buried or partly imbedded pipes, and pipes carrying surcharges. The case is then more complicated, and hitherto separate analysis of each problem has been required. Another engineer, however, dealing with cases of this class, has been able to summarize them by tables and formula in a second article, to be published shortly. The two articles in conjunction will constitute a collection of fundamental reference data on pipe analysis.

## Progress of the "American Plan"

CONSIDERABLE impetus has been given in the building trades within the past few months to the "American Plan" of employment. The sentiment for the plan, which is nothing more than a sincere attempt to operate an open shop—to use union and non-union men together, without prejudice—is particularly strong now as a reaction against union-labor unreasonableness, an unreasonableness that was strongly indicated by the dispassionate display of facts made by Colonel Gow in his paper before the Boston Society of Civil Engineers. (See *Engineering News-Record*, June 9, p. 991.) Of course, it is well known that in the past the so-called "open shop" was not an open shop in fact; it was open to non-union men, but closed against union men. The employers used the term to deceive, knowing that it would gain the plaudits of the public. The American plan professes to be sincere and to attempt to use both union and non-union men on the same terms. It is to be expected that union labor will fight the plan as bitterly as the employers who have had costly experience with union-shop operation oppose the latter. The sentiment on behalf of the plan may be gaged by the action in San Francisco in raising a million dollar fund with which to promote its growth. The San Francisco employers determined on this measure after union labor had refused to accept a wage reduction recommended by an impartial arbitration board. The movement is growing rapidly in other large cities, and growth may be expected to continue until union working agreements have been modified to reasonableness and union wages have come down to a point that the public deems commensurate with the conditions and demands of the present time.

## Credit to the Manufacturer

IN THE issue of July 21, reference was made to the presidential address of R. W. Newman before the South African Society of Civil Engineers. One additional feature deserves special emphasis. In urging upon his fellow members a close study of construction equipment, he gives the manufacturers great credit for what they have done in making it possible for engineers to reduce the cost of work. He gives them credit not

only for the development of materials and machinery, but also for having a great fund of experience regarding the uses of those materials and the efficient operation of plant. He counsels his hearers to profit by that experience, whether through the literature published by the manufacturers or through the well-informed salesmen who represent them. We, in this country, do know what the engineer owes to the manufacturers, but seldom, either through the spoken or the printed word do we give them credit for their part in engineering development of the present day. We accept their work. We use daily the tools on which they have spent fortunes in development, expenses with little thought of its amount. Our art surely could not have developed to its present degree of perfection were it not for their vision and, principally, their courage. That the manufacturer is spurred on in his endeavors by the hope of profit does not belittle the contribution that he is making to engineering. If he hopes for profit, he also risks much in the development of his devices. His accomplishments entitles him to a place in the construction trinity, alongside the engineer and the contractor.

## Cleveland Station Decision

IF THE COMMISSION'S summary of the petitioning and opposing cases is a fair one, the Interstate Commerce Commission in refusing to sanction the Cleveland Public Square station project decided in accordance with the weight of evidence. The decision is not based on one point. The commission is unwilling to sanction the "enormous expenditure"—$72,000,000, as against $42,000,000 for the project on the Mall site—particularly as the latter would take in the four big roads, while only three roads plan to use the Public Square terminal. It points out the diversity of view with reference to street traffic congestion at the Public Square, giving, in the commission's opinion, at least reason to doubt the wisdom of locating the station there. It holds that the views of the public on station location are entitled to considerable weight, but it points out that the project as put before it is not the same as that which the citizens of Cleveland approved in 1919, the greatest difference being that the proposed public square terminal will not be "a real union passenger station" (the argument of the referendum campaign), since only three railroads will enter it. Moreover, there is now no question of providing work for returned soldiers—another campaign argument. Finally the commission gives such space to the control and financial features as to indicate that these were a very considerable factor in reaching the decision. A certain O. P. Van Sweringen would control the terminal company during the construction period, although the railroads would own all the stock of the terminal company and provide the financial credit which would make possible the marketing of the bonds. Furthermore, the Van Sweringen interests would control the "air rights" above the terminal, and the reader will draw the inference from the report that the commission did not consider the amount to be paid for such rights as adequate. The commission itself says that it is not persuaded that the proposed reservation of air rights "is in accord with sound public policy."

Obviously in a real-estate transaction of such dimensions it is not improper for a real-estate agency to be employed. In this case, however, it seems that the railroad companies desire to hold down their investment; some one else then must carry it. It is apparent that this is the function proposed to be performed by the Van Sweringens. Their purpose and function may be entirely legitimate but it is manifest that the railroad companies have failed to show it to be so clearly enough to remove doubts of the character of the transactions from the mind of the commission.

All in all, if the commission's report is fairly representative of the testimony, it seems that no other decision could be reached.

## Concerning Detours

SOME of the state highway departments, in addition to the placing of signs to mark detours around roads closed for repair, are issuing detour reports designed to keep the traveling public informed as to the condition of the principal routes of the state highway system. Through the medium of the daily press this information can be transmitted directly to the highway users with the result that many miles of useless travel may be avoided and many gallons of gasoline saved. Of equal importance, however, is the increase of the public's good will toward the state highway department which follows practices of this sort. Until recently highway engineers failed utterly to realize the significance of posting detour routes properly. Intent upon getting construction work finished rapidly, they were satisfied to let traffic shift for itself where main routes were closed and substitutes had to be used. This attitude on the part of highway officials is fast disappearing. They are beginning to realize that the posting of detours is an important point of contact between the state department and the public, and that, justly or unjustly, the highway department is judged by its practice at detours. It is so simple a matter to place signs indicating detour routes that there is no excuse for failure to do so. Dealing largely with material things, the engineer, time and again, gives little thought to the psychological aspects of his work. The railroads and the large industrial organizations long ago learned that a public-be-damned policy was fatal to their own interests. Some of our state highway departments are lacking in this knowledge. Highway detours—necessary evils as they are—offer to the engineer a means of establishing cordial relations with the public instead of bringing down upon the highway department the wrath of every motor vehicle driver. Detour posting can be the best—or the worst—form of advertising in which a highway department can indulge.

## Commerce Commission's Decision on Labor Inefficiency

ALLOWANCE to the railroads has been denied by the Interstate Commerce Commission for additional sums spent for maintenance due to the decreased effectiveness of labor during the six-month guarantee period. In view of the part the government had in decreasing the effectiveness of labor through the consummation of the national working agreements, the decision is unfair to the railroads.

In taking over the carriers, the president recommended that definite guarantee be given to maintain the properties in as good repair and as complete equipment as before. Subsequently, this provision was included in the "standard contract" between the Director General

of Railroads and the carriers, with provision that annual expenditures for maintenance equivalent to the average of the test period, with due allowance for differences in "cost of labor and materials" should serve as full compliance with this stipulation. It was also provided that the results should be "as nearly as practicable, the same relative amount, character, and durability of physical reparation."

The controversy which the commission has just decided is over the construction placed on the words "cost of labor." The railroads have contended that cost of labor does not mean *price* of labor, or wage, and have asked for full allowance for "labor inefficiency" due to the national working agreements and other causes. The commission has denied their request, and is willing to make allowance only for differences indicated by actual wage scales.

The commission's decision is based on a legal type of argument intended to determine what the contracting parties had in mind by the word "cost" when the standard contract was drafted. It places relatively little weight on the significant words about results being "as nearly as practicable, the same relative amount, character, and durability of physical reparation." The commission contends, too, that such labor inefficiency as may have existed was a "war burden" that the carriers would have had to bear had the properties not been under federal control. The main issue, if equity is to be considered, namely, what amount is fairly due the railroads, is not considered.

Yet the government's responsibility for the national working agreements cannot be denied. That these agreements, too, were responsible for a large proportion of the railroad labor inefficiency is generally admitted. On the other hand, it must be conceded that the determination of that proportion is not easy. There was, everybody well knows, a heavy lapse in efficiency in every line of endeavor. The losses incident to that general lapse the railroads must bear, even as other industries bore them. Some approximation of the government's responsibility could, however, have been made. Such procedure would have been in accord with the spirit under which the carriers were taken over.

## Ford and the Muscle Shoals Power

HENRY FORD is the modern magician. He makes more automobiles quicker and cheaper than anyone else; he converts, with alchemic ease, the base metal of business liabilities into the gold of assets and, wonder of wonders, he buys a railroad and makes it pay, or at least he says it does. When he offers to take off the government's hands that hundred million dollar white elephant known as the Muscle Shoals development, it is not strange that the man in the street thinks that the government would make a good bargain in letting him have it. Reports from Washington, indeed, indicate that the authorities there, in the absence of any other private offer, are favorably inclined toward the proposition, as the only way out from government operation of the project, which few want to contemplate.

In effect, Mr. Ford offers to pay on a renewable 100-year lease a rental of 6 per cent for the cost of completing the two power plants and to amortize the total cost of those plants (that is, what has already been spent plus what will be required to complete) at 4 per cent over 100 years. In addition, he will pay $5,000,000 for the title outright to the nitrate properties which cost the government during war years $87,000,000 to build. His amortization, however, is based on a cost of $48,000,000 for the power plants, whereas the government's estimate of that cost is $75,000,000. In other words, assuming his rental percentage to be fair, he is asking the government to write off $109,000,000 on the cost of a $162,000,000 plant and to turn it over to him, at a rental based on a low estimate of what it will cost to complete, practically in perpetuity, with quite proper provisions for war-time temporary capture by the government and some hazy provisions for supervision of rates to be charged for power and products in times of peace.

Obviously, the government is not going to make any money on any such agreement. The question is, as it is in the disposition of all the war-time plants, not how much can be made but how little must be lost. Do we want another such case as that of the steamship "Leviathan," for which a year ago the Shipping Board refused an inadequate though substantial offer, to find now that they may have to pay someone to take the ship to sea and sink it, so useless and expensive does it appear to be?

The issue at Muscle Shoals, however, is complicated by the water-power element. If it were only the nitrate producing plants that were involved, the government would be quite justified in putting them up to the highest bidder, with proper qualifications as to charges and war preparedness. Those plants were built by the government in prospect of war; their operation is not properly a government function and no one could rightfully complain if Mr. Ford were awarded them on the highest bid. The water power on the Tennessee River, on the other hand, is a national property, subject to the same control as the power in all of the federal lands and on all of the navigable rivers. By act of Congress in June, 1920, all such powers are subject to certain rules and regulations, prominent among which are absolute control by the Federal Water-Power Commission, the right of recapture by the United States and the renewal of lease at 50-year intervals. None of these provisions are included in the Ford offer. On its face that offer puts Muscle Shoals in a class by itself, and by accepting it Congress would violate the principles of water-power control fought over for many years prior to 1920 and crystalized in the 1920 Act.

It may be that conditions today do not justify anyone but Mr. Ford, whose industrial requirements are unique, in making an adequate proposal, under the Federal Water-Power Act, for the Muscle Shoals power, but that power is so great and its future market so sure that it cannot possibly be more than a few years before other private interests will be ready to consider it. Rather than to go backwards in our administration of public water powers, it would be the better part of judgment to demand of Mr. Ford that he do not go beyond the law in his proposal for the power and if a bargain cannot be made today on that basis, to postpone all action on the whole Muscle Shoals development. The nitrate plants can be kept in good stand-by order without undue expense, and the dam cannot deteriorate. Money would be lost in the dispersal of the construction plant, to be sure, but the amount would be small in comparison to the total cost of the project. Uncontrolled ownership of public water powers is a thing of the past; it should not be permitted to be revived.

# Stresses in Horizontal Pipes on Rigid Saddles

## Formulas and Tables Based on Theory of Radial Concentrated Loads and Fixity of Shell at Saddle Support

By Theodore B. Parker
Captain, Corps of Engineers, U. S. A., Camp Jackson, S. C.

THIS study is an effort to establish a rational basis for the design of large horizontal pipe lines with supporting saddles or cradles, where it is necessary to depend upon the saddles for lateral support. As the size of such conduits increases, the tendency toward radial distortion, due to unequal pressure at top and bottom of the shell, becomes a very important factor. Several large pipe lines have collapsed from this cause, and in other cases unexpected weakness has developed. It is toward a determination of the effects of this distortion that the present analysis is directed.

The critical condition as regards distortion (but not as regards stress) occurs when a pipe is just full of water, with zero pressure at top of shell. Further increase in static pressure produces a uniform increase in shell tension, which tends to return the pipe to a true circle. This additional tension is added algebraically to the stresses resulting from the unequal water pressures.

To proportion the structure it is necessary to determine the stresses in the pipe shell, the distortion or deflections, and the reactions against the saddle.

*Assumptions*—Previous solutions of this problem (as that given by B. Haukelid in *The Engineering Record*, June 14, 1913, p. 669) have largely depended upon certain assumed distributions of load over the supporting saddles. Since this distribution is one of the most essential things to be determined, and varies greatly with different conditions, it should not be assumed. In the present analysis the only such assumption made is in regard to the *direction* of the saddle reactions: Forces between pipe shell and saddle are taken as acting radially. Distribution and intensity of pressure at various points in the saddle are then calculated. In this way a reasonable basis is furnished for the design of both pipe and saddle. The methods employed could also be used to determine tangential components of the forces between pipe shell and saddle. This would furnish an exact but less simple solution. In view of the usual uncertainties in this class of construction, such refinement does not seem justified.

Weight of shell is neglected throughout. Other assumptions made are those commonly used in structural theory, and need no explanation.

The least-work method is used. By this means the radial deflection of the pipe shell is determined for two cases, Case I, pipe just full of water and supported on bottom element; Case II, empty pipe supported on bottom element, but acted upon by two equal radial forces of unity, symmetrically placed. By equating outward deflection from water pressure to inward deflection due to radial forces, it is possible to determine the magnitude of any single pair of reactions. In the same way the magnitude of any number of symmetrical radial forces may be determined by equating inward and outward deflections at each support and solving the resulting equations.

Saddle reactions may be assumed to consist of any desired number of pairs of radial forces. The magnitude of these forces may then be determined as outlined above. Resultant stresses and deflections in pipe shell follow.

In the analysis, bending moments producing compression in the outer fiber of the pipe shell will be taken as positive (+).

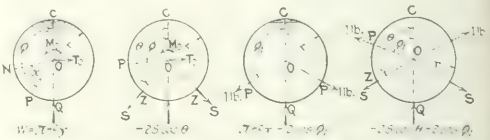


FIG. 1 FIG. 2 FIG. 3 FIG. 4

FIG. 1. FORCES IN PIPE FULL OF WATER

FIG. 2. DEFLECTION RELATIONS, PIPE FULL OF WATER

FIG. 3. FORCES IN PIPE WITH CONCENTRATED LOADS

FIG. 4. DEFLECTIONS FOR PIPE WITH CONCENTRATED LOADS

*Shell Stresses for Case I* (pipe supported only along bottom element, and just full of water)—Since the loading is symmetrical, the shear at point $C$ (Fig. 1) is zero, leaving two unknowns, the tension and bending moment at the top, *reduced to center of pipe* as $T_o$ and $M_o$. The pipe is considered as cut in two on its vertical diameter, being then two cantilever beams joined at the bottom, each acted upon by the force $T_o$, the moment $M_o$, the water pressure, and the reaction and moment at its lower end. Reduction of the crown tension and moment to the center of the pipe greatly simplifies the algebraic work.

The portion of the left-hand cantilever beam above any point $P$ is held in equilibrium by $T_o$ and $M_o$ acting at $O$; by the water pressure, whose moment about $P$ is $M_L$; and by a tension and bending moment $T$ and $M$ acting at $P$. For one linear inch of the pipe the water pressure at any point $N$ above point $P$, on the arc $ds$, is $\gamma h ds = \gamma h r d\alpha = \gamma r [r - r\cos(\phi - \alpha)] d\alpha$. The moment arm of this force about $P$ is $r \sin\alpha$, and its moment about $P$ therefore $\gamma r^2 [r - r\cos(\phi - \alpha)] \sin\alpha\, d\alpha$. The total water-pressure moment $M_L$ is the integral of this elementary pressure from 0 to $\phi$, or $M_L = \gamma r^3 (1 - \cos\phi - \frac{1}{2}\phi\sin\phi)$. Taking moments about $P$, and using this value of $M_L$, the stress moment $M$ at $P$ is,

$$M = M_o + \gamma r^3 (1 - \cos\phi - \tfrac{1}{2}\phi\sin\phi) + T_o r\cos\phi \quad (1)$$

and taking moments about $O$, the tension in the shell at $P$ is found to be

$$T = \frac{M}{r} - \frac{M_o}{r} - \gamma r^2 (1 - \cos\phi - \tfrac{1}{2}\phi\sin\phi) + T_o\cos\phi \quad (2)$$

Then the total work (both sides of pipe) is

$$W = 2\int_0^{\phi} \frac{M^2 r d\phi}{2EI} + 2\int_0^{\phi} \frac{T^2 r d\phi}{2EA}$$

By the theorem of least work,

$$\frac{dW}{dM_o} = 0; \quad \frac{dW}{dT_o} = 0$$

To apply these, substitute the expressions for $M$ and $T$ given by (1) and (2) in the equation for $W$ just

above, and then differentiate and integrate. The resulting equations are,

$$\frac{dW}{dM_o} = 0 = \frac{2\pi r}{EI}(M_o + \tfrac{1}{2}\gamma r^2)$$

$$\frac{dW}{dT_o} = 0 = \frac{2\pi r^2}{EI}(\tfrac{1}{2}T_o r - \tfrac{3}{4}\gamma r^3) + \frac{2\pi r^2}{EA}(\tfrac{1}{2}T_o - \tfrac{3}{4}\gamma r^2)$$

From these, $M_o = -\frac{1}{2}\gamma r^3$ and $T_o = \frac{3}{4}\gamma r^2$, which in turn give the crown moment $M_c = M_o + rT_o = \frac{1}{4}\gamma r^3$. The moment and tension at any point $P$ are, from eq. (1) and (2) with the above values,

$$M = \gamma r^3(\tfrac{1}{4} - \tfrac{1}{4}\cos\phi - \tfrac{1}{2}\phi\sin\phi) \quad (3)$$

$$T = \gamma r^2(1 - \tfrac{1}{4}\cos\phi - \tfrac{1}{2}\phi\sin\phi) \quad (4)$$

*Shell Stresses for Case II* (empty pipe supported along bottom element, and acted upon by two symmetrical radial outward forces, Fig. 2)—Here the application of a concentrated load at $Z$ makes it necessary to write one set of expressions for values of $\phi$ less than $\theta$, and another set for values of $\phi$ greater than $\theta$. Proceeding as before, and considering that portion of the left-hand cantilever above any point $P$, the moment of the external forces, $M_L$, is zero when $P$ lies above $Z$, and $Sr\sin(\phi - \theta)$ when $P$ lies below $Z$. Then the bending moment $M$ at $P$ is

$$\left\{\begin{array}{l}\text{for } \phi > \theta,\ M = M_o + T_o r\cos\phi + Sr\sin(\phi-\theta)\\ \text{for } \phi < \theta,\ M = M_o + T_o r\cos\phi\end{array}\right\} \quad (5)$$

and the tension in the shell at $P$ is found by taking moments about 0,

$$\left\{\begin{array}{l}\text{for } \phi < \theta,\ T = \dfrac{M - M_o}{r} = T_o\cos\phi\\ \text{for } \phi > \theta,\ T = \dfrac{M - M_o}{r} = T_o\cos\phi + S\sin(\phi-\theta)\end{array}\right\} \quad (6)$$

The total work for both halves of the pipe, is

$$W = 2\int_o^\theta \frac{M^2 r d\phi}{2EI} + 2\int_o^\theta \frac{T^2 r d\phi}{2EA} + 2\int_\theta^\pi \frac{M^2 r d\phi}{2EI} + 2\int_\theta^\pi \frac{T^2 r d\phi}{2EA}$$

$$= \int_o^\theta \frac{(M_o + T_o r\cos\phi)^2}{EI} r d\phi + \int_o^\theta \frac{(T_o\cos\phi)^2}{EA} r d\phi + \int_\theta^\pi \frac{[M_o + T_o r\cos\phi + Sr\sin(\phi-\theta)]^2}{EI} r d\phi + \int_\theta^\pi \frac{[T_o\cos\phi + S\sin(\phi-\theta)]^2}{EA} r d\phi$$

Differentiating with respect to $M_o$ and $T_o$ respectively, placing the resulting expressions equal to zero, integrating and solving for $M_o$ and $T_o$, gives,

$$M_o = -\frac{Sr}{\pi}(1 + \cos\theta);\quad T_o = \frac{S}{\pi}(\pi - \theta)\sin\theta$$

and the bending moment at the top of the pipe, $M_c$, which is equal to $M_o + rT_o$, becomes

$$M_c = \frac{Sr}{\pi}[(\pi - \theta)\sin\theta - (1 + \cos\theta)]$$

Inserting the values of $M_o$ and $T_o$ in eq. (5) and (6) we obtain the final values of the tension and bending moment at any point of the pipe shell,

for $\phi < \theta$,

$$M = \frac{Sr}{\pi}[(\pi - \theta)\sin\theta\cos\phi - (1 + \cos\theta)] \quad (7a)$$

$$T = \frac{S}{\pi}[(\pi - \theta)\sin\theta\cos\phi] \quad (8a)$$

for $\phi > \theta$,

$$M = \frac{Sr}{\pi}[(\pi - \theta)\sin\theta\cos\phi - (1 + \cos\theta) + \pi\sin(\phi - \theta)] \quad (7b)$$

$$T = \frac{S}{\pi}[(\pi - \theta)\sin\theta\cos\phi + \pi\sin(\phi - \theta)] \quad (8b)$$

*Deflections for Case I*—The radial outward deflection at any point $P$ in Fig. 3, under *any loading*, is

$$\Delta r = \int_o^\pi \frac{Mm\,ds}{EI} + \int_o^\pi \frac{Tt\,ds}{2EA}$$

where $m$ and $t$ are the bending moment and tension due to *outward loads of unity* acting at points $P$, and $M$ and $T$ are the values due to the actual loading.

From a study of the stress equations previously developed it is apparent that the effect of direct tension is comparatively small. Neglecting, therefore, the second member of the preceding equation, we have

$$\Delta r = \int_o^\pi \frac{Mm\,ds}{EI} = \int_o^\pi \frac{Mm}{EI} r d\phi$$

Here $m$ is the value of $M$ in Case II, provided we make $S = 1$; and $M$ is the value of $M$ in Case I. Inserting their values previously found, integrating and simplifying,

$$\Delta r = \frac{\gamma r^5}{2EI}[(1 + \cos\phi_1) - \tfrac{1}{2}\phi_1\sin\phi_1 - \tfrac{1}{4}(\pi^2 - \phi_1^2)\cos\phi_1] \quad (9)$$

*Deflections for Case II*—The pipe is represented by the diagram Fig. 4. As before, the outward deflection at $P$ is

$$\Delta r = \int_o^\pi \frac{Mm}{EI} r d\phi$$

in which $M$ is the bending moment in the pipe found for Case II above, for $\theta$ and $\phi$ (variable angle), and $m$ is found from the same expression for $\phi_1$ (in place of $\theta$) as fixed angle and $\phi$ as variable angle, and $S = 1$.

$M$ for $\phi < \theta$,

$$M = \frac{Sr}{\pi}[(\pi - \theta)\sin\theta\cos\phi - (1 + \cos\theta)]$$

$M$ for $\phi > \theta$,

$$M = \frac{Sr}{\pi}[(\pi - \theta)\sin\theta\cos\phi - (1 + \cos\theta) + \pi\sin(\phi - \theta)]$$

$m$ for $\phi < \phi_1$,

$$m = \frac{r}{\pi}[(\pi - \phi_1)\sin\phi_1\cos\phi - (1 + \cos\phi_1)]$$

$m$ for $\phi > \phi_1$,

$$m = \frac{r}{\pi}[(\pi - \phi_1)\sin\phi_1\cos\phi - (1 + \cos\phi_1) + \pi\sin(\phi - \phi_1)]$$

Combining these in the equation for $\Delta r$ gives a solution in two parts,

for $\phi_1 < \theta$,

$$\Delta r = \int_o^{\phi_1} \frac{M_1 m_1}{EI} r d\phi + \int_{\phi_1}^{\theta} \frac{M_1 m_2}{EI} r d\phi + \int_\theta^\pi \frac{M_1 m_2}{EI} r d\phi$$

for $\phi_1 > \theta$,

$$\Delta r = \int_o^{\theta} \frac{M_1 m_1}{EI} r d\phi + \int_\theta^{\phi_1} \frac{M_2 m_1}{EI} r d\phi + \int_{\phi_1}^{\pi} \frac{M_2 m_2}{EI} r d\phi$$

Substituting $M_1$, $M_2$, $m_1$ and $m_2$ and integrating, we get

for $\phi_1 < \theta$,

$$\Delta r = \frac{Sr^3}{2\pi EI}\{[(\pi - \theta)\sin\theta]\phi_1\sin\phi_1 + [\pi(\pi - \phi_1)\cos\theta + \pi\sin\theta - 2(1 + \cos\theta)]\cos\phi_1 - [2(1 + \cos\theta)]\} \quad (10)$$

for $\phi_1 > \theta$,

$$\Delta r = \frac{Sr^2}{2\pi EI}\Big\{[\pi \sin\theta + \pi - \phi_1 - \pi\cos\pi]\sin\phi$$
$$- [\pi\cos\theta + \pi - \phi_1 - 2\cdot 1 - \cos\pi]\cos\phi_1$$
$$- [2(1+\cos\theta)]\Big\}$$

Since most of the foregoing expressions are too cumbersome for convenient and practical use, they have been reduced to tabular form. Table I gives values of equations (3), (4), and (9) at ten-degree intervals, and Tables II and III show the values of (7) and (12) respectively. All tabular quantities are for pipes of any diameter, and are to be multiplied by a constant containing the radius, as indicated. The total weight of water is $\pi r^2\gamma$.

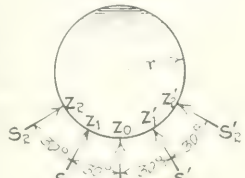


FIG. 5
CASE OF FIVE SADDLE REACTIONS

It is now possible to determine the magnitude of all saddle reactions supporting a pipe full of water. Since at any point on the pipe shell which remains on a rigid support the resultant radial deflection is zero, it follows that the outward deflection due to water pressure alone must exactly equal the inward deflection due to the supporting reactions. If these saddle reactions be represented by a number of symmetrical concentrated forces, it becomes possible to write this equation at each panel point in terms of the unknown quantities. Thus a series of simultaneous equations is obtained, equal in number to any desired set of unknown forces, and capable of algebraic solution. For approximate results a small number of points may be chosen, while for greater precision the forces may be subdivided indefinitely.

*Example*—The following simple example will serve to illustrate the general method: Consider a pipe supported as shown in Fig. 5, and just full of water. At points $Z_2$ and $Z_2'$ the outward deflection due to water pressure alone (Table I, $\phi = 120°$) is $0.1392\,\frac{\gamma r^5}{EI}$. The inward deflection due to forces $S_2$ and $S_2'$ (Table III, $\phi = 120°$, $\theta = 120°$) is $0.3035\,\frac{S_2 r^3}{\pi EI}$, and the inward deflection due to forces $S_1$ and $S_1'$ (Table III, $\phi = 120°$, $\theta = 150°$) is $0.1340\,\frac{S_1 r^3}{\pi EI}$. Hence, if there is no radial movement at points $Z_2$ and $Z_2'$,

$$0.1340S_1 + 0.3035S_2 = 0.1392\pi\gamma r^2$$

Similarly, from the absence of radial movement at points $S_1$ and $S_1'$,

$$0.0901S_1 + 0.1340S_2 = 0.0662\pi\gamma r^2$$

Solving the above equations, and placing $\pi\gamma r^2 = w$, we find that

$$S_1 = 0.152w \text{ and } S_2 = 0.392w$$

Then $S_0 = w - 2(S_1\cos 30° + S_2\cos 60°) = 0.344w$

To obtain the deflection or bending moment at any point in the shell it is only necessary to compute the algebraic sum of the deflections and moments resulting

TABLE I. BENDING MOMENT, TENSION, AND RADIAL OUTWARD DEFLECTION DUE TO WATER PRESSURE ALONE

| $\phi$ | $M$ / $\gamma r^3$ | $T$ / $\gamma r^2$ | $\Delta$ / $\gamma r^5/EI$ | $\phi$ | $M$ / $\gamma r^3$ | $T$ / $\gamma r^2$ | $\Delta$ / $\gamma r^5/EI$ |
|---|---|---|---|---|---|---|---|
| 0° | 0.7500 | +0.2500 | 0.2338 | 100 | 0.1840 | −0.3160 | +0.1316 |
| 10° | 0.7386 | +0.2387 | −0.2624 | 110 | 0.1855 | −0.3165 | +0.1424 |
| 20 | 0.7054 | +0.2054 | 0.2050 | 120 | 0.2181 | −0.2819 | +0.1392 |
| 30 | 0.6526 | +0.1526 | 0.1712 | 130 | 0.2916 | −0.2084 | +0.1234 |
| 40 | 0.5841 | +0.0841 | −0.1276 | 140 | 0.4062 | −0.0938 | +0.0977 |
| 50 | 0.5051 | +0.0051 | −0.0776 | 150 | 0.5620 | +0.0620 | +0.0662 |
| 60 | 0.4216 | −0.0785 | −0.0250 | 160 | 0.7923 | +0.2574 | +0.0347 |
| 70 | 0.3405 | −0.1595 | +0.0258 | 170 | 0.9885 | +0.4885 | −0.0100 |
| 80 | 0.2691 | −0.2309 | +0.0709 | 180 | 1.2500 | +0.7500 | |
| 90 | 0.2146 | −0.2854 | +0.1073 | | | | |

TABLE II. BENDING MOMENT DUE TO TWO RADIAL OUTWARD FORCES

(Coefficients to be multiplied by $S = \pi$, eq. 7)

| $\phi$ | $\phi$-90° | 100° | 110° | 120° | 130° | 140° | 150° | 160° | 170° |
|---|---|---|---|---|---|---|---|---|---|
| 0 | +0.5708 | +0.5486 | +0.4900 | +0.4069 | +0.3113 | +0.2147 | +0.1278 | +0.0591 | +0.0151 |
| 10 | +0.5469 | +0.5277 | +0.4726 | +0.3931 | +0.3011 | +0.2079 | +0.1238 | +0.0573 | +0.0146 |
| 20 | +0.4761 | +0.4657 | +0.4208 | +0.3522 | +0.2710 | +0.1876 | +0.1120 | +0.0519 | +0.0133 |
| 30 | +0.3604 | +0.3644 | +0.3382 | +0.2854 | +0.2217 | +0.1546 | +0.0927 | +0.0431 | +0.0110 |
| 40 | +0.2033 | +0.2269 | +0.2214 | +0.1947 | +0.1549 | +0.1097 | +0.6665 | +0.0312 | +0.0080 |
| 50 | +0.0097 | +0.0574 | +0.0799 | +0.0830 | +0.0725 | +0.0544 | +0.0343 | +0.0165 | +0.0043 |
| 60 | −0.2146 | −0.1389 | −0.840 | −0.0465 | −0.0229 | −0.0099 | −0.0033 | −0.0056 | −0.0000 |
| 70 | −0.4628 | −0.3561 | −0.2654 | −0.1898 | −0.1286 | −0.0805 | −0.0445 | −0.0195 | −0.0048 |
| 80 | −0.7272 | −0.5876 | −0.4586 | −0.3425 | −0.2411 | −0.1561 | −0.0885 | −0.0396 | −0.0099 |
| 90 | −1.0000 | −0.8264 | −0.6580 | −0.5000 | −0.3572 | −0.2340 | −0.1340 | −0.0603 | −0.0152 |
| 100 | −0.7272 | −1.0652 | −0.8574 | −0.6575 | −0.4733 | −0.3119 | −0.1795 | −0.0810 | −0.0205 |
| 110 | −0.4628 | −0.7512 | −1.0306 | −0.8102 | −0.5858 | −0.3875 | −0.2235 | −0.1011 | −0.0255 |
| 120 | −0.2146 | −0.4394 | −0.6865 | −0.9535 | −0.6913 | −0.4589 | −0.2649 | −0.1150 | −0.0304 |
| 130 | +0.0097 | −0.1431 | −0.3214 | −0.5375 | −0.7869 | −0.5224 | −0.3023 | −0.1371 | −0.0347 |
| 140 | +0.2033 | +0.1397 | −0.0834 | −0.1202 | −0.8548 | −0.5777 | −0.3345 | −0.1518 | −0.0384 |
| 150 | +0.3604 | +0.3894 | +0.3672 | +0.2854 | +0.1384 | −0.6271 | −0.3607 | −0.1637 | −0.0414 |
| 160 | +0.4761 | +0.6022 | +0.6098 | +0.6672 | +0.5854 | +0.4189 | +0.1655 | −0.1725 | −0.0437 |
| 170 | +0.5469 | +0.7716 | +0.9321 | +0.0135 | +1.0039 | +0.8949 | +0.6827 | +0.3676 | −0.0450 |
| 180 | +0.5708 | +0.8925 | +1.1461 | +1.3138 | +1.3809 | +1.3367 | +1.1750 | +0.8948 | +0.5000 |

TABLE III. OUTWARD DEFLECTION DUE TO TWO RADIAL OUTWARD FORCES

(Coefficients to be multiplied by $S = \pi$, eq. 10)

| $\phi$ | $\phi$-90° | 100° | 110° | 120° | 130° | 140° | 150° | 160° | 170° |
|---|---|---|---|---|---|---|---|---|---|
| 0 | −0.4295 | −0.4868 | −0.4964 | −0.4622 | −0.3923 | −0.2983 | −0.1948 | −0.0986 | −0.0275 |
| 10 | −0.4141 | −0.4711 | −0.4815 | −0.4490 | −0.3816 | −0.2905 | −0.1898 | −0.0962 | −0.0259 |
| 20 | −0.3698 | −0.4252 | −0.4372 | −0.4086 | −0.3503 | −0.2676 | −0.1755 | −0.0892 | −0.0250 |
| 30 | −0.3001 | −0.3523 | −0.3678 | −0.3485 | −0.3001 | −0.2309 | −0.1523 | −0.0778 | −0.0219 |
| 40 | −0.2104 | −0.2577 | −0.2767 | −0.2676 | −0.2341 | −18.26 | −0.1219 | −0.0629 | −0.0178 |
| 50 | −0.1062 | −0.1485 | −0.1725 | −0.1563 | −0.1253 | −0.0996 | −0.0856 | −0.0450 | −0.0130 |
| 60 | −0.0023 | −0.0331 | −0.0567 | −0.0698 | −0.0716 | −0.0627 | −0.0457 | −0.0253 | −0.0076 |
| 70 | +0.0969 | +0.0791 | +0.0582 | +0.0335 | +0.0146 | +0.0016 | −0.0045 | −0.0049 | −0.0020 |
| 80 | +0.1791 | +0.1781 | +0.1593 | +0.1301 | +0.0915 | +0.0634 | +0.0355 | +0.0152 | −0.0035 |
| 90 | +0.2337 | +0.2537 | +0.2437 | +0.2132 | +0.1680 | +0.1185 | +0.0717 | +0.0335 | −0.0086 |
| 100 | +0.2537 | +0.2964 | +0.3006 | +0.2729 | +0.2234 | +0.1629 | +0.1017 | +0.0490 | −0.0130 |
| 110 | +0.2437 | +0.3006 | +0.3222 | +0.3035 | +0.2578 | +0.1928 | +0.1240 | +0.0605 | −0.0164 |
| 120 | +0.2123 | +0.2729 | +0.3051 | +0.3035 | +0.2666 | +0.2052 | +0.1340 | +0.0671 | −0.0185 |
| 130 | +0.1680 | +0.2234 | +0.2578 | +0.2666 | +0.2463 | +0.1974 | +0.1327 | +0.0681 | −0.0191 |
| 140 | +0.1185 | +0.1629 | +0.1928 | +0.2052 | +0.1974 | +0.1678 | +0.1183 | +0.0629 | −0.0180 |
| 150 | +0.0717 | +0.1017 | +0.1230 | +0.1340 | +0.1327 | +0.1183 | +0.0901 | +0.0511 | −0.0154 |
| 160 | +0.0335 | +0.0490 | +0.0605 | +0.0671 | +0.0681 | +0.0629 | +0.0511 | +0.0327 | −0.0109 |
| 170 | +0.0086 | +0.0130 | +0.0164 | +0.0185 | +0.0198 | +0.0180 | +0.0154 | +0.0109 | −0.0047 |
| 180 | | | | | | | | | |

from the water pressure and from each pair of radial forces. The steps of this calculation have been tabulated in Table IV for 10° intervals, portions of Table I being repeated for the sake of clearness. In the table $M_w$ and $\Delta_w$ represent the bending moment and deflection, respectively, due to the water pressure alone, and are taken directly from Table I; $M_1$ and $M_2$, $\Delta_1$ and $\Delta_2$ are obtained by multiplying the proper parts of Tables II and III by the values found for $S_1$ and $S_2$, and represent the moments and deflections produced by these forces. $M_r$ and $\Delta_r$ are the resultants. All bending moment figures in Table IV should be multiplied by the constant $\gamma r^3$, deflection figures by $\gamma r^5/EI$.

This example shows but one special case. Reactions for any width of saddle may be worked out in the same way, and as many forces chosen to represent the saddle reactions as may be thought necessary. Table IV is then computed with a corresponding number of columns.

It is worth noting that for saddles having a total central angle of much less than 80°, that portion of the pipe shell over the middle of the saddle tends to rise, and thus to leave the pipe supported only at the tips of the saddles. This shows that narrow saddles are subject to heavy pressure at their tips, where most of the reaction is concentrated. As the width of support is increased, the pressure becomes more evenly distributed, but has a greater resultant moment about the center line of the saddle. All saddle reactions thus obtained are the greatest which can exist, since any movement of a support decreases the pressure against it. As the supports are assumed not to move, the saddle reactions do not depend upon the rigidity of the pipe shell.

TABLE IV. RESULTANT BENDING MOMENTS AND DEFLECTIONS FOR PIPE SUPPORTED OVER 120° SADDLE, USING 5 CONCENTRATED REACTIONS

| $\phi$ | $M_w$ | $M_1$ | $M_2$ | $M_r$ | $\Delta_w$ | $\Delta_1$ | $\Delta_2$ | $\Delta_r$ |
|---|---|---|---|---|---|---|---|---|
| 0° | 0.2500 | 0.0195 | 0.1593 | 0.071 | 0.2338 | 0.0297 | 0.1810 | 0.023 |
| 10 | 0.2387 | 0.0189 | 0.1539 | 0.066 | 0.2264 | 0.0290 | 0.1758 | 0.022 |
| 20 | 0.2054 | 0.0171 | 0.1379 | 0.050 | 0.2050 | 0.0268 | 0.1599 | 0.019 |
| 30 | 0.1526 | 0.0141 | 0.1117 | 0.027 | 0.1712 | 0.0232 | 0.1364 | 0.012 |
| 40 | 0.0841 | 0.0101 | 0.0762 | 0.002 | 0.1276 | 0.0186 | 0.1048 | 0.004 |
| 50 | 0.0051 | 0.0052 | 0.0325 | 0.033 | 0.0776 | 0.0130 | 0.0676 | 0.003 |
| 60 | 0.0785 | 0.0005 | 0.0182 | 0.060 | 0.0250 | 0.0068 | 0.0274 | 0.009 |
| 70 | 0.1595 | 0.0068 | 0.0743 | 0.078 | 0.0258 | 0.0007 | 0.0131 | 0.013 |
| 80 | 0.2309 | 0.0135 | 0.1341 | 0.083 | 0.0709 | 0.0054 | 0.0510 | 0.015 |
| 90 | 0.2854 | 0.0204 | 0.1958 | 0.069 | 0.1073 | 0.0110 | 0.0831 | 0.013 |
| 100 | 0.3160 | 0.0274 | 0.2574 | 0.031 | 0.1316 | 0.0155 | 0.1068 | 0.009 |
| 110 | 0.3165 | 0.0341 | 0.3172 | 0.035 | 0.1424 | 0.0188 | 0.1194 | 0.004 |
| 120 | 0.2819 | 0.0404 | 0.3733 | 0.132 | 0.1392 | 0.0204 | 0.1188 | |
| 130 | 0.2084 | 0.0461 | 0.2104 | 0.048 | 0.1234 | 0.0202 | 0.1044 | 0.001 |
| 140 | 0.0938 | 0.0510 | 0.0471 | 0.004 | 0.0977 | 0.0180 | 0.0804 | 0.001 |
| 150 | 0.0620 | 0.0550 | 0.1117 | 0.005 | 0.0662 | 0.0138 | 0.0524 | |
| 160 | 0.2574 | 0.0252 | 0.2612 | 0.029 | 0.0347 | 0.0078 | 0.0262 | 0.001 |
| 170 | 0.4885 | 0.1041 | 0.3968 | 0.012 | 0.0100 | 0.0024 | 0.0072 | |
| 180 | 0.7500 | 0.1792 | 0.5144 | 0.056 | | | | |

It is believed that while this method may not lead to an exact determination of pipe stresses, owing to the neglect of tangential forces and deflections, it furnishes a rational basis for saddle design, and gives results which do not depend upon arbitrary assumptions of pressure distribution.

## Duralumin Made Brittle by Corrosion

Sheets of duralumin used in aeroplane construction have been found to become brittle in service by the development of intercrystalline weakness or cracking. This action has been studied at the Bureau of Standards, and it is found that it can be produced either by corrosion alone or by corrosion and stress acting simultaneously. Both acid and neutral solutions displayed this effect, while alkalis did not. Annealing and cold rolling did not materially affect the corrosion.

## Road Transport by Railways

(London Correspondence)

THE committee of eight, appointed by the British Ministry of Transport, "to enquire and report whether it is desirable that the railway companies should have general or limited powers to carry goods by road, and, if so, what, if any, conditions should be attached to the exercise of this power," has issued three separate reports. These are, briefly:

1. The railway companies have given assurances that they do not intend to obtain a monopoly of road transport by rate-cutting, but restrictions should be imposed which would make such action impossible. An objection to the granting of general powers to railway companies to carry goods by road is that the indirect effect would result in increasing the power of the railway workers' unions, and that, in the event of a railway strike, it would be more difficult for the government to organize road transport. The gist of this report is that railway companies should be given the right to run road services under certain restrictive conditions.

### Traffic Diverted To Highways.

2. Although to some extent traffic has been diverted from the railway lines to the roads by means of independent carriers by road, that traffic in no sense belonged to the railway companies, but is the legitimate extension of the business of the old road haulage contractor. It is ancient history that the railways, by reason of the greater facilities they afforded, have diverted traffic from stage coaches and other horse-drawn vehicles and from canals. If the internal combustion engine as applied to vehicles running on the road does divert traffic from the railways, the companies are only suffering in their turn what happened to the stage-coach proprietor, road-haulage contractor, and the companies owning canals. In the view of the committee only those are entitled to traffic who can carry it in the best and cheapest way, and therefore the committee is not prepared to recommend that a railway company should begin, under the powers of an act of Parliament, an entirely new trade. "We are satisfied," the committee states, "that the haulers and the railway companies have resulted in benefit to the public. In our view, railway companies, if they are prohibited from carrying direct by road, would be induced by the competition of legitimate road haulage to give better facilities on the railways and to fix their rates at a reasonable level. If, on the other hand, they were allowed to carry on the trade of carriers by road, they would not have the inducement to do the best they possibly could with the railways."

3. The third report, which is signed exclusively by a prominent trades unionist belonging to the United Vehicle Workers and National Transport Workers' Federation, says: "I am not disposed to recommend that railway companies be given any further powers without their first proving, by the efficient application of their present power, that they are prepared to give the public better service. I am, however, in favor of granting powers to the railway companies to establish "test services" in agricultural or other sparsely populated areas, purely for development purposes." The gist of this report is that nationalization of all forms of transport is the only complete solution.

# Railroad Ash-Handling Plant Has Buckets and Crane

### Installation on Burlington Railroad Designed for Economical and Direct Handling From Pits to Cars

AN EXTENDED study was made of various types of pits and ash-handling devices in order to secure a plant which would give the most economical service and best meet local conditions where improved ash pit facilities were required at the engine terminal of the Chicago, Burlington & Quincy R.R. at Denver, Col. A compact arrangement was specially desirable on account of limited space. The arrangement selected, constructed along the lines of plants developed and built by the Buffalo, Rochester & Pittsburgh Ry., comprises a series of cast steel buckets placed in shallow pits to receive ashes directly from the locomotives. The buckets are handled by means of an overhead crane from the pit directly to the ash car, as shown on the drawings.

Two concrete ash pits, 72 ft. long, and a parallel ash car track are spanned by the 5-ton electric traveling crane, Fig. 1. The crane runway and supports are of timber construction, on creosoted piles and sills. The pits are of unusual shape, with sloping sides in the upper part and narrow rectangular lower portion, old 56-lb. rails being imbedded in the sloping surfaces with their bases projecting ⅛ in. from the surface of the concrete. Each parapet wall is capped by a 12-in. channel, to which the 85-lb. track rail is secured by clips and bolts.

The buckets, each with a capacity of about 2 cu.yd., are seated on the projecting rails of the pit walls. When all the buckets are filled the traveling crane is put into service to lift and carry them over the cinder car, where they are dumped automatically and then replaced in the pit. In dumping, the bucket opens at the bottom like a clamshell, the two halves being carried by a pair of scissors levers at the middle. When the loaded bucket is over the ash car it is raised to bring the horizontal arms of these levers in contact with a ring on a frame projecting below the crane trolley, as shown. With further hauling of the cable the lever arms are depressed and swing the bucket open. The average time of emptying the buckets, or cleaning the two pits is 75 to 80 minutes.

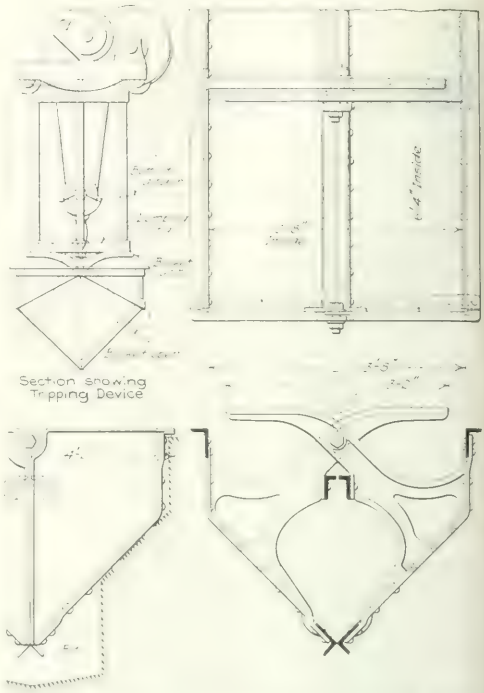



FIG. 2. BUCKET FOR RECEIVING LOCOMOTIVE ASHES

About 45 engines have fires cleaned in the 24-hour period. Shoveling ashes from the pit directly into a car was the former method employed at this terminal, and the new installation has effected a material saving in labor. The design of this ash-handling plant was developed under W. T. Krausch, engineer of buildings; F. T. Darrow, assistant chief engineer, and A. W. Newton, chief engineer, all of Chicago, Burlington & Quincy R.R.

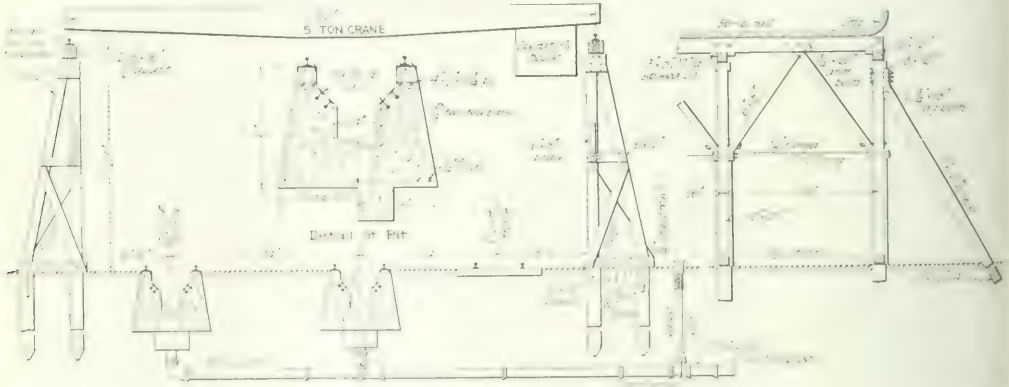



FIG. 1. ASH PIT WITH OVERHEAD CRANE

# Nitrogen—with Special Reference to Activated Sludge

*An abstract by Kenneth Allen, Sanitary Engineer, Board of Estimate and Apportionment, New York City, of a 93-p monograph by Dr. Gilbert J. Fowler, entitled "The Conservation of Nitrogen with Special Reference to Activated Sludge," comprising the December issue of the "Journal" of the Institute of Science, Bangalore, India (rupees, 2-8-0).*

DR. GILBERT J. FOWLER, formerly chemist of the sewage-works of Manchester, England, but for some time professor of chemistry of the Indian Institute of Science at Bangalore, India, has published a monograph, "The Conservation of Nitrogen with Special Reference to Activated Sludge," which deserves the careful attention of engineers and scientists interested in the subject. As clearly set forth by Dr. Fowler, the nitrogen problem is one of fundamental importance; in fact, "*the most important problem confronting the human race.*" For even before the supply is exhausted the poverty and distress occasioned by lack of nitrogen as a fertilizer will result in such stress of competition as may explode in war.

As early as 1898 Sir William Crookes pointed out the necessity of increasing the wheat yield per acre and of conserving the nitrogen now lost in sewage and other wastes.

There are three available sources of nitrogen upon which to draw: (1) *Atmospheric Nitrogen*, of which there is a sufficient amount over each square mile of the earth's surface to supply the world's present requirements for 20 years. (2) *Nitrates*, of which the largest source available is some 500,000 tons per annum of Chili saltpeter.

(3) *Organic Nitrogen*, or that recoverable (a) as ammonia from coal, peat or silt; (b) slaughter house refuse; (c) fish meal; (d) animal refuse—leather, bones, hoofs, etc.; (e) green manures; (f) oil cake; (g) animal manure, including 10,000,000 tons of guano recently discovered near Campeche, Mexico; (h) town sewage.

Assuming Rubner's figure of 1.4 grams of nitrogen of fecal origin per capita per day, the world's supply is estimated at 500,000 tons per annum, or, from a total of 8,000,000 tons of solid and liquid excreta, a supply of 1,300,000 tons per annum.

As an illustration of the value of this nitrogen Dr. Fowler mentions the fact that the City of Shanghai received £40,000 per annum from contractors for its nightsoil. In addition to this payment the contractors maintain an army of coolies and a fleet of nightsoil boats. But the method of utilizing the nitrogen of nightsoil by direct application to the land is inadmissible in a society with the ideas of decency that exist in America and Western Europe. How, then, may the products of sewage treatment be utilized by the recovery of this nitrogen content?

Comparing the sludges for different processes we find the following:

PERCENTAGES OF NITROGEN IN VARIOUS TYPES OF SEWAGE SLUDGE. (CALCULATED ON SLUDGE DRIED AT 100 DEG. C.)

| Source | | Percentage |
|---|---|---|
| Sedimentation tanks | Manchester | 3.32 |
| | Lawrence | 2.37 |
| Chemical precipitation | Dorking | [illegible] |
| | Glasgow | 1.50 |
| Septic tanks | Manchester | 2.30 |
| | Lawrence | [illegible] |
| Activated-sludge process | Manchester | [illegible] |
| | Withington Work | 7.00 |

The activated-sludge process—which, by the way, was first suggested and developed by Dr. Fowler—is seen to furnish a product particularly rich in nitrogen, containing even more than the crude sewage. This is due to the action of nitrifying bacteria that are cultivated in the sludge and which cause fixation of nitrogen from the atmosphere. Furthermore the effluent is also rich in nitrates that may be utilized in agriculture by irrigation.

At Withington, Manchester, with a dilute, domestic sewage, the yield was about 500 tons per annum per million inhabitants, a figure almost identical with the estimated demand of that population. So that, without the sacrifice of sanitary or esthetic requirements, a population may be practically sustained by the nitrogen it produces.

The availability of the nitrogen of activated sludge for plant growth demonstrated with such favorable results by Bartow and Hadfield at Urbana, Ill., has been confirmed by Arden at Manchester and by Nasmith and McKay at Toronto. To conserve the entire supply, however, the ammonia and nitrate in the effluent must be utilized, and this may be done either by irrigation of crops or by the culture of fish, as practiced in many places in Austria and in China. The rapid nitrification produced by activated sludge suggests to Dr. Fowler the possibility of producing similar results on ammonium salts available from coal, peat and other substances, and this, with the prevention of nitrogen losses, is a broad subject that is being further investigated.

The fixation of atmospheric nitrogen has received much attention, especially during the war. In the arc process "the oxygen of the air is caused to combine with nitrogen in a high tension electric arc with formation of oxides of nitrogen which are afterward absorbed by water to form nitric acid of 33 per cent strength." This action undoubtedly occurs through the influence of lightning. "It consumes 10.5-hp. years of electrical energy per ton of nitrogen fixed as nitric acid per annum."

The cyanamide process consisting of the formation of calcium carbide by the application of heat to lime and coke, its combination while hot with nitrogen, decomposition by steam under pressure with release of ammonia and the oxidation of the latter to form nitric acid. This required 2.5-hp. years per ton of nitrogen as nitric acid.

Lastly there is the Haber process requiring 0.5-hp. years, and the cyanide process, which may be termed "thermo-chemical."

The world's production by fixation in 1917 was:

| | Tons |
|---|---|
| Arc process | 31,000 |
| Cyanamide | 200,000 |
| Haber | 114,000 |
| Sundry | 39,000 |
| Total | 384,000 |

Regarding these it may be observed that all require high temperatures and high initial and operating expense, while the total product is insignificant when compared with the 8,000,000 tons of nitrogen in the world's excreta.

There remain, however, various ways by which nitrogen fixation occurs through biological action. In 1885 Berthelot suggested this action by bacteria in the soil and three years later it was confirmed by Hellriegel and Wilforth. The chief of these nitrogen fixing bacteria are the *Azotobacter* and *B. radicicola*, the former thriving best on mannite, the latter on maltose, but the best results are reached by the two working by symbosis on dextrin.

Among other things heat has been shown to contain substances that stimulate plant growth termed *auximones*. These are produced by bacteria working on organic matter, rendering it available for plant life, and assisting in the production of the better known vitamines, which are an important ingredient of animal food. It is believed that the bacteria in activated sludge may produce auximones and that it is for this reason that this material shows a superiority to other manures.

Experiments at the Frankland laboratory at Manchester by Mumford and Gaul show a marked increase in the nitrogen of activated sludge over that in the sludge of the raw sewage, due in part to coagulation of colloids, but also to absorption from the air, and these have been confirmed by Sarangdhai and Nayak under Dr. Fowler's direction at the Indian Institute of Science. "The extent to which this fixation can be carried and the conditions of its maximum efficiency have yet to be determined."

From a review of all the evidence Dr. Fowler draws the following conclusions:

1. By scientific and economic use of waste material the nitrogen requirements for the world's agriculture can be readily supplied.
2. Very large populations in China and elsewhere are already adequately supplied without the need of artificial fertilizers.
3. Inorganic nitrogen in the form of nitrate, sulphate of ammonia or calcium cyanamide is not alone adequate for plant growth.
4. Auximones are necessary for vigorous plant life.
5. These are only found in organic manures.
6. Of these, *activated sludge* has given the most striking results.
7. If properly utilized this process offers the recovery of all the nitrogen in town sewage.

In order to obtain the best results further research is required in the form of laboratory, field and technical experiments, the suggested details of which are outlined.

# Bridge Across Colorado in Grand Canyon Completed

THE views on this page show completed the 500-ft. suspension bridge across the Colorado River in the Grand Canyon, the design of which was described in *Engineering News-Record*, Feb. 10, 1921, p. 254. The smaller view to the right is down the north anchorage toward the south side of the river; the larger view below is looking upstream from the left, or south, bank. D. L. Reaburn, superintendent of the Grand Canyon National Park, and the engineer who supervised the construction of the bridge, writes as follows.

The bridge was completed and opened for travel on May 15. No difficulty was experienced in getting horses and mules to cross. At first the animals were somewhat skittish about starting onto the bridge, but they soon became accustomed to it.

The cost of the bridge including the approach trail was about $17,000. The total amount of material packed into the canyon including camp equipment, supplies, forage and bridge material was about forty-five tons. The pack train was running continuously from Dec. 15, 1920, to May 15, 1921. The period of bridge work was from Feb. 1 to May 15, work during the previous six weeks having been on the building of a trail two miles in length from top of the Granite Gorge to the river.

The problem of transporting the main cables was solved by packing 200 lb. of cable on a mule at each end, and the intervening 300 ft. of cable was carried by 15 men, carrying a weight of about 35 lb. each, spaced at a distance of 20 ft. The only trouble encountered was to prevent the cable from throwing a kink in rounding the sharp turns in the trail.

SUSPENSION BRIDGE ACROSS COLORADO RIVER AT BOTTOM OF THE GRAND CANYON

The eleven miles from rim to river were covered in five hours.

Already rim to rim travel has increased—and when the Kaibab Trail up Bright Angel Creek is improved, and telephone communication established (which will be done next fall and winter) the bridge will supply a long felt want for crossing the canyon. The north rim country known as the Kaibab Forest, contains the largest undeveloped tract of timber in the United States, and probably the largest herd of deer, estimated at fifteen to twenty thousand. When railroad communication to the north rim his been established by the construction of a railroad from some point on the Salt Lake in Utah, the north rim will become one of the greatest summer recreational grounds in the United States, and with a commercial rim-to-rim aviation service it will be possible for the transcontinental traveler to route over the Union Pacific via Grand Canyon, completing the journey over the Santa Fé, or vice-versa.

The official name of the bridge is the Kaibab Suspension Bridge, and the rim-to-rim trail is known as the Kaibab Trail.

## Progress Made in Federal Water Power Development

UNDER date of July 8, 1921, the Federal Power Commission has issued a statement of the progress made in the first year of operation of the Federal Water Power Act of June 10, 1920. An abstract follows:

Up to June 30, 1921, there had been filed with the Commission 229 applications aggregating 14,675,000 hp. and affecting 33 states, the District of Columbia, and Alaska. This amount is 75 per cent greater than the entire water-power development of the United States today. It is 50 percent greater than the combined water-power resources of Norway and Sweden, and considerably in excess of the combined resources of France and Italy. It is five times greater than the aggregate of all applications filed with the federal government in the preceding 15 years. The projects applied for vary in size from less than 100 horsepower up to the three million horsepower scheme of the Southern California Edison Co. on Colorado River.

Although the commission has been obliged to work under serious handicap, it has nevertheless accomplished many things in the first year of its operations. The law under which it acts is complicated, and great care has been necessary in the preparation of rules and regulations for its administration. The first ten regulations, covering the requirements for applications, were issued on September 3; the remaining ten, covering maintenance and operation of project property, rental charges, depreciation and amortization reserves, allocation of earnings, and accounts and reports were first issued on February 28 and later revised and reissued on June 6.

The issuance of permits and licenses necessarily awaited the approval of the regulations. The first license was issued on March 1 to the Niagara Falls Power Co. Between that date and July 1, final action has been taken on 47 applications, 13 preliminary permits have been issued, involving 1,075,000 hp., and 15 licenses, involving 757,000 primary horsepower and 460,000 secondary horsepower, or a total of 1,217,000 hp., making an aggregate of 28 projects, involving 2,292,000 hp., or as much as was issued by all of the executive departments during the 10 years preceding the passage of the federal Water Power Act. There were also pending on June 30 for final action at the next meeting of the commission 16 applications, involving 190,000 hp.

Only 60 per cent of the applications filed with the commission have been accompanied by sufficient information to warrant more than preliminary action. Seventy-five per cent of them have been advertised in local newspapers, as required by the Act, and an equal number have been submitted to the field for examination, hearing, and report by the several departments. A draft of a system of accounting has been prepared, following as closely as the requirements of the Act will permit the uniform system proposed by the National Association of Railway and Utilities Commissioners. The commission has also instituted investigations of Deschutes and Columbia Rivers as a preliminary to action upon applications for power sites on those streams. It has handled scores of applications for restoration to entry of lands in powersite reserves and has passed upon many legal questions involving the interpretation of the Act. It has been unable to make any of the valuations required by the Act.

The Commission realizes that there is no possibility of immediate development of all the projects applied for. The market could not absorb the power even if its construction could be financed. It does expect, however, that a progressive development of water powers will be undertaken as rapidly as financial conditions and market requirements will warrant. It believes that the Act is workable, and that its provisions will not interfere with the financing of legitimate undertakings,—an opinion which is confirmed by the national association of the electric-power industry. In fact, projects involving hundreds of thousands of horsepower and tens of millions of dollars are now being constructed under licenses issued by the commission. The chief present defect in the Act is its failure to provide adequate means for its expeditions administration.

## New Division of Sanitation, New York State Department of Health

THE newly created Division of Sanitation of the New York State Department of Health, which on July 1 succeeded the Division of Sanitary Engineering, has a personnel made up from that of the old division. Except as to passing on plans for sewerage and sewage disposal the new division has substantially the same duties as the old one.

C. A. Holmquist, principal assistant engineer of the old Division of Sanitary Engineering, is director of the new division of Sanitation, and the following named assistant engineers in the old division have been transferred to the new division with the title of assistant sanitarian: Earl Devendorf, W. W. Young, Alfred Mullikin and A. I. Howd.

The activities of the Division of Sanitation, as outlined for *Engineering News-Record* by Dr. John A. Smith, secretary, State Department of Health, are as follows:

1. General supervision over sanitary quality of some 550 public water supplies, including field investigations, analytical studies and reports.
2. Enforcement of rules and regulations enacted by the Department for the protection of drainage areas of some 90 public water supplies.
3. Preparation of permits for the discharge of wastes, sewage and sewage effluent from municipalities, industrial establishments and public institutions.
4. Examination and approval of plans for the work of the Nassau County Mosquito Extermination Commission.
5. Investigation of major public nuisance.
6. Special investigations ordered by the Governor under Section VI. of the Public Health Law.
7. Investigations and studies of stream pollution and operation of water and sewage disposal plants.
8. Examination and reports of sanitary condition of construction, equipment and operation of milk pasteurization plants.
9. Special investigation of sanitary conditions of parks, fair grounds, camps and other public gathering places.
10. Examinations and reports of the sanitary conditions of state institutions.
11. Investigation of typhoid fever and other water-borne epidemics.
12. Advice to municipalities, corporations and individuals upon sanitary matters, including water supply, garbage disposal, plumbing, ventilation, drainage, etc.
13. Furnishing data to Surgeon-General of United States Public Health Service regarding water supplies used by common carriers in interstate traffic.

# Large Apparatus for Tests of Lateral Earth Pressures

## Measures Pressure Against 6-Ft. Retaining Wall—Test with Sand Gives Satisfactory Check on Theory

By G. M. Braune and Jacob Feld

Professor of Civil Engineering and Instructor in Civil Engineering, University of Cincinnati

SINCE the days of Vauban, the French military engineer who, 200 years ago, laid the foundations for Coulomb's theory of lateral pressures, engineers have been handicapped by lack of experimental data in designing retaining walls, bins, grain elevators, etc. An attempt to establish a correlation between the present earth-pressure theories and the actual existing pressures, and to afford the engineering profession a certain confidence in the design of retaining walls, has resulted in the construction of an earth-pressure apparatus on the campus of the University of Cincinnati, in size much larger than any ever tried before. The free-gate arrangement used is the same as employed in 1906 by Müller-Breslau. The design of the apparatus was conceived by G. M. Braune and C. C. Myers (one time Professor of Industrial Engineering, University of Cincinnati); the details of the design have been worked out by the fellows of the civil engineering department, namely, B. H. Wulfkoetter (1916-17) and Jacob Feld, the latter being responsible for completing the present design, installing the apparatus successfully, and carrying out the tests presented in this article.

The method of obtaining the pressure of earth (or any other granular material) is to measure the horizontal and vertical components of the action of the filling material upon a "free body." A wooden wall, 5 ft. wide and 6 ft. high, fits into the open front of a concrete bin, 5 ft. wide and 9 ft. long, 6 ft. high at the front and 12 ft. high at the rear. The wall is supported by two vertical rods, which rest directly upon 2,000-lb. Fairbanks platform scales. Any vertical force acting on the wall is directly transmitted to the scales and is registered. The horizontal thrust of the earth against the wall is measured by three horizontal struts, one at the top in the center of the width, and one at each of the lower corners. These struts, by rocker-arm arrangements, transmit the pressures directly to 1,000-lb. scales. In this transmission of pressure, the amount is reduced to half its real value. The three horizontal contacts give a stable support and approximately equal scale readings (with full bin), which tends to keep the apparatus in adjustment and equalize strain in the different parts. From the individual scale readings the amount, direction and point of application of the resultant pressure can be computed. The various parts are designed to keep deflections and deformations at a minimum under maximum loading.

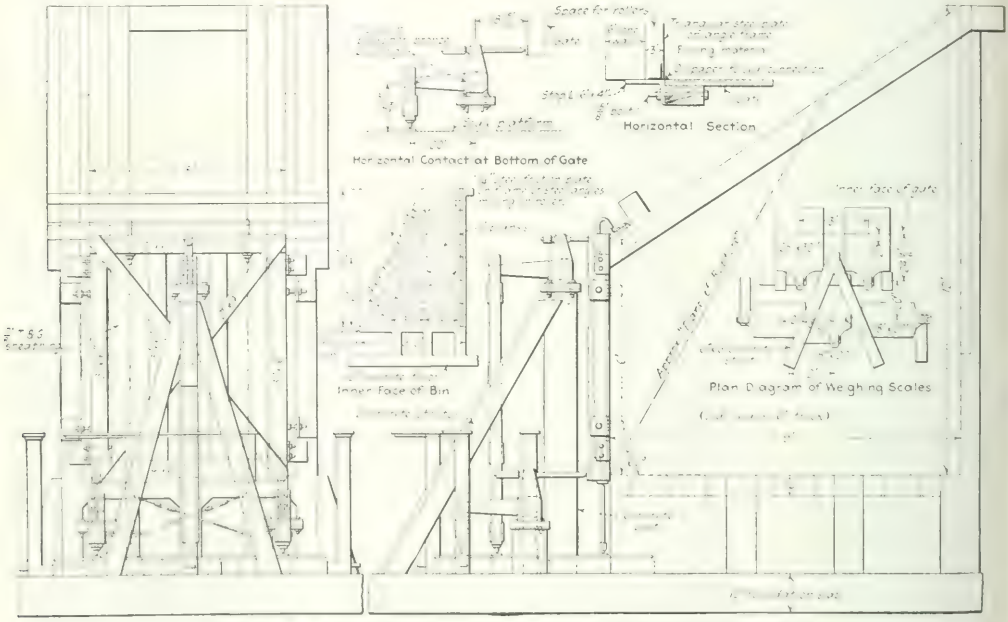

Space for rollers
Horizontal Section
Horizontal Contact at Bottom of Gate
Inner Face of Bin
Plan Diagram of Weighing Scales

FIG. 1. ELEVATIONS OF TEST APPARATUS, AND ESSENTIAL DETAILS

Previous experimenters on such earth pressure have shown the importance of reducing the movement of the test wall under action of the pressure. They also experienced difficulty in sealing the joint between wall and bin, without introducing friction. These points received special study in the design of the present apparatus. To reduce the movement of the wall to a minimum, stops were placed on the scales to limit the range of movement of the scale beams. A range of 1/40 in. was at first provided, but later a range of 1/20 in. was found most satisfactory, since it made reading of the scales easier. With the 1/20-in. play of the weighing beam, the platform of the scale moves 1/2,000 in., since the lever ratio of the scales is 1:100. This is the maximum vertical displacement or possible motion

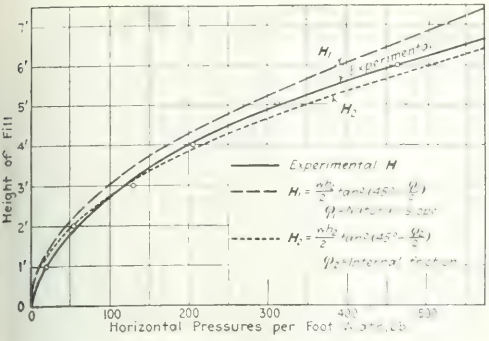



FIG. 2. TEST CURVE FOR SAND AND TWO THEORETICAL CURVES

of the wall. The horizontal motion of the wall is limited to 1/4,000 in., by virtue of the bell-crank multiplication.

The inside face of the free wall is in the same vertical plane as the front edges of the bin sides (see detail in Fig. 1). Thus a close joint is obtained without friction; leakage is prevented by a strip of thin oiled paper in the corner. Short steel angles fixed to the wall and bearing against the bin prevent any motion of the gate toward the bin or *against* the filling material. Lateral displacement of the gate is prevented by angles fixed to the bin.

The retarding effect of the side walls has always introduced an element of uncertainty into earth pressure measurements of this kind. Winkler (1871) used a thin partition wall in the center of his bin, parallel to the sides; thereby getting four friction losses. Without the partition he gets two friction losses and so determines the value of each retarding force. This method has been shown to be inaccurate. Müller-Breslau (1906) states that some correction must be made in his results to take this loss in pressure into account, but does not try to evaluate it. In this apparatus the friction between the filling material and the side walls is eliminated. The part of the earth which tends to slide (wedge of rupture) is a triangular prism, since the surface of rupture is approximately a plane. The sides of this prism are in contact with two stiffened steel plates, to each of which are fastened three rollers (on phosphor-bronze bushings). The rollers bear on the inside face of the concrete side walls, on polished surfaces. The side walls below and back of these steel triangles are faced with timber, so that the clear width of the finished bin is 5 ft. at all points. A thin strip of oiled paper covers the joint between the timber and steel plates, keeping out the filling material from the cracks. The steel triangles are exactly counterbalanced vertically. The filling material binds against these plates, and any tendency for the wedges of rupture to separate from the rest of the filling material will cause a movement of the steel plates, thus eliminating the side-wall action, except the friction in the rollers, which, however, can be determined but is small. The effect of the side-wall friction can be determined by running a set of tests with these plates fixed to the side walls.

*Method of Operation*—Before any filling is placed in the bin, the riders are run out on the scale beams, so that the beams will always be down. The reading on the scales will at all times be in excess of the computed active earth pressures; the wall is prevented from moving into the bin by the bearing angles. Then, by moving the riders and allowing the beam to float, we will get active and not passive pressures. In this manner we are also able to eliminate the deformation in the struts, and the scale movements recorded represent the actual movements of the wall. By changing the positions of the stops we are able to control the amount of movement of the wall.

An extensive set of experiments has been outlined. It is intended to conduct tests on various materials, under different conditions, as to methods of filling, moisture content, surcharge, etc., acting upon various walls. The inclination of the wall can be easily changed; by attaching a triangular prism, we can have a back face which slopes forward or slopes backward.

*Tests with Sand*—The following is a part of some of the tests which were made on the material excavated from the Cincinnati subway cut on Canal St.

The material is sand, containing about 3 per cent of clay, 9.4 per cent of water, and weighing 100 lb. per cu.ft. Specific gravity is 2.64. A mechanical analysis shows 8 per cent retained on the ¼-in. sieve, and 62 per cent passing the 28 sieve. The angle of natural repose was 40 deg. The angle of internal friction was 34 deg., found by actual experiment.

The angle of friction between the sand and the dry wood of the wall was 26 deg. The angle of friction

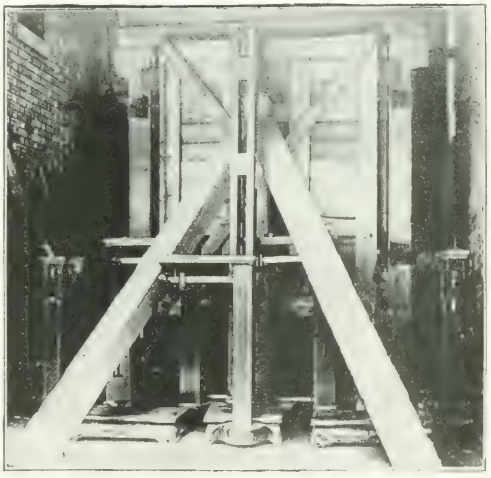


FIG. 3. FRONT VIEW OF BIN AND WEIGHING SCALE

between the sand and the wet wood of the wall was 31 deg. When the bin was emptied, it was noticed that the wood was wet, and the angle of action of the resultant ($\phi'$) should be 31 deg. Readings were taken for every 3-in. increase of fill, the material being shoveled in horizontal layers. A few of the readings are given below. The tabulated quantities are defined as follows:

$h$ = height of fill, feet;
$P = \sqrt{H^2 + V^2}$, total pressure per foot width;
$H$ = horizontal component per foot width, pounds;
$V$ = vertical component per foot width, pounds;
$\phi'$ = angle of inclination of the resultant from the normal to the back of the wall; $\tan \phi' = V/H$;

$x$ = height of point of application above the base of the wall = $\frac{H \text{ top}}{H \text{ total}}$;

$x\,h$ = ratio of height of the point of application of the resultant to total height of fill;

$H_1$ = theoretical horizontal component from formula $H = \frac{wh^2 \tan 45}{2}$;

$w$ = weight per cu.ft.;

$\phi_1$ = angle of natural slope (40 deg., as determined for this material);

$H_2$ = same as $H$, where

$\phi_2$ = angle of internal friction (34 deg., as determined for this material).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 ft. | | | | | | | | 14 lbs. |
| 2 | | | | | | | | 56 |
| 3 | | | | | | | | 127 |
| 4 | | | | | | | | 226 |
| 5 | | | | | | 360 | 272 | 352 |
| 6 | | | | | | | | 507 |

The curves reproduced in Fig. 2 herewith show the relations between $H$, $H_1$, and $H_2$. The readings constitute an average between three sets obtained under the same conditions. The readings checked very closely, especially for fills over 3 feet.

*Conclusions*—For this case, horizontal fill and vertical wall, the curves show that the formula may safely be used, if $\phi$ is taken as *the angle of internal friction*. For this special case, Coulomb's and Rankine's theories give the same formula, but both used the angle of natural slope. Further experiments showed that the maximum pressure occurs just after filling, and slowly decreases as the fill settles. The above readings are the maximum values, obtained just after filling.

## Water Treatment Plants in Iowa

Out of 475 municipal water plants in Iowa less than three dozen attempt to purify the water. At twenty plants filters or coagulation and sedimentation basins exist. There is one iron-removal plant and a dozen chlorination installations for water from wells or infiltration galleries. Jack J. Hinman, Jr., bacteriologist and chemist of the Iowa State Board of Health, in a paper before the Iowa Engineering Society, stated that samples examined by the State laboratory indicate that nearly every plant has given at least one unsatisfactory result during the period 1914 to 1920.

| | | | | | |
|---|---|---|---|---|---|
| Chariton | 12 | 4 | Lenox | 8 | 4 |
| Fairfield | 12 | 2 | | | |

It is his opinion that unless effluents are watched daily so as to provide some way of quickly spotting inadequate treatment, unsatisfactory water may be supplied for long periods. Daily analyses are made at Des Moines, Cedar Rapids, Council Bluffs, Davenport, Iowa City and Oscaloosa. Frequent analyses are made of the supplies at Burlington and Keokuk.

The accompanying table gives the details of bacterial sampling in fifteen of the cities where investigations were made.

## Tests on Built-Up Timbers

PROGRESS reports are now available of the strength tests of built-up southern yellow pine timbers made at the Forest Products Laboratory, Madison, Wis. In tests on 11 built-up beams it has been found that there is no marked difference between built-up beams of "dense" material practically free from defects and solid beams of "dense" material with defects limited as in the select structural grade of the Southern Pine Association. Advantages of built-up beams consist in the utilization of smaller stock, quick and easy seasoning, availability and the possibility of avoiding bad checks, shakes and other defects. The tests were made at the Forest Products Laboratory in co-operation with the National Lumber Manufacturers' Association by G. E. Heck, engineer in forest products.

Each built-up beam consisted of five 2 x 12-in. planks 16 ft. long bolted together. The planks composing a beam were matched by comparing ends, material of practically the same quality being used in each beam, and were surfaced on both sides in order to have the resulting beams of uniform dimensions and all planks fitting closely together. After the built-up beams had been tested, small clear test specimens called "minors" were sawed from each plank in the beam near the point of failure and tested according to the laboratory's standard method for testing small clear specimens. The nominal sectional dimensions were 1.6 x 2 in.

The ratio of the modulus of rupture or maximum fiber stress of the built-up beams to that of the small test specimens was 72 per cent, while the same ratio for the solid beam was 66.3 per cent, based on average values. The ratio of the modulus of rupture of the built-up to the solid beams was 107 per cent.

The modulus of elasticity of the built-up beams was 16.2 per cent higher than the average of the small test specimens, while for the solid beams this value was 17.8 per cent higher.

As a rule the stiffest plank in a built-up beam takes the largest share of the load and the planks of lesser stiffness receive proportionately smaller shares. The stiffness, or modulus of elasticity of the planks in a built-up beam may vary under extreme conditions more than 100 per cent of the lowest value.

The large number of tests made at the laboratory on small clear specimens has shown that a piece of high modulus of elasticity normally deflects farther at the elastic limit and at maximum load than a less stiff piece. This being true, it is apparent that the built-up beam is most likely to fail in a plank of low modulus of elasticity rather than in the stiffer plank even though the latter carries a larger share of the load. This, however, is not true of defective material, for the first failure will usually occur in the most defective timber. The strength of the built-up beam depends upon the deflection the defective piece takes at failure.

The Forest Products Laboratory has made no tests with defective built-up beams to ascertain if the defects in the component planks can be staggered in the beam and the latter so fastened together that results will be comparable to results on solid beams containing the same number and size defects similarly located. Neither have any tests been made to determine if laminations will act independently as individual beams, each breaking at its particular defect, the net results being practically equivalent to having all the defects at the same point in a solid beam.

## Short Courses in City Planning in California

Friday and Saturday evening lectures on city planning, to extend through six weeks, were begun at Sacramento in May, under the auspices of the University of California Extension Division and the California Real Estate Association. Other short courses in city planning were proposed for San Francisco and Oakland and have already been given in Los Angeles.

# Fence of Wire Cloth Retains Hydraulic Fill

## Steel Pile Cofferdam, 900 x 750 Ft., Built Within 1,000 x 918-Ft. Bulkhead for Milwaukee Sewage Works

By R. R. Lundahl
Division Engineer, Milwaukee Sewerage Commission, Milwaukee, Wis.

A FENCE of ⅜-in. and ¼-in. wire cloth held to shape successfully a long narrow fill recently made by a hydraulic dredge in connection with the construction of the new sewage works at Milwaukee, Wis. Whereas a board fence was repeatedly undermined and torn out, the wire fence let the water through and still retained the solids because of the porous mat of light material formed against the close mesh.

As indicated by Fig. 1, a reclaimed area about 1,000 x 918 ft. off the east shore of Jones Island, is the site of the new sewage works. The contract provided for building approximately 1,800 lin. ft. of pile bulkhead filled with stone; for driving 2,400 lin. ft. of steel sheetpile cofferdam, and tie piles to support the same, including batter piles; for placing all tie rods and cables; for excavating within the cofferdam to an elevation of 12; and for placing the excavated material between the pile bulkhead and the steel sheet piling.

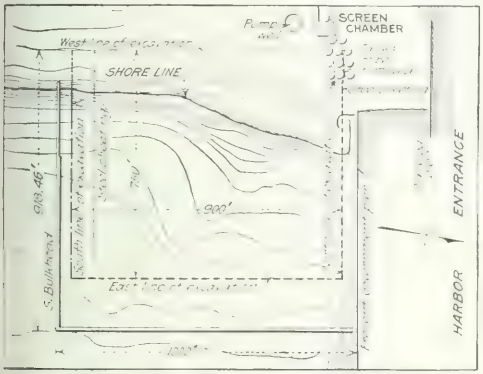



FIG. 1. PLAN OF BULKHEAD AND COFFERDAM, MILWAUKEE SEWAGE WORKS

A hydraulic dredge, having a 24-in. discharge excavated the material. Necessarily a very large amount of water was discharged with the solid materials, and this water washed the fill so that it could not be retained above the top of the pile bulkhead, and from there it took a slope down to the top of the sheet steel piling and spilled over into the cofferdam.

A solid board fence, heavily braced was first built 20 ft. back from the steel sheeting and parallel to it, along the entire east side. The theory was that this fence would impound the water and allow the solid particles to settle out, the water flowing over the top of the fence. This proved to be a costly failure; instead of spilling over the fence the water worked its way underneath, and in a very short time the fence, bracing and all, was washed out. The fence was rebuilt several times, with different bracing, but always with the same results.

In place of using boards it was suggested that the fence be built of heavy wire cloth. The contractors regarded this plan skeptically, but after persuasion finally agreed to try it. The fence boards were removed and 24-in. wire cloth of ⅜-in. and ¼-in. mesh (galvanized) was substituted.

The theory of this construction was that there was enough light material, such as grass, cinders, sticks and bark, which would not pass through the cloth, to form a barrier for the heavier materials but still allow the water to pass through.

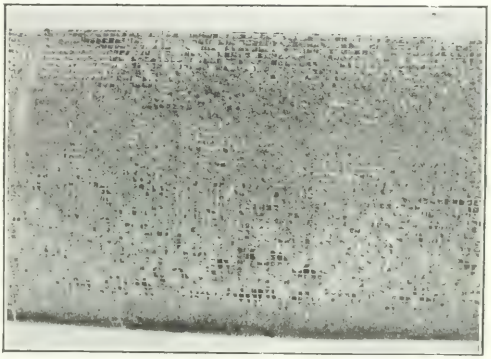


FIG. 3. VIEW OF BARRIER MAT ON WIRE FENCING

The fence worked exactly as had been expected. The water always carried enough lighter materials to form a barrier mat on the fence, in fact there was enough to keep the "scum" on the fence about 6 in. above the solid materials. The water passed through the scum and the wire cloth very nicely, whereas the heavier materials were settled out on the fill as desired. Scarcely any of the coarser sand or dirt passed through the fence, in fact only the very finest particles of sand escaped.

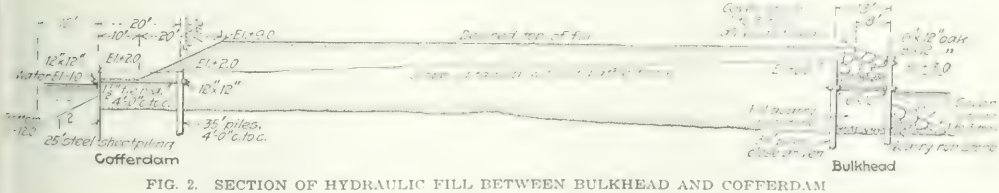



FIG. 2. SECTION OF HYDRAULIC FILL BETWEEN BULKHEAD AND COFFERDAM

No only did the wire cloth fence form an excellent barrier for the floating materials, but it also formed a drain for the fill next to the fence so that very little pressure was exerted upon the fence. In some cases the wire cloth spanned as much as 15 ft. Credit should be given for the construction of the fence to Carl Nelson, field engineer for the Great Lakes Dredge & Dock Co., the contractors for the work.

# Population Density as a Basis for Housing Regulations

## Intensive Rochester Study Indicates That Improved Transit, Industrial Decentralization, Zoning and Other Current Changes Render Dense Tenement Populations Unnecessary in Most Cities

By Frank B. Cartwright
Assistant Engineer, Bureau of Municipal Research, Rochester, N. Y.

IT IS THE OBJECT of this discussion to demonstrate that the tenement, in its present form as an urban institution, is no longer justifiable from any point of view, and that the housing laws and building codes which regulate tenement construction are without logical bases for their requirements and limitations. The observations which led to these conclusions were made in the course of a study of the Rochester building code, and of zoning procedure, land and improvement assessment and transportation facilities in that city. It is believed that an analysis of the housing conditions in any large city may be made in the manner described and that such an analysis will show almost invariably that the density of population allowed by the building

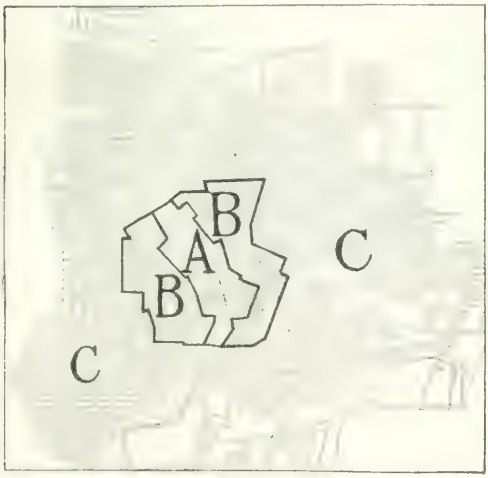



FIG. 1. THREE MAIN USE DISTRICTS, ROCHESTER, N. Y.

code is unjustifiable from the point of view either of the public, the tenement owner, or the tenement dweller.

It is a question whether the dense concentrations of human beings and their works, now characteristic of our cities, will not entirely disappear within a comparatively short period under the influence of recently developed transportation facilities. It certainly is true that many of the generalities which apply to the previous development of cities must be cast aside in predicting future development, because the reasons which underlie these general rules have altered or disappeared. The city stands for co-operation, which involves also association of human beings. Therefore, up until recently, the city was of necessity a close-packed hive of humanity. The telephone and an increase of several hundred per cent in the efficiency of transportation have removed in part the necessity for concentrating large numbers of people upon small areas of land. The results of these changed conditions are just beginning to be important, and one of the first to be expected is the elimination of the tenement as it now exists. Its only reason in the past has been the need of working men and women to be within a short distance of the highly centralized industrial and commercial districts in which they were employed. The area within walking distance of these districts or within the radius of cheap and quick street transit was much restricted by lack of the rapid transit facilities, the comprehensive street-railway systems and automobile transport which we now have. The number of people who were called upon to reside in close proximity to these central areas was unlimited by any restrictions on the height or area of the business structures which were built to house their labors or by any distinctions as to the type of enterprise which could be carried on within those areas, limitations of both of which are characteristic of the building codes and zoning ordinances now in force.

The need to be near the place of employment was capitalized by land owners and disproportionate land values were created, based on the very dense type of development necessary because of the concentration of the working population. The high value of land in turn required that every possible inch of surface be developed to as great a height of structure as was practicable in order that the builders' investment might pay dividends, and the watchful land owner followed, or in some cases anticipated, each new possibility of development with a further increment in the valuation of land. The limit of this progression, both figuratively and actually, was the sky, before building regulation stepped in, and the result was the congestion of population and low standards of housing which we find in the older tenement districts of American cities.

With the coming of better, quicker and cheaper transportation facilities, the need for such concentration in great part disappears. An increasing proportion of the population possesses sufficient income to allow of occupying private homes in the outer areas of land which, by reason of their greater extent in comparison to the demand, are cheaper, and to afford the time and expense involved in the longer journey to and from work. This effect of rapid transit, slow at first, is accelerating rapidly, and lately is much increased by the tendency toward decentralization of industry and by certain other causes to be discussed a little later.

*Present Methods of Regulation*—The need for tenements, at least partially, has ceased, but their construction continues under control of building regulations, usually known as "tenement house laws." Practically all of these laws now in force are fashioned along the same lines, being adaptations of the tenement house law evolved for the purposes of New York City. Each sets a limit to the height of tenement structures and the percentage of lot area which they may cover under different sets of conditions; prescribes to a certain extent the size and arrangement of courts and yards provided for entry of light and air; and regulates the size and arrangement of rooms and windows. Variations between laws occur rather in the terms of

such restrictions than in the method. Each represents a compromise between the recognized disadvantages of tenement house life and the influence of those who would have tenement building unregulated; in other words, a balance between the interests of the tenant and the builder.

Through such laws an attempt is made to assure the tenement dweller of certain desirable privileges by the withdrawal of which his landlord would profit. The degree to which his general welfare is protected has depended in the case of each tenement house law on the adverse influence of the tenement house builders as a class, on the extent to which tenements were regarded as a necessity, and on the extent to which the courts have been disposed to regard such regulation as coming under the police power.

*Determination of Necessary Population Density*—To arrive at the facts which would govern population density in the absence of the special influences mentioned above it is necessary to consider the territorial relations which characterize the usual American city.

Lacking the influence of special topographical features, a city will be roughly circular in shape and made up of three concentric areas. There will be a central section, *A*, for business and industry; a belt, *B*, of surrounding heavy residential areas, the outer radius equal roughly to the distance that people will walk to and from work; and a still larger belt, *C*, of territory which can be reached in a reasonable time by surface cars. The two outside areas will usually be cut by several radial thoroughfares along which are business buildings in the heavy residential belt, and business and tenement buildings in the outer belt. Speaking in general, the population of the city lives in the *B* and *C* areas, and works, shops and amuses itself in the *A* area. The boundaries of such districts are often vague; business or industrial foci will exist in the outer areas; and isolated residence districts in the central area, but if balanced against the mass of the city these exceptions will be found to be unimportant in extent.

It has been found that one mile is about the maximum average distance which people will walk to and from work, and five or six miles about the limit for ordinary street railway transportation. The outer radius of the *B* area will therefore be about one mile and that of the *C* belt not over five or six miles from the center of the *A* area. Local conditions may and do distort these boundaries, extending them in one place and withdrawing them in another. Some form of rapid transit, with a consequent unbalancing of the city's growth, usually enters in before the maximum limit of the outer belt is reached. Speaking in general, however, conditions will be about as described.

A portion of the population must, by reason of poverty, or will, by preference, live close to the center area; or within the outer boundary of the *B* area. The rest of the people in the city, able to spare the time or the money, will live outside the *B* area and mostly in one- or two-family dwellings, both of which avoid most of the abuses connected with tenement houses. It appears, then, that the extent of tenement housing necessary depends solely on the necessary population density in the *B* area. The excuse, if any, for multi-family dwellings, or rather for more such, if they are built, will be that the area within the one-mile circle will not otherwise accommodate those who must live there. The density of the population in the crowded *B* area; the height of the tenements there; the narrowness and dampness of their courts; the lack of play area for children, and of privacy for elders; all the abuses which go with tenement life and to which building codes and housing laws attempt to set limits, logically should depend on the extent of the area and the population which must be sheltered. It appears, furthermore, that legislation concerning the height, area, and structural arrangements of tenements, being in effect a compromise between the apparently conflicting interests of different classes, does not go to the root of the matter. The solution of the problem is arithmetical. A division must be performed: — population ÷ acreage = population density. With the quotient in mind, each tenement must be limited to accommodate as many people as the acreage of its lot will warrant and reasonable and compatible restrictions as to height, area, and structural arrangement must be provided. Only thus will housing regulations be evolved which afford a maximum of public protection in the face of the practical demands of the situation.

Having reached this conclusion, it remains to determine for the individual city the dividend and divisor, the prospective tenement population, and the acreage available for its accommodation. It is difficult to make close estimates of these matters, for there are many factors which may influence the flow of population, not all of which can be foreseen. The problem is much simplified in cities which have adopted zoning ordi-

FIGS. 2 AND 3. TENEMENTS SHOWN AT THE LEFT (2) ARE DIRECTLY ACROSS THE CORNER FROM THOSE AT THE RIGHT (3)

The families housed in the tenements, if evenly distributed, would give a development on the land shown in (3) more in accordance with site value.

nances and in which, as a consequence, the boundaries of the respective areas are well defined. It is possible, however, in any case to make such estimates with sufficient accuracy to permit of regulating tenement building so that the cupidity of landlords alone will not determine the type of the city's housing accommodations. It does not appear that the preparation of such an estimate or its support in the courts is more difficult than many of the investigations which have been necessary to the preparation of zoning plans.

To make this discussion apply more generally the following demonstration, which is based on conditions in Rochester, N. Y., is made without reference to the zoning ordinances in force there, though the effect of these is to define a much larger tenement area than the size of the city would seem to justify.

*Area of "B" Districts*—Rochester's present business and commercial development is mostly comprehended in an area 1¼ miles long and ½ mile wide, symmetrically located with respect to the Genesee River and Main St. There are a number of growing industrial centers and many scattered plants outside this area. There also are many dwellings, both tenement and otherwise, within the central area as defined on the accompanying map. All these appear for the prosecution in the case against the tenement, since they tend to reduce the number of people who must be housed within walking distance of the central area, and to make it easier for workmen, without crowding, to be near their work.

In the case of Rochester the one-mile limit for the outer radius of the *B* area results in a belt ⅜ mile wide on both sides of the central area, and ⅜ mile wide on both ends. As noted heretofore the *B* belt is cut by a number of thoroughfares only partly usable for residential purposes, and there is also a considerable area at each end of the business district which is not inhabitable on account of the river and industrial developments. After making allowance for these lost areas there still remain the two side belts, which are 1½ miles long and ⅜ mile wide, a total area of about 1,200 acres. It is not meant that this area is that required to house the entire working population, but that the areas described are the only ones within which the erection of multi-family dwellings might be justifiable through the need of people to be near their work. Other commercial and industrial foci in the city are small enough or scattered enough to permit of housing their tributary population in normal fashion.

## Maximum Population Density

*Population in "B" Districts*—The following observations, taken together with Rochester's population of approximately 300,000, are helpful in determining the population which the 1,200 acres may reasonably be required to accommodate.

1. With the possible exception of New York, from 50 to 90 per cent of our larger urban populations live in single- or two-family dwellings. Data gathered in the course of a census of refuse collection stops, made in Rochester in 1917, indicate that eight out of ten Rochesterians are thus accommodated.

2. At about the million mark in the history of a city ordinary street-railway transportation becomes inadequate and rapid transit facilities of some kind begin to spread the population more widely and to break up the normal balance between population in *B* and *C* areas. Because of conditions in Rochester, unusually favorable to rapid transit development, it is thought that this influence will be felt before even the 500,000 mark is reached, but here, as elsewhere in this discussion, it is intended to make every necessary assumption well on the safe side.

3. Business and pleasure traffic increases about as the square of the population. For a Rochester of 500,000 people street traffic would therefore be nearly three times as great as at present. It is inconceivable that such an increase could take place without a considerable expansion in the central area and corresponding growth of the *B* areas. In fact, traffic difficulties already have resulted in the initiation of a parallel to the main business street, which will widen considerably the *A* and *B* areas as they stand at present.

## Decentralization of Manufacturing Plants

4. There is a steady and increasing movement, both in Rochester and elsewhere, to decentralize manufacturing and to build up industrial centers about the present outskirts of the city. Each move of this kind tends to spread the population more evenly and to reduce the strain upon the housing accommodations in the *B* areas.

5. The average population density of the ten largest cities in the United States is less than 20 persons per gross acre. Rochester, in spite of its comparatively large park and water areas, has better than 18 persons per gross acre. It therefore is not to be expected that an increase in the population will mean a much greater population density or more inhabitants proportionately for the *B* areas.

In view of the foregoing considerations and making every possible allowance for the effects of contrary influences, there seems no reason to expect that Rochester's tenement belts will be called upon at any time to house more than 30 per cent of the population or that the city's total population will exceed the half million mark without either a corresponding increase in the areas devoted to tenement dwellings, a lightening of their load through rapid transit facilities, or both of these influences working together. This means that the 1,200 acres referred to have in prospect at most a demand for housing accommodations for about 150,000 persons. The average proportion of this area devoted to streets and other public uses is slightly more than 25 per cent, leaving at most 900 acres net for housing purposes. The average population density necessary over this area therefore will never rise to more than 166 persons per acre.

*Possibilities of Present Building Code*—As now written the Rochester Building Code admits of tenement buildings covering 70 per cent of an inner lot, and 90 per cent of a corner lot. They may be built to a height not to exceed 1½ times the width of the widest street on which they face. The court and yard regulations are such as to be compatible with the area provisions; i.e., they do not require a greater area than 10 per cent or 30 per cent of the lots.

The average width of streets in the *B* areas is 60 ft. This means that tenements ordinarily may be built 75 ft., or not more than seven stories, in height.

On account of a requirement that tenements over four stories in height be of "fireproof" construction, present practice does not realize the full possibilities of the code. Following is a tabulation of the pertinent facts concerning a typical group of such buildings erected within the last few years. The cases include two

corner-lot developments, one very deep lot and three ordinary inner lot developments.

POPULATION DENSITY IN TYPICAL TENEMENT BUILDINGS ROCHESTER, N. Y.

| Item | No. of Stories | No. of Apartments | Capacity: Persons | Area of Lot, Sq.Ft. | Sq.Ft. of Lots per Family | Population per Acre |
|---|---|---|---|---|---|---|
| 1 | 4 | 24 | 113 | 3,175 | 132 4 | 1,552 |
| 2 | 3 and 4 | 80 | 376 | 23,902 | 299 0 | 685 |
| 3 | 4 | 21 | 98 | 4,860 | 231 3 | 878 |
| 4 | 4 | 32 | 150 | 17,000 | 532 0 | 384 |
| 5 | 4 | 32 | 150 | 6,000 | 187 5 | 1,088 |
| 6 | 3 and 4 | 48 | 225 | 8,380 | 175 0 | 1,170 |
| Totals and Averages | 4 | 237 | 1,112 | 63,317 | 267 0 | 764 |

It should be noted that not one of the tenements included in the tabulation is over four stories in height. This means that in no case was the land developed to more than four-sevenths of the density which the code allows. In spite of this, the average population for which accommodations are provided is 764 persons per acre, or over 15 times the density of 50 people per acre usual in the outer portions of the *C* area. If all the 900 acres of the *B* areas were to be developed at this rate, their housing capacity would be 680,000 persons. If the full average development for which the code provides were to take place over this area of 900 acres, 1,200,000 people could be housed.

### Tenements Not a Community Asset

*Economics of the Situation*—That tenements as an institution are not an asset for the community is generally conceded. It appears from the data given that in Rochester, at least, they are not justified by the demands of the situation. It furthermore is true, and can readily be proven, that the present possibilities of extreme development of land are not even to the interests of the property owners in the tenement districts.

At the present time the land within these areas is comparatively undeveloped. There are, as noted, occasional lots rather fully developed, but for each of these there are at present a hundred lots occupied by one- or two-family dwellings of the older types. The land thus occupied, by reason of its location, and the present possibilities of extreme development, has a valuation much out of proportion to its present use, and the owners must be considered as holding it as a speculation more than as a year-to-year dividend-paying investment. If these speculative holdings are eventually to pay even a fair rate of interest on the money invested, there must at some time be a fuller development of the various properties. But as the building code now reads there is no prospect that more than 10 per cent of the land so situated will be developed to a greater extent than at present.

Suppose for a minute that the total population of the *B* areas does ultimately rise to something like 150,000 persons, as the foregoing discussion indicates is possible. Even then, for each of the six lots mentioned above, and for a large number of others similarly developed, there will be eight times as great an area for which only one family per lot can be found. Disregard the questions of health, morals and the amenities for tenement dwellers. Are the property owners themselves going to profit under the present system of regulations?

If each of the present holdings was to be improved as the five lots already mentioned are improved, the population of the *B* areas described would be 680,000. Are any of the hopeful owners of real estate within the tracts devoted to heavy residential use willing to wait to develop their land until Rochester's tenement population amounts to that figure? Some of them must if the building code is not amended. Nor is this the worst of it, for neither of the foregoing suppositions takes account of the 75 per cent greater density of development possible under the provisions of the present building code.

In Rochester, as matters stand at present, property owners as a class suffer rather than profit by the privilege of building large tenement houses. They cannot all build tenements; or they could not fill them if they did. They cannot sell or use their property for business purposes. The use regulations will not allow of it. They cannot sell or use their property for new single and double residences, because people who want or can afford single or double residences will not, to any extent, build or occupy them in tenement districts. The only thing the majority of these owners can do is to hold on and hope for the best. While they do this they pay interest and taxes on an exaggerated and doubtful value which their land has because of the present possibilities of extreme development.

*Uniformity of Development Basis of Proper Tenement Regulations*—The keynote of tenement regulations should be uniformity of development, not a compromise as to the amount of light, air and space people need for healthful existence. Regulations affecting the height of structures, area and arrangement of courts, yards and shafts, lighting and ventilation of rooms, etc., have been passed, amended, and violated ad infinitum without materially abating the nuisances of tenement house life or protecting the inmates as hoped. The only solution which can be satisfactory and permanent, equitable both to property owners and to the dwellers in tenement districts, is to assume a fair population density, based on investigations such as have been outlined in the foregoing discussion, and to limit the housing accommodations on each lot on the basis of the part which the lot area forms of an acre.

### Supplementary Restrictions

*Supplementary Restrictions Necessary*—It will be argued, very correctly, that the above restriction alone does not guarantee desirable housing developments. Supplementary requirements are necessary, but they are very simple and easily enforced, since the logic of the situation created for the builder precludes any attempts at dark rooms, high structures, narrow courts, small rooms, etc. The following brief list includes all that are believed necessary in the way of supplementary restrictions: (1) No dwellings over three stories in height; (2) no part of a dwelling to be at any point over thirty feet in width, perpendicular to the side walls; (3) no part of a dwelling to face an open area on the same lot, less in width, perpendicular to the face of the building, than 30 per cent of the height of that part; (4) no inclosed part of a dwelling to be closer than forty feet to, or farther than one hundred and twenty-five feet from the center line of a street.

*Summary*—Recent developments in transportation have removed the necessity for large numbers of people to live within relatively small areas. In consequence, the building of large tenement structures, involving high population densities on certain lots and great unevenness of land development, is an anachronism and should be prevented. The actual demands which will be made on central housing districts may be predicted within reasonable limits and should be made the basis

for a uniform density of housing development to be secured through building regulation. Enforcement of this uniform density, which in Rochester and most other large cities is much less than the rate of development now allowed, will react to the benefit not only of tenement dwellers and of the community at large, but also to that of real estate owners in tenement districts, by establishing a real connection between the market values of their holdings and the possibility of their utilization.

## California Motor Carriers Do Large Business—Companies Combine

AN OUTSTANDING feature of recent development in the motor bus business in California is the consolidation of companies made in the interests of more efficient operation. A typical case is the recent formation of an association in Stockton whereby sixty cars, formerly operated by a number of small com-

1926 STATISTICS FOR COMPANIES OF THE MOTOR CARRIERS ASSOCIATION

| | Number of Passenger Cars | Number of Trucks and Trailers | Land Miles | Car-Miles | Passengers Carried | Passenger-Revenue | Operating Expenses | Taxes and Licenses | Liability Insurance | Investment |
|---|---|---|---|---|---|---|---|---|---|---|
| Total for 18 passenger carrying companies | 344 | 412 | 5,603 | 19,587,727* | 8,841,408 | $3,398,043* | $2,367,014‡ | $46,615* | $118,353 | $1,126,315** |
| Average per company | 20 | 23 | 311 | 1,132,210 | 491,189 | 199,885 | 205,876 | 2,742 | 6,575 | 125,146 |

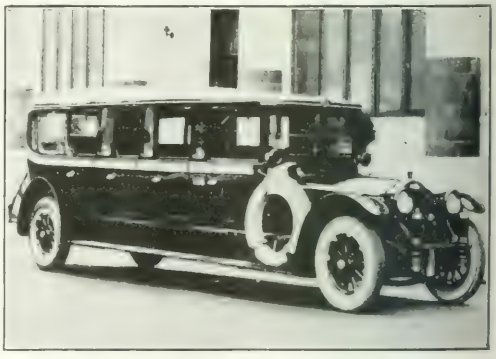
| | Number of Trucks and Trailers | Land Miles | Car-Miles (Tons) | Freight Revenue | | | |
|---|---|---|---|---|---|---|---|
| Total for 14 freight carrying companies | 57 | 53 | 344 | 558,085** | 674,453 | $231,671 | $8,520 | $12,791 | $256,892* |
| Average per company | 4 | 4 | 24 | 26,120 | 48,175 | 25,930 | 594 | 914 | 32,111 |

*170 companies. †54 companies. ‡111 companies.

peting companies and individuals, have been put under a common administration which is expected to make material improvement in service and profits to owners. Combinations have been formed in both south and central parts of the state. Where a number of lines have a common terminal stage depots are becoming popular.

Records of the California Railroad Commission show that 157 freight carriers reported last year total receipts of $2,401,336 and expenses of $2,292,889. A total of 350 passenger carriers, reporting for the same period, showed receipts of $6,856,161 and expenses of $6,028,821. The accompanying table gives tables and averages for freight and passenger companies affiliated with the Motor Carriers' Association, a representative group of bus companies with headquarters in southern California.

With improvement of operating conditions, better roads and more business, the type of passenger cars has been very greatly improved. The accompanying illustrations show a typical passenger car of a few years ago and the modern semi-closed bus of a type being used in many parts of the state since the advent of a system of hard-surfaced roads.



OLD AND NEW TYPES OF BUSES, SHOWING INFLUENCE OF IMPROVED STATE HIGHWAY SYSTEM

## Use of Poison in Maintenance Work on Drainage Canals

By O. C. Kulicka
Drainage Engineer, Greenville, Miss.

THE most important part of the maintenance work on drainage canals, and one of the principal items of expense, is the removal of woody growth, like willows. Cutting affords only temporary relief, as the stumps will sprout again and in a few months conditions will be as bad as before the clearing, if not worse. To prevent stumps from sprouting, experiments with various chemicals were made in the Riverside and Bogue Phalia Drainage Districts of Washington County, Miss. The following method was found most effective:

The trees and bushes within the channels were cut about 6 in. from the surface of the ground, and the stumps poisoned with a preparation made of granulated caustic soda and white arsenic. In a suitable vessel containing 8 gal. of water 10 lb. of caustic soda are poured, and as soon as the water begins to steam from its action upon the soda, 10 lb. of white arsenic are added and dissolved by vigorous stirring with a wooden paddle until the mixture cools. Two gallons of water are then added and the compound is ready for use. Since both the arsenic and the caustic soda are exceedingly poisonous, great care must be taken not to inhale or swallow any of the dust or fumes arising while the preparation is being made. A bottle of vinegar, or some other acid, is kept on hand to neutralize the soda in case of accidents.

The best results were obtained by splitting the stumps with an ax, brush hook, or machete, and applying the poison on the frsh cuts with mops made of old sacks tied to sticks about 24 in. long. The organization of the crew varied, depending upon the size of the canal and the density of the growth. In the Bogue Phalia Cut-off, 120 ft. wide at the bottom, with a very dense growth extending for almost its entire width, eight men were used, two men splitting the stumps, two preparing and supplying the poison, and four applying it. In smaller ditches only three or four men were used.

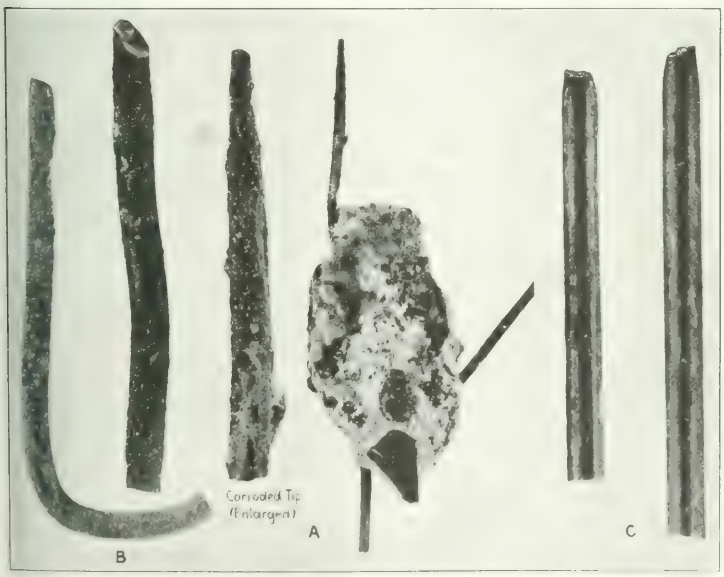
The rate of progress ranged from one-half mile to three miles per day, with an average of about two miles. The average cost per mile was as follows:

| | | | |
|---|---|---|---|
| Foreman | 5 hr. @ | 36 ¢ | $1 80 |
| Laborers | 20 hr. @ | 15 ¢ | 3 00 |
| Arsenic | 25 lb. @ | 9¢ | 2 38 |
| Caustic soda | 25 lb. @ | 10¢ | 2 50 |
| | | Total | $9 68 |

To eliminate all danger to persons and stock, the property owners and tenants were notified by the foreman superintending the work, notices were published in the local newspapers, and signs were placed conspicuously on the banks of the canals where stumps had been poisoned. Stock should be kept away from such canals for a period of at least ten days.

## Corrosion of Reinforcing Wires in Marlborough-Blenheim Failure

Supplementing the facts of the Marlborough-Blenheim kitchen roof-slab failure given by Lewis R. Ferguson on page 271 of last week's issue of *Engineering News-Record*, photographs of some of the reinforcing wires are shown herewith. Along the slab face which Mr. Ferguson concluded was the seat of the failure, reinforcing wires were found corroded as shown by the sample marked "A." The badly corroded end, which has very little sound metal showing on the small fracture face (enlarged view of tip at left) represents an extreme case of rust effect. The two samples "B" show corrosion, but the decided localization of the action is evidenced by the appearance of one of the samples, which shows strong rusting and perfectly clean wire barely an inch apart. The two wires marked "C," at the right, exhibit normal tension fractures. They were also taken from the fractured edges of the slab, and according to Mr. Ferguson are to be taken as indicating that after the failure of part of the reinforcing mesh because of reduction of section, other wires were torn apart by the excess load thrown on them.




WIRES FROM REINFORCING MESH OF COLLAPSED ROOF SLAB, MARLBOROUGH-BLENHEIM KITCHEN

The badly corroded wire shown projecting from a piece of concrete (the tip of this wire is also shown enlarged) was taken from the fallen roof of the slab. It was almost rusted through when it broke. At the right are shown, also enlarged, two wires that evidently fractured in tension as shown by the necking and the cup-shaped fracture tips.

## Railway Electrification in France

SHORTAGE of coal in France during the World War, with the prospect of continued shortage for many years, led the French government to appoint commissions to consider means of reducing the consumption and also the importation of coal. One evident move in this direction was to introduce electric traction on railways in districts where water power is available. In 1918, therefore, the government appointed a commission on electrification of railways.

As a first consideration it was necessary to decide upon a uniform system, so that the locomotives and rolling stock equipment of any railway could be utilized on other lines if necessary, as in case of war. Committees composed of government officials and the engineers of the several railways studied various installations in the United States, England, Switzerland and Italy. The conclusion arrived at was that 1,500-volt direct-current system should be adopted, the locomotives being equipped with apparatus for taking current from both third-rail and overhead wire conductors. For exceptional conditions, the use of 3,000-volt current may be permitted.

Great economies in coal consumption by steam locomotives had been effected by the French railways prior to 1914, but all these have been lost by the disorganized conditions of fuel supply, labor and railway operation resulting from the war. Oil fuel has been introduced with satisfactory operating results, but France does not produce oil and must import it.

The development of electric traction with hydro-electric power stations is certain, as there is abundant water power available in France. Surveys are being made, a large part of the concessions has been granted, and the work will commence shortly on three railways. Nevertheless, it will be some years, especially with the present delays in construction, before an appreciable saving in coal is reached.

# An Investigation into the Use of Bulk Cement

**Discussion of the Use of Bulk Cement on Large Concrete Building Jobs' Prepared by the Staff of the Turner Construction Co., New York City**

THE generally governing feature for the economical use of bulk cement is a railroad siding conveniently located. Preferably the siding should be within 500 ft. of the concrete plant, and at such an elevation that a practically level runway can be obtained between the car floor and the charging hopper on the mixer. There are times, however, when bulk cement can be received by truck from sidings at a considerable distance, or by sidings close at hand, but at a considerably lower elevation than the charging hopper by the installation of special conveying or elevating equipment.

Frequently a siding either permanent or temporary is to be installed as part of the building contract. When conditions permit this work should be pushed and the layout should be made to facilitate the receiving of bulk cement. For instance, if a saving can be shown to an owner permission may be obtained to put in even a permanent siding at a temporary elevation. Sometimes it is impossible to obtain the use of a siding before the foundation or first floor is completed. In such a case it may prove economical to use bag cement in the early stages of the work and bulk cement for the balance.

### Special Plant Possible

It may prove an advantage to spend considerable money for equipment or a special plant layout in order to make the use of cement in bulk possible, for the initial saving in purchase price may be expected to be 5c. per bbl. and there may be additional savings.

The inconvenience caused by cement dust is no greater with bulk cement than with bag cement. In fact the operation of shaking empty bags by hand is disliked more by the average man than the shoveling of bulk cement.

If a great deal of brick or tile work is to be done, it may be advisable to order some bagged cement. This is not essential, however, as bulk cement can be hoisted in carryalls or wheelbarrows on the hod hoist, just as sand is now handled, and dumped in convenient piles on the various floors near the mortar beds.

Table I outlines the principal points to be considered in making an analysis to determine the comparative cost of bagged and bulk cement. The actual figures used will vary with price fluctuations, special local conditions, and labor rates, and are only given for sake of illustrations.

TABLE I.

| | Saving per Bbl Using Bulk | Extra per Bbl Using Bulk |
|---|---|---|
| A—Cost of cement per bbl., f.o.b. cars mill | 5 | |
| B—Freight (with differences in weight if must be neglected) | | |
| C—Cartage, [illegible] actually weighing of cement [illegible] Extra charge for [illegible] average [illegible] 1 150 : 240 = [illegible] | | 0.5 cts. |
| D—Storage—If a [illegible] head storage space at the mixer [illegible] provided for more than 10% of the total [illegible] the job. This storage space may be provided in the shape of a raised platform on the [illegible] and in some cases special mechanical equipment, such as conveyors, may have to be provided. Depending upon [illegible] variable conditions, the cost per barrel of [illegible] | | 1.6c. to 6c. |
| E—[illegible] | 2 to 4 | |
| F—Freight charges and trucking and loading [illegible] | [illegible] to 2 | ..... |
| G—Loss of bags and money invested ..... | 1 to 4c. | ..... |
| | [illegible] | 2 1 to 6 5c |

### Ordering and Testing

Although the amount of money involved in the re-weighing of cars is small, and not usually a determining factor, the local freight rulings governing in each case should be carefully studied. Charges are generally as follows: If car has not been placed for delivery and written order requesting re-weighing has been received previous to arrival at destination, there will be no charge, provided a variation from shippers weight of 1 per cent or minimum of 500 lb. is found. When the above difference is not found there will be a charge of about $3. When a car has been placed for delivery, or arrived at destination, without re-weighing being ordered, there will be a weighing charge of about $3 and a switching charge of about $7 per car. If a 1 per cent variation or minimum of 500 lb. is disclosed these charges will be refunded.

When placing a contract for bulk cement the purchasing department must arrange to have each car weighed by the shipper both before and after loading. The tare weight stenciled on the side of the car is not always accurate and should not be used. The bill of lading will then show the tare, gross and net weights, and the shipper should also be instructed to show these on his invoice in addition to the number of barrels.

The purchasing department when letting the testing contract should impress on the testing engineer the necessity of having the results of the 24 hr. tests on the job before the cement is unloaded, for when bulk cement is used, it cannot be easily segregated in storage awaiting the result of the test.

### Receiving and Checking

The possible sources of loss are from incorrect weights, either tare or gross, by the shipper and loss in transit by leakage from a damaged car. There must also be provided an adjusted check on the volume upon receipt of the car for, due to the constant shaking of the car in transit, and the consequent compacting of the cement, there will be a reduction in bulk ranging around 2 per cent.

The jobs must use care in checking the quantity of bulk cement received, both by weight and by volume, for although the shipper charges in the unit of barrels, the number of barrels is computed by dividing the weight of the cement in any one car by the weight per barrel. It is a general standard to figure the weight of one barrel as 376 lb. or four times the weight per bag of 94 lb. This figure should be confirmed by each shipper for the Canadian standard is 350 lb. per barrel, or 87½ lb. per bag.

To check up on the shipper's weights the job must advise the freight agent at destination to re-weigh about one car out of each five received, and when the car is light to again re-weigh for a check on the tare weight. Job must follow closely to see that light weighing is not missed, and in addition to notifying freight agent should also speak to conductor of switch crew when they take away the light car.

All other cars except those re-weighed must be checked by measuring the volume of the cement in the car, and multiplying by the weight per cubic foot and dividing by weight of cement per barrel. The volume can be easily computed by driving a marked iron rod down through the cement in a number of places to obtain the average depth and by measuring the car dimensions.

When checking up by volume it is necessary to know the exact weight of a cubic foot of the cement in question after reduction in bulk after transit. This unit may be obtained by having the first three cars to come in re-weighed, and then carefully computing the volume and the weight per cubic foot by dividing the total net weight by the volume. After we have made this check on several different jobs, sufficient data may be accumulated to make an assumption of definite weights for certain cement under certain traffic conditions.

Loss of material in transit or damage by water is not very likely, as the cement companies usually line with paper the floor and sides of the cars that are not tight. Should there be evidence, either before or after opening the car, that a quantity of cement has leaked out in transit, or that damage has been caused by water, the freight agent must be notified and affidavits made out as covered in superintendents instructions.

The records of all weights and volume measurements should be kept as in Table II and III. For weight records use a standard size blank book, and for volume records a standard engineer's field book will be found most convenient.

TABLE II. VOLUME RECORDS FOR BULK CEMENT

Shipper _____
Car No. _____
Date _____
Width Car Inside _____
Length Car Inside _____
Average Depth _____
Weight per cu ft Used _____

Sketch of Car and Contents

40′ 0″

9′ 0″

oA oB oC oD oK oL oM oN
oF oG oH oI oO oP oQ oR

Depth Readings

[Use this space for Computations]

_____ _____
_____ _____
_____ _____
Total _____
Average _____

## Unloading From Cars

The amount to be spent on equipment for handling bulk cement is a question that must be settled on each individual job in the light of the conditions existing. It is generally true, however, that the cement handling equipment so far developed is so expensive, and of such nature that it is doubtful if it could be economically used in temporary installations for handling comparatively small quantities. Manufacturers are now developing a type of shovel that is intended for unloading cars. There are also certain air conveying systems in use in permanent plants, but the equipment is too costly and complicated to warrant using in temporary installations.

If a condition should be met where the cement storage is close to but at a considerably different elevation than the railroad siding, some form of conveyor might be used. The experience of the cement mills has been that a screw conveyor is the most practical type for approximately horizontal runs. Before installing any type of conveyor some assurance must be had that it will operate successfully.

When the railroad siding is within a reasonable distance of the mixer and is at such an elevation that the car floor is not lower than the top of the charging hopper, unloading by carryalls or trucks or a combination of both, will prove most economical. It is not possible to state a limiting distance when the use of carryalls would become inefficient and the use of trucks more desirable. For if cars are being unloaded, even at a distance of 500 ft. from the mixer, at the same time as concrete was being mixed, it would prove more economical to use carryalls direct from the car to the mixer. At other times when the cement was being placed in storage motor trucks might be used.

When the car platform is at the proper elevation, carryalls can be wheeled into the car. Here they may be filled by two laborers using standard square point shovels. It is false economy to try and use scoops for the average laborer will soon tire with a large shovel and not move as much material in a day as with the standard shovel.

Under other conditions it may only be possible to throw the cement near the car doors into carryalls standing outside and then use wheelbarrows for moving the cement in the ends down to the doorway and there dumping into carryalls.

Where a No. 4 mixer is used and unloading is done with carryalls direct to the mixer it is always advisable to have two cars unloading at the same time. Our experience has shown that one car cannot be unloaded economically and efficiently and at the same time fast enough to keep a No. 4 mixer running at full capacity.

Under normal railroad conditions it should be possible to schedule deliveries so that a large part of the cement received can be wheeled directly from the car to the mixer.

Contrary to what might be expected the storage of bulk cement does not present any unusual difficulties, and in fact the actual cost of placing in storage and removal from storage for use may be considerably less than with bagged cement.

If a storage shed is built, the three governing features are a tight strong floor, a water-tight roof and

TABLE III. WEIGHT RECORDS FOR BULK CEMENT

| Shipper | Date | Car No. | Shippers Loaded Weight | Shippers Tare Weight | Shippers Net Weight | Arrival Weight Loaded | Arrival Weight Light | Arrival Weight Net | Variation | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| ento Cem. Co. | | | | | | Indicate whether | | | | Reweighing ordered 3/16 |
| | | | | | | arrived at by reweighing | | | | Applied for refund |
| | | | | | | or by computation | | | | |

sidewalls both water-tight and sufficiently strong to withstand the side pressure. The floor should be built of tongue and groove, or shiplap boards, and the floor beams must be sufficiently strong and so placed as to take the load without serious deflection. If lapped flooring is not obtainable the floor may be made both tight and damp proof by covering with old canvas tacked down.

The studs for the sidewalls should be of 2 x 6-in. sound lumber, solidly spiked to the floor beams. When sheeting the side walls use shiplap or tongue and groove boards, always turning the tongue up. The strongest and most satisfactory result will be obtained by sheeting on the inside of the vertical wall studs. Care should always be used to see that the bottom board of the wall sheeting is at least one inch below the floor line so as to make a water-tight joint. The side wall pressure can be taken care of by placing horizontal ties of ½-in. steel rods about 6 ft. above the floor and securing them on the outside with 4 x 4-in. horizontal standards and bolt clamps. This type of construction will be safe for an 8 ft. head of cement.

When possible it is advisable so to locate the storage house in relation to the elevation of the railroad siding, that the cement can be dumped through hatchways in the roof of the shed. These hatchways should be built near the center of the shed, or each section, as the cement when dumped will flow to the corners and almost assume a water level. When it is expected to unload the greater part of the cement by motor truck, it may be possible so to locate the shed that it will be at a considerably lower elevation than the roadway. Under these conditions it may be advisable to build a short timber runway to enable trucks to dump through the hatchway in the roof of the shed. With this arrangement it would be necessary to place a cross partition in the shed so as to facilitate the removal of cement from storage in one section of the house at the same time as cement is being dumped in the other section.

If the cement must be placed in storage at the floor level of the shed it will not be practical to pile to a depth greater than 3 ft. In this case carryalls can be wheeled to the far corners of the space and as the pile builds up run panels should be placed on top of the cement to enable succeeding carryalls to dump at a higher level.

Frequently it will be found possible to receive bulk cement direct from the cars, or to use bag cement, until such time as one or more floors are concreted. A very simple timber platform covered with canvas can then be laid direct on the concrete slab. A toe board about 6 in. high should be built around the edge of the platform to keep the cement from flowing over the edge. The bulk cement can then be placed on this platform either by motor trucks, or carryalls, but should not be piled to a depth that would load the structural concrete beyond its designed carrying capacity.

### Measuring the Cement Unit

A satisfactory and efficient method must be used to insure the proper amount of bulk cement going into each batch of concrete, and also to positively count the number of batches in any day's run. With bag cement we have a positive gage of the quantity in each batch, and by counting the empty bags at the end of a run we know the total used.

The simplest gage per batch is to charge the mixer with cement dumped from carryalls or measuring hoppers of a known capacity expressed in bags of cement. As the volume of a bag of cement varies, due to compacting or differences in specific gravity of different cements, the capacity of the measuring device should be checked in each case by filling it with the required number of bags of cement. The cement used for this check must have the same degree of compactness as will be the case during the operation of the plant.

If bagged cement is available, the measuring device can be checked by filling it with the required number of bags of cement. When only bulk cement is obtainable the capacity can be checked by weight. The common factor in the United States is 94 lbs. per bag, but if the cement in question is not of one of the well known brands, or is from a mill in Canada or any other foreign country, a check should be made to determine the number of pounds allowed per bag.

In some cases the cement storage may be at such an elevation, or a small bin may be built over the mixer, so that the bulk cement can be charged by gravity. If so, the measuring gage or hopper must be visible so as to guard against the possibility of the cement arching and not entirely filling the measuring hopper.

Our present method for checking the total amount of bulk cement used per run is by making a mark on a board as each batch is mixed. This is a simple and effective way unless the human element fails to function. A check of the bulk cement on hand at any one time is not any more difficult to obtain than in the case of bag cement. Usually it resolves itself to subtracting the amount of cement used from the amount received. If, however, there is reason to believe the record of the amount used is not accurate or for a check on this figure, it is a simple matter to measure the amount in stock in the same way as cars are measured.

## Drought Yields of British Water Supplies

The British Ministry of Health has instructed E. A Fawcett, chief engineer of its engineering department to collect and tabulate statistics showing the yield of the various sources drawn upon for potable water supply in England and Wales in order to establish records of minimum yields during the present drought An effort will be made to obtain the average daily yield, the minimum yield in 24 hr. during the year 1920 and the minimum yield for 24 hr. during the present drought. According to the London *Surveyor*: "The present drought is almost unprecedented in its severity and duration and is not likely to be equaled for many years to come. The minimum figures on the present occasion will therefore furnish the only possible basis upon which future supply schemes may be developed." Mr. Fawcett has urged that since the minimum yield of underground water supplies may not occur until weeks or months after the drought is broken observations on such supplies should be maintained for some time to come.

## Panama Canal Traffic Low

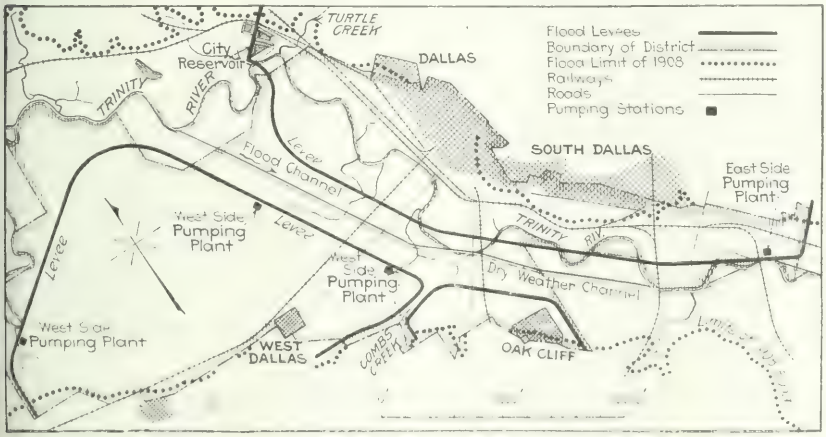
Traffic through the Panama Canal during May was the lowest it has been since June, 1920. Of the commercial ships 118 vessels carrying 334,000 registered net tons passed to the Pacific and 109 vessels carried 423,000 tons to the Atlantic. Total tolls were $792,735 against $974,919 in May of 1920.

# Flood Protection Channel Project for Dallas, Tex.

## Levees to Control Trinity River, Protect City and Reclaim Low Lands—Pump Drainage in High Water—Flood Records

A 10-MILE leveed channel 2,000 ft. wide through the bottom lands of the Trinity River is the plan proposed for flood protection of the city of Dallas, Tex., and of a large area of low lands now subject to periodical flooding. The main part of the city is on the east side of the river but there are large residential districts on the west side and industrial development is expected within the area which will be protected and which is largely waste land.

To provide for this development the Dallas and Dallas County Levee Improvement District No. 10 was organized in 1920 with an area of 4,300 acres bounded by the high water line of the great flood of 1908. Plans for protection by means of a flood channel were prepared by E. N. Noyes (of Myers & Noyes, Dallas, Tex.), who is chief engineer of the district, providing for levees about 25 ft. high having their tops 5 to 7 ft. above the 1908 flood level. The space between the levees would be cleared of obstruction and in it would be a low-water channel 190 ft. wide and 25 ft. deep, having a fall of 1.66 ft. per mile. Drainage and storm water from the area outside of the levees would be discharged through culverts in the levees during low water periods, the gates being closed and water pumped over the levee during high-water.




RIVER DIVERSION FOR FLOOD RELIEF AT DALLAS, TEX.

The preliminary plans and estimates were submitted by the District to Alvord & Burdick, consulting engineers, Chicago, who approved them, with some minor modifications, after a study of the situation. A brief summary of the main parts of their reports is given below.

At Dallas, the Trinity River, draining about 5,900 sq. miles, occupies normally a V-shaped channel about 25 ft. deep and 100 ft. wide, but overflows several times in a year, the larger floods spreading to a width of from one to three miles and invading the business and manufacturing districts of the city. The frequency of these floods renders the lower bottom lands practically useless.

In the flood of 1908, the greatest on record in 80 years, a height of 52.6 ft. above low-water level was reached, the lower lands being about 20 ft. under water and considerable damage being done in the city, in addition to the interruption of business. The peak flow is estimated at 255,000 sec.ft. or 43 sec.ft. per square mile, which record was approached closely by the floods of 1840 and 1866. In 80 years the flood level of 40 ft. has been reached or exceeded nine times, and for the eighteen years 1903 to 1920 (excluding the 1908 record) the flood levels have ranged from 21 to 40 ft. From the records of other rivers it is considered not improbable that a flood of 33 per cent greater capacity than that of 1908 may occur at some future time. Rainfall at Dallas averages about 33 in. per year, of which only 2.4 in. passes away through the streams owing to high evaporation and retentive subsoil. The 1908 flood followed a series of local storms, the main storm approximating 6.2 in. in 48 hours. With an average flood rate of 47,500 sec.ft. the ratio of the maximum to the average is 5.4, as compared with 4.92 and 3.52 for the Miami and Scioto rivers at Dayton and Columbus respectively in 1913, and with 3.72 for the Kansas River at Lawrence, Kan. Although Texas has only a small annual rainfall its floods are among the greatest in the country. Flood control by detention basins on the Trinity River is practicable to a limited extent, but would involve such great cost that the levee system as proposed is considered the most economical as well as the most effective method for flood relief. Below the city there are extensive levee systems for farm protection, but these would raise the height of minor floods only, as they would be overtopped by floods of over 100,000 sec.ft., corresponding to a height of 41.5 ft. The same is true even if the levees should be raised to the 1908 level, provided that the space within the flood channel is kept clear of trees and brush.

Good material and hard bottom being available for the levees, a top width of 8 ft. with slopes of 1 on 2½ is considered satisfactory. Bank protection would be required only at points where the new channel is close to the levee. As the levee crosses the old river channel at six places and will be about 50 ft. high, specially heavy construction will be required at these points, a 50-ft. berm on the land side being recommended, slightly above the ground level, with a slope of 1 on 20 and then a levee slope of 1 on 4 from the berm to the old river bed. Railways which cross the bottom lands will have to be raised to the level of the top of the levee.

Outlet culverts and pumping plants would be required to deal with the drainage and storm water, there being one such outlet on the east or city side and three on the opposite side. Allowing for storage capacity in the drainage ditches during the peaks of floods, it is considered that the pumping capacity need not exceed 800 sec.ft. against 26 ft. head on the east side and 100, 30 and 7 sec.ft. at the three plants on the west side. Electrically operated pumps are proposed, with five units in the largest station. The total estimated cost is $4,871,500, including $3,210,100 for levees, land and miscellaneous work, $558,700 for five culverts and drainage outlets and $660,000 for four pumping stations.

## Reservoirs vs. Additional Pumps for Peak Demands

By L. A. Quayle
Chief Mechanical Engineer Water Works, Cleveland, Ohio

*Abstract of paper presented at the forty-second annual meeting of the American Waterworks Association at Cleveland, O.*

IN THE planning of a new waterworks project of comparatively large size, or the enlarging of one that is in service, it is necessary to determine how much of the hourly, daily, or monthly peak demands shall be taken by one or more equalizing or distributing reservoirs and how much by pumping engines in addition to those required to supply the average quantity of water consumed over a given period. It is assumed that the reservoir is elevated sufficiently above the highest buildings being supplied and that the distribution mains are of sufficient size to allow the water level in the reservoir to fluctuate over a wide range without appreciably affecting the distribution pressure.

To determine for what variation in demand for water a reservoir should be planned, we have studied the department's pumpage and water consumption records back to the year of 1910, and have assumed that the maximum variation in demand a reservoir will be required to meet, corresponds to the maximum variation found on the maximum day, week, or month of the maximum year during the ten-year period. The study is based on an average yearly water consumption of 100 m.g.d. which is referred to as 100 per cent capacity.

Fig. 1 shows the hourly variation in demand on a maximum demand day, when the total is 150 m.g.d. and the hourly rate ranges from 220 to 60 m.g.d. and the maximum momentary rate of pumpage about 225 m.g.d. If a pumping station furnished water at a uniform rate of 150 m.g.d. a reservoir of 20.6 m.g.d. capacity would take care of all the hourly and momentary fluctuations shown on the curve. If no reservoir were used a pumpage capacity of 225 m.g.d. would be required.

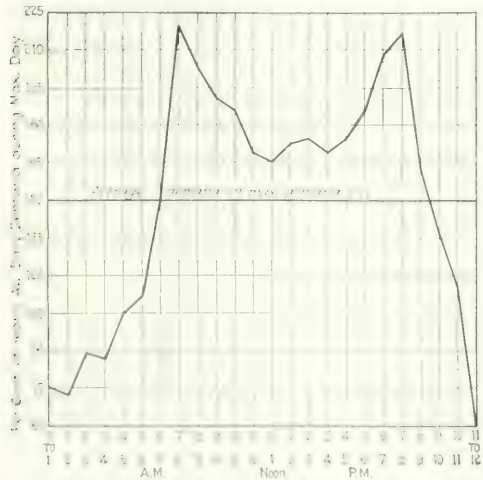



FIG. 1. HOURLY VARIATIONS OF PUMPING DEMAND ON A MAXIMUM DAY

Fig. 2 shows the variation in daily demand of the month having the maximum variation in the maximum year of the ten-year period. The average pumpage for the maximum month would be 126.7 m.g.d. The maximum sustained pumpage above the average monthly pumpage would be for the eight-day period from the 20th to the 27th, inclusive, which would average 135.2 m.g.d. A reservoir large enough to take care of the eight-day sustained demand and the two days of highest pumpage, the 25th and 26th, on which days the demand was 147 and 150 m.g.d., respectively, would more than take care of all other variations in demand during that month, or any other month of the ten-year period.

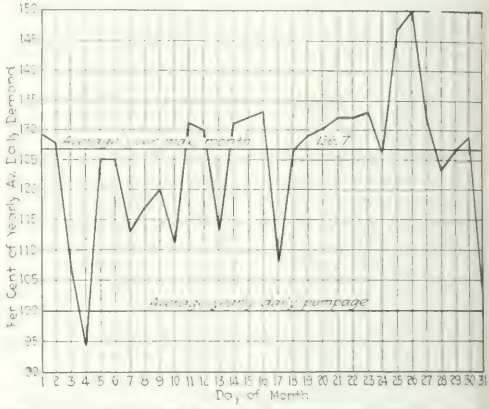



FIG. 2. VARIATIONS IN DAILY PUMPING DEMAND OF MAXIMUM MONTH HAVING MAXIMUM VARIATIONS IN DEMAND IN 10-YEAR PERIOD

Fig. 3 shows the monthly variation in pumpage in the year having the greatest variation over the ten-year period. The average pumpage of the maximum month is 126.7 m.g.d., as was also shown by Fig. 2. If the pumping station should work at a uniform rate of 100 m.g.d. for the entire year, a reservoir having a capacity of 1.8 billion gallons would be required to take care of all variations.

A study of Fig. 1 showed that a 20.6-m.g. reservoir would take care of hourly fluctuations on a maximum day of 150 m.g.d. demand. With a station of larger capacity the size of reservoir decreases. With a pumping station of less capacity than 150 m.g.d. the two days of 147 and 150 m.g.d. pumpage (to simplify, say two days of 150-m.g.d. demand) become the factor which determines the size of the reservoir up to the point where the eight days of 135.2-m.g.d. pumpage require greater reservoir capacity, which corresponds to a station of 130 m.g.d. capacity. The eight-day demand line crosses the line showing the reservoir capacity necessary to take care of the monthly fluctuations over a year's period, at about 124 m.g.d. pumping station capacity. By combining these lines into one curve we can determine from the curve the size of the reservoir required to take care of any demands which will be made upon it over a year's period, with different capacities of pumping stations supplying the average demand.

Having determined from the curve the combination of sizes of pumping station and reservoir required to take care of all fluctuations in demand, we must next find out what the first cost of the various combinations is, in order to determine the most economical combination to construct, in so far as first cost is concerned. The accom-

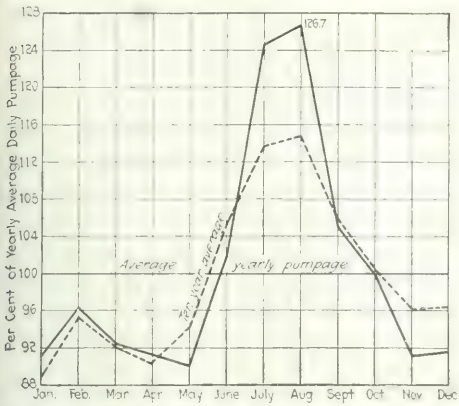



FIG. 3. MAXIMUM MONTHLY PUMPAGE VARIATION IN YEAR OF GREATEST VARIATION IN 10-YEAR PERIOD

panying table shows the approximate costs (pre-war basis) of our various waterworks projects, the average cost per million gallons of capacity for each, and the assumed life of the property upon which we based the annual fixed charges.

COST OF CRIBS, TUNNELS, AQUEDUCTS AND SCREEN WELLS

| | Kirtland System Permanent steel | Division System Submerged |
|---|---|---|
| Type of crib | | |
| Diameter of tunnel system, ft | 9 | 10, 7 and 5 |
| Length of each sized tunnel, ft | 26,000 | 16,100 and 9,200 |
| Total cost of intake system | $1,500,000 | $2,530,000 |
| Capacity of tunnel system, m.g.d. | 175 | 175 |
| Cost per million gallons per day of capacity | $8,550 | $14,450 |
| Average cost of cribs, tunnels, aqueducts and screen wells for Kirtland and Division systems per million gallons of daily capacity | $11,500 | |

The assumed life of cribs, tunnels, aqueducts and screen wells is 100 years. The cost of land used for water-works purposes has not been included in this comparison as the yearly appreciation of Cleveland water-works land more than covers the yearly cost of the bonds which are required for its purchase.

PUMPING STATION COSTS

| | Kirtland | Division |
|---|---|---|
| Buildings (pumping engine and boiler house) | $600,000 | $405,000 |
| Triple-expansion pumping engines | 786,000 | 805,000 |
| Boilers, piping and miscellaneous equipment | 224,000 | 190,000 |
| Total pumping station cost | $1,600,000 | $1,404,000 |
| Ultimate capacity of pumping station, m.g.d. | 165 | 165 |
| Cost per million gallon of capacity | $9,700 | $8,500 |
| Average cost of both stations per million gallons of capacity | | $9,100 |
| Assumed life of complete pumping station | | 30 years |

FILTRATION PLANT

| | |
|---|---|
| Cost of Division Avenue filtration plant (rated capacity, 150,000,000 m.g.d.) | $2,250,000 |
| Cost per million gallons of capacity | 15,000 |
| Assumed life of filtration plant | 50 years |
| Cost of low lift building, pumps and proportional cost of boilers and miscellaneous equipment | $297,000 |
| Cost per million gallons capacity | 1,800 |
| Assumed life of complete low lift pumping station | 40 years |

We have assumed that the cost of the distribution system would be the same for streets for reservoir pumpage and have not included it in the data compiled herein.

RESERVOIR COST

| | Hilltop | Kirtland | Warren Road |
|---|---|---|---|
| Capacity of reservoirs, gallons | 80,000,000 | 45,000,000 | 22,500,000 |
| Year completed | 1887 | 1885 | 1914 |
| Cost of reservoir | $404,400 | $177,450 | $157,500 |
| Cost per million gallons | 5,300 | 4,475 | 6,470 |
| Average cost of three reservoirs per million gallons of capacity | | $5,515 | |
| Assumed life of reservoirs | | | 100 years |

In determining the costs of works at a proper capacity o meet an average yearly demand of 100 m.g.d. with umping stations of various maximum capacities, a large umber of assumptions had to be made and those having he greatest influence on this subject are shown diagramatically in Fig. 5. In the curve labeled "Pumping Station Buildings, Cribs, Tunnels and Aqueducts" the cost has been ncreased 80 per cent for double the capacity. This is due o the fact that the unit costs of the tunnel systems and umping stations would be somewhat less for the larger apacities, and the boiler house building would be relatively maller due to the fact that the boiler could be run at higher ratings for short periods and the tunnel size could be relatively smaller for peak demands than for steady demands, as the friction loss could be somewhat greater for a peak demand of a given rate than for a steady demand of the same rate. The tunnel capacity does not exceed 150 m.g.d. when used in connection with a filter plant, as the clear water basin is assumed to take care of the hourly fluctuations of filtered water pumpage.

The pumping station boiler and miscellaneous equipment costs curve shows that the costs vary directly with the station capacity up to 150 m.g.d. and that they increase 30 per cent more for a 225 m.g.d. capacity station as compared with the 150-m.g.d. station. The filter plant capacity does not exceed 150 m.g.d. as the clear water basin is assumed to take care of all hourly fluctuations throughout a maximum demand day. No increase has been made in the cost of coal for the plants operating up to 130 per cent capacity, but it has been assumed that the

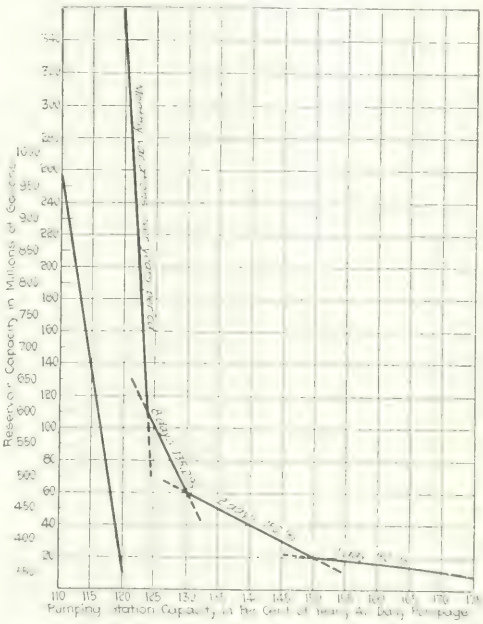



FIG. 4. RESERVOIR CAPACITIES FOR ALL VARIATIONS IN DEMAND IN ONE-YEAR PERIOD FOR VARIOUS PUMP CAPACITIES

coal cost would be gradually increased until it becomes 10 per cent higher for direct pumpage at a 225-m.g.d. peak than for a station which would only have to pump a 130 m.g.d. maximum. With the direct system of pumpage, pumps and boilers run at a lower load factor, as the station must be ready at all times for large fluctuations in demands which would result in a somewhat lower over-all station duty and resulting increase in coal consumption. The pumping station supervision and operation is assumed to increase 60 per cent for an increase in pumping station capacity of 125 per cent. The cost of tunnel operation, which includes cribkeeper's salaries, etc., remains the same irrespective of the size of the tunnel.

Reservoir operation costs consisting principally of keeper's and gardener's salaries vary from $115 p.m.g. for a 10-m.g. reservoir to $15 for a reservoir of 200 m.g. capacity or over.

Filter plant supervision, labor, chemicals and supplies are assumed to be the same over a year's period, whether the plant operates steadily at a 100-m.g. rate or filters up to rates of 150 m.g. per day.

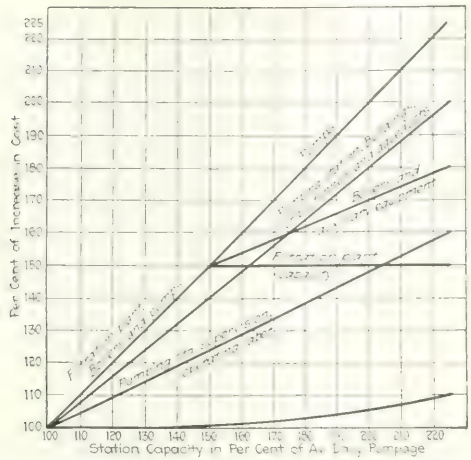



FIG. 5. GENERAL ASSUMPTIONS OF COST INCREASE FOR VARIOUS SERIES USED IN COMPUTING COSTS FOR INCREASING PUMP CAPACITIES

From Figs. 4 and 5 the tabulated costs of the pumping stations, tunnel systems, etc., we have determined (Fig. 6) the combined first cost of various sizes of tunnels, pumping stations, filter plants and reservoirs required to take care of all variations in demand throughout the year.

The capital charges for conditions *A*, *B*, and *D*, are all approximately a minimum for a 130 m.g.d. pumping station and a 60-m.g. reservoir. For the centrifugal station, filter plant and covered reservoir combination of Curve *D*, the minimum cost would be for a 150-m.g.d. capacity pumping station and a 20.6-m.g. reservoir. These curves also show that it would be just as economical from the standpoint of first cost to build either pumping stations of 225 m.g.d. capacity for direct pumpage or open reservoirs of approximately 340 m.g. capacity for conditions *A* and *B*, and closed reservoirs of approximately 240 m.g. capacity for conditions *C* and *D* with the corresponding sizes of pumping stations.

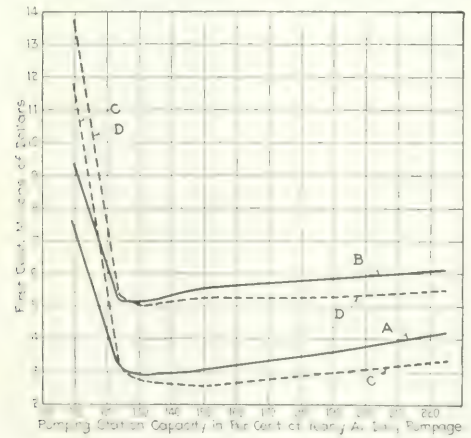



FIG. 6. COMBINED FIRST COST VARIOUS SIZED PLANTS TO TAKE CARE OF ALL VARIATIONS IN PUMPAGE DEMANDS DURING A YEAR

The plants include tunnels, pumping stations, filters and reservoirs.

A. Open reservoir, triple expansion station, based on conditions at Kirtland pumping station from 1901 to date.

B. Same as A, with filters based on operations at the New Division Ave. pumping stations and filter plant since put in use in 1917.

C. Covered reservoir, centrifugal station, based on Kirtland St. operations, if centrifugal pumps were to be used after Baldwin St. reservoir is built.

D. Covered reservoir, centrifugal pumps and filters; based on conditions at both pumping station, if equipped with centrifugal pumps after Baldwin reservoir completed.

In the construction or reconstruction of a waterworks, the first cost is of relatively less importance than the annual costs made up of operation, maintenance and fixed charges. By the use of Figs. 4 and 5 and the assumptions given below, Curves *E*, *F*, *G*, and *H*, Fig. 7, have been drawn to show the combined annual operation, maintenance and fixed charges for various sizes of tunnels, pumping stations, filtration plants and reservoirs required to take care of all variations in demand over a year's period.

In computing the annual fixed charges the life of the various waterworks properties have been assumed to be a certain number of years, and there has been added to the yearly maintenance cost the annual payment required to retire a serial bond in the amount of the cost of the property, the bond having the same life as the waterworks property being considered. In other words, the money borrowed to pay for the construction of the tunnels, pumping stations, filtration plants and reservoirs, will have been paid back by the time they have become obsolete.

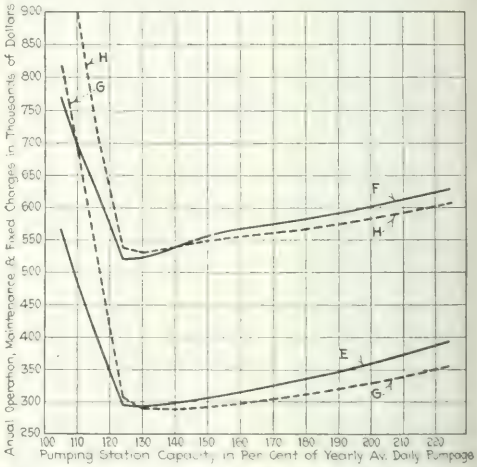

Anual Operation, Maintenance & Fixed Charges in Thousands of Dollars
Pumping Station Capacity, in Per Cent of Yearly Av. Daily Pumpage

FIG. 7. COMBINED ANNUAL OPERATION, MAINTENANCE AND FIXED CHARGES FOR VARIOUS SIZED WORKS TO TAKE CARE OF ALL VARIATIONS IN DEMAND DURING A YEAR

E. Open reservoir, triple expansion engine.
F. Open reservoir, triple expansion engine with filters.
G. Covered reservoir, centrifugal station.
H. Covered reservoir with filters.

Curves *F* and *G* are a minimum for 130 and 140 m.g.d., respectively, while Curves *F* and *H* reach their minimum points at 124 and 130 m.g.d. The difference between these points in both cases is due to the fact that the cost of operation and maintenance of the triple expansion station, with an open reservoir, is relatively greater than for the centrifugally operated station with a covered reservoir and therefore the pumping capacity of the triple-expansion station would be smaller than the centrifugal for the same annual costs. It will also be observed for Curves *F* and *H*, which include a filtration plant, that the difference in pumping station capacity is 6 m.g.d. whereas for Curves *E* and *G*, which do not include a filtration plant, the difference in pumping station capacity is 10 m.g.d. This is explained by the fact that the annual cost of filtration plant is a relatively large percentage of the entire annual waterworks cost and therefore the difference in annual cost between the triple-expansion open reservoir combination and the centrifugal covered reservoir combination is relatively less.

# LETTERS TO THE EDITOR

***If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.***

## Design Provisions in Joint Committee Report

Sir—I have read with interest your review of the "Joint Committee's Tentative Concrete Specifications," in the July 14 issue of *Engineering News-Record*. There are, unfortunately, some typographical errors in the report on which this review is based and in at least one instance this has resulted in a misinterpretation of the report. There are a few other places in which the review gives what I believe is a wrong interpretation of the specifications. I wish briefly to call attention to these points, in order to set the matter clearly before the public.

On p. 68 about the middle of the second column is found the sentence: "A footnote gives preference to billet steel pins." Undoubtedly, the word "bars" was intended instead of "pins."

On p. 69 under "Design Provisions," the impression may be taken that for reinforced-concrete beams the only conditions under which as high a shearing stress as 12 per cent of the 28-day strength of the concrete will be permitted, is the case in which longitudinal bars are bent up in a single plane and in which all longitudinal bars are anchored. While it is possible that the summary of working stresses in Article 201 and 202 might lead to this impression, study of Sections 125 and 129 of the specifications shows that the maximum allowable shearing stress of $0.12\,f'_c$ is for the case in which the longitudinal bars are anchored and in which the beams are reinforced with stirrups or bent-up bars or a combination of the two methods.

Although the "Summary of Stresses" is quoted directly from the report, I believe that misunderstanding in connection with the maximum shearing stresses in beams with bars bent up at a single point would be less likely to occur if the summary on shearing stresses in concrete had been made in the original report, as follows:

MAXIMUM SHEARING STRESSES IN CONCRETE

| | |
|---|---|
| *Longitudinal Bars not Anchored.* | |
| (a) Beams without web reinforcement | $0.02f'_c$ |
| (b) Beams with stirrups or bent-up bars or a combination of the two methods | $0.06f'_c$ |
| *Longitudinal Bars Anchored.* | |
| (a) Beams without web reinforcement | $0.03f'_c$ |
| (b) Beams with stirrups or bent-up bars or a combination of the two methods | $0.12f'_c$ |

Under the "Flat Slab Provisions" the term $M_o$ is referred to frequently, but it seems nowhere to be stated that

$$M_o = 0.09\,Wl\left(1 - \frac{2c}{3l}\right)^2.$$

The sentence indicating the tolerance in the moments might be clearer if it read as follows: "A tolerance of $0.03M_o$ is permitted in the sum of the maximum negative moments in the two column strips and $0.01M_o$ in the sum of the maximum positive moments in the two column strips, as well as a tolerance of $0.01M_o$ in the maximum negative moment and also in the maximum positive moment in the middle strip."

The inference is given that the provisions for the slab thickness are "identical with the provisions of the 1916 J. C. report * * *." The slab thickness provision is identical with the requirements of the 1916 report only for the thickness at the column in the case of the slab which has a dropped panel and provided that the diameter of the column capital is equal to 0.225 times the span, provided also that the dropped panel is 0.4 of the short panel length and that the moment coefficient $R$, of this formula is equal to 0.54. It should be stated that in the slab formula

$t$ = thickness of slab or of slab plus dropped panel
$c$ = diameter of column capital
$l$ = long span center to center of columns
$l_1$ = short span center to center of columns
$b_1$ = width of dropped panel in the direction of the short span or, in the case of slabs without dropped panels, $b$ is $\frac{1}{3}$ the short panel length.

On p. 70, the statement is made that "The general point of inflection is $\frac{1}{7}$ instead of 0.2 in earlier reports." The coefficient $\frac{1}{7}$ is a typographical error which occurred in the Progress Report on which your review was based. The coefficient should be $\frac{1}{5}$. It has apparently escaped your notice, however, that the distance $\frac{1}{5}$ is measured from the center of the span instead of from the support (as in the report of the former committee), so that actually the assumed position of the point of inflection is the same as in the report of the former Joint Committee.

W. A. SLATER,
Secretary, Committee on Design, Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.
Washington, D. C., Aug. 2.

## In Defense of Maude and Jerry

Sir—In *Engineering News-Record* of July 21, p. 89, is an editorial on truck mortality. It is no matter of surprise that truck mortality is great. In my experience any gasoline motor is short lived and unreliable. While the blame can justly be placed largely on carelessness and inexperience of the operators, yet it must be admitted that a high degree of skill and careful operation are not generally obtainable. It has been my firm belief for some time that few should purchase either tractor or truck who were not going to operate it personally. This is especially true of the farmer. When one considers the first cost, the cost of upkeep and renewals and the salvage value of the motor and the mule, the latter is without doubt the more economical.

The justification of the motor is in the possibly larger amount of work it can do, not in its greater economy; and now that labor is more plentiful and horse feed is much cheaper, the engineer, contractor and farmer should not forget the possibilities of the mule and horse. In a recent experience of the writer it was observed that in harvesting a field of wheat three good horses and one man were cutting twice as much grain as a tractor and two men. These were being used in the same field under identical conditions. The foreman of the farm expressed the wish that he had had two teams so he could discard the tractor.

The mule has survived, notwithstanding shortage of labor and high cost of feed, an ignorant prejudice. He has had no propaganda in his favor, while our Sunday papers reek with articles on the motor. Our trade journals are congested with advertisements, and paid propagandists roam the country extolling the virtues of the truck, tractor and automobile, while the lowly mule needs none of these things to intrigue the wise purchaser.

Let the prospective purchaser of a truck or tractor visit the bone yards and junk depots—those all too numerous graveyards of truck, tractor and auto—before discarding Maude and Jerry, and let those who have tried machinery observe and try out the possibilities of the mule and I predict that that product of old Missouri, though "without pride of ancestry or hope of prosperity," will be with us for years to come, to our own satisfaction and profit.

Have you ever seen anyone digging a mule out of a mud hole? Or jacking up the leg of a mule on the roadside? Have you ever seen a mule on fire or with his gears stripped? Have you ever seen a collision between two mules? Or ever seen a mule with a broken axle? Have you ever seen a one ton mule team that cost $3,000; or a five ton mule team that cost $5,000; or ever seen either that lasted only a year; or which had an annual depreciation of even 20%?

Have you ever seen a mule team that had to be towed in? And if a mule breaks a hame-string or clevice, does that stop the whole outfit until you can send to town for a 'part" and an "expert" to put it in? Did you ever have to send to Detroit for a mule shoe or a tug, or any other

part, and remain idle until the part arrived? Did you ever think it necessary to build roads costing $30,000 per mile for a mule to travel over?

On the other hand: Did you ever see a truck that knew when it was out of gas or oil? Or that was both an alarm clock and a dinner gong? Did you ever seen one which had sense enough to stop when the plow struck a stump; to refuse to run over a man or to not skid over a steep embankment? Did you ever see a truck that would travel a mountain trail with a pack? Or that you could ride up the middle of a stream while fishing for trout?

Did you ever see a truck that, when lost, would bring you safely home over bad roads, through forest and flood, or that would keep to the road while the driver slept, and at the same time give itself more gas and apply the brakes as circumstances required? Did you ever see a truck that would put its radiator on your shoulder and beg for a chew of tobacco? Did you ever see one that in spite of mud and steep grades and poor drives would ramble right along and deliver the goods? Did you ever see one that grew more valuable during the first four years of service, or one that was tractor, truck, saddle horse and driving animal all in one, and that would repair itself by simply turning it out to pasture?

Long live the mule! May his tribe increase!

Denver, July 28. JOHN E. FIELD,
Consulting Engineer.

## Engineering Courses of Professional Grade

Sir—Prof. Burr's address on engineering education gives expression to thoughts that are not uncommon among engineers who concern themselves about the standing and recognition of the profession.

That it is *desirable* that an engineer should be made "a man of cultivation as well as of technical excellence" is an opinion that will be generally subscribed to. It is not only desirable for the personal benefit of the individual, broadening his faculties, widening his scope of vision and increasing the value of his technical training, but for the consequent improvement of the general standard of the profession.

Such cultivation may be acquired by self training, in the course of technical education, or subsequently (fine instances of that kind of successful education are not rare), but the foundation for it will be laid most securely in early life, and in advance of the strictly technical training. It may well be, as Prof. Burr points out, that, "if our secondary schools were administered a little more intelligently," it would be possible to incorporate a course of cultural or liberal-arts work in the education of the young engineer as would add cultivation, without unduly postponing entry into active practice or imposing undue strain in the period of technical study.

To make such preliminary cultural or liberal course a *compulsory* pre-requisite to technical study, cannot, however, be so readily accepted.

It is essential that the engineer should have the sure foundation of thorough knowledge of the scientific principles that govern the work he will engage in; it is not essential though it may be desirable, that he should be even familiar with history and literature in general, or of engineering in particular, or that he should be able to express himself clearly, forcefully and with conviction, or with intelligence and discrimination on public affairs, in general. It may have to be admitted that there always has been, and probably always will be, a relatively large percentage of engineers who are peculiarly fitted to conceive, design and execute the class of work that lies within the province of their calling, and who are, either by mental endowment, limited or specialized, just as peculiarly unadapted to receive any real benefit from a course of cultural or liberal-arts work. To such men, the "closed door" of compulsory preliminary cultural requirement might act as the only obstacle to the full expression of their talents, and, to the profession, might result in non-utilization of the best material.

It is also true, one may suggest, that there always will be a necessary and possibly large percentage of "hewers of wood and drawers of water" within the profession, which class must be relied upon and which ought, for many apparent reasons, to be admitted into the ranks.

The vision of a professional body all of whose members shall, *under compulsion*, be broadly cultivated and thoroughly trained technically, may be a delectable one, but it may be doubted if it is a practicable or obtainable one.

Prof. Burr may be inclined to exaggerate the effect of increased cultivation, by itself, upon the attitude of the public toward the proper recognition of the profession. It may be doubtful if the greater recognition of the legal and medical professions has been due to the broader cultivation of their members, or if the members of these professions would make such contention seriously.

While some of Prof. Burr's comments might be read to imply that he places little reliance on the efforts of organization to secure such recognition, and that apart from his arraignment of S. P. E. E. to properly utilize its opportunities, previous failures of organization cannot be made to justify the conclusion that the desired result cannot be so secured.

The hope of greater public recognition of the engineering profession may lie in the combination of broader cultivation with sounder organization. Concentration of effort should mark the future, as dissipation of energy in a multiplicity of organizations has marred the past.

Los Angeles, Aug. 5. GEORGE G. ANDERSON.

Sir:—Prof. Burr is correct—the engineering profession will never take its rightful place in forums until individuals in the profession, and a large and growing number thereof, are broadly and liberally educated. We need more of language, history, philosophy, ethics and economics and less of the minute technic of manipulation which is common in much of the engineering training now being given, with the result that graduates believe themselves to be full-fledged engineers upon graduation instead of beginners requiring much experience. We need more training for manhood and citizenship with human understanding and less as expert manipulators of processes.

How this much-desired liberal training shall be obtained is not so easily stated or determined. Sometimes it may be in a university, where opportunity is afforded for both kinds and degrees of training in simultaneous work. Sometimes it may be where opportunity, time and personal finances permit, by first securing an academic and collegiate or business training and then by specialization in a recognized institution, devoting its major time to technical work. Or it may well be in many cases where time and money permit of a few years' work, only, beyond the high or preparatory school, that the technical college shall so modify the present rigid curriculum of science and technic to provide less of this and more of the development of manhood.

It must be remembered, however, that there is always opportunity in our varied life for training for all degrees of attainment and in the above remarks the writer would not be interpreted as saying that there is no opportunity for the trade school and the training of those who would become fitted, some even from the graded school work, for the positions of high-grade artisans, mechanics and the rank and file of those who work in the engineering and technical professions under the leadership of the more completely trained man. The responsibility then arises of distinguishing different degrees and breadths of training and this may well be taken care of by classified membership in societies, degrees or registration of engineers.

The paper of Prof. Burr is understood to relate to the training of the higher grades in the profession, to the leaders and directors of enterprises. The catch phrase that leaders are "born but not made" will likely lead us to the erroneous conclusion that training for all shall be alike. There is opportunity for the rank and file, as well as for the captains, and the training may well be differentiated.

It will probably interest the readers to know that at the same meeting at which Prof. Burr presented his paper there was also, among other reports, one by a Committee on Business Training for Engineering Students. This report relates to business training as distinguished from technical training. The reasons for the former are some-

what the same in principle as the arguments for a liberal education. While there are many who still may be displeased with any suggestion to omit less of the technical work and introduce more subjects of general training, it appears that there is a growing feeling, even among the teaching profession, that a great opportunity is being lost in training engineering students for technique rather than for life.

MORRIS KNOWLES.

Pittsburgh, Aug. 5.

[The report that Mr. Knowles refers to endorses the conclusions of the Conference on Business Training for Engineers, held in Washington, June 23, 1919, to the following effect:

1. That there be *required* in all engineering courses 12 to 18 semester hours in the following subjects—general economics, cost accounting, business organization and business law.

2. That there be offered as electives 15 to 30 units in business economics, including labor and employment problems, statistics, corporation management and finance, political science, marketing (including advertising and salesmanship), psychology, scientific management, and transportation.—EDITOR.]

## The Providence Club-House

Sir—I would suggest that the Providence Engineering Society furnish as part of its club-house, as described in your issue of August 4, a stock of logarithms in order that the members can borrow ten when they are short, and that the society keep the surplus tens in stock that they may accrue during the process of their weighty deliberations while engaged in the pool, billiard and dining rooms.

Cincinnati, Aug. 10. A CINCINNATI ENGINEER.

Sir—I have read with interest the extremely instructive description by Warren B. Lewis of the proposed club-house for the Providence Engineering Society. It would seem that Providence is the only agency properly equipped to care for institutions of this sort. Present day styles in engineers' club-houses fall far short of the ideal, and any serious, painstaking effort looking toward a solution of existing difficulties is to be commended. The subject is one near my heart, and I know the designer of this act of Providence will welcome criticism and suggestion from a fellow worker in the vineyard.

In the first place a mistake was made in selecting as the site for the building the "center of gravity" of the club membership. It would have been far better to have chosen the center of gaiety or frivolity. However, as it is frequently difficult to distinguish the finer shades of meaning differentiating the terms, the oversight is not fatal. Perhaps the locations might have proved identical.

The method of eliminating overhead is original and effective. There is another *bête noir* of the engineer which might be adequately disposed of in Mr. Lewis' building. That is amortization or obsolescence. I suggest its being stored in the library.

The projection apparatus for lantern slides and movies is not specifically mentioned, but its use is indicated, display apparently to be made on the ceiling. There is a distinct advantage in having the projector handy to the speaker, thus eliminating the operator, but it is suggested that the audience might receive vary impressions from the illustrations, as individuals must of necessity view them from different angles. This difficulty might be obviated by revolving the projector horizontally while the picture is on view.

The cafe is in a position to specialize. Clams will always be easily obtainable, and slightly added expense will provide brooding apparatus on the roof warmed by the protruding boilers, thus making spring chickens and broilers available the year 'round.

Altogether, it's some club-house, I'll tell the world.

W. E. ROLFE,

St. Louis, Aug. 10. Engineers' Club of St. Louis.

## A Plea For Easier Building Credit

Sir—Has not the keynote of building depression been struck by E. F. Quirke, in his letter under the caption "Steel Lower," published in *Engineering News-Record*, August 11, p. 250, when he states:

"It is not so much the cost of material that is holding up the jobs as the fact that projects can not be financed at a reasonable rate of interest?"

Are not bankers deterrent factors from their discouragement of prospective builders? It may be they wish to safeguard themselves against drop in value of securities in past building projects with inflated values. Undoubtedly, when steel, which is the leading industry in building, starts to rise in price, building will improve. A banker will not recommend investment in a falling market.

Profiteering has been rampant among labor, material manufacturers and bankers. Labor and materials have been liquidated considerably. When will the banker see the writing on the wall? The banker's slogan lately has been "liquid loans," which result in "get-rich-quick" schemes, that surely can not last long.

A banking system that can only loan money for two or three months (at exorbitant rates), enabling material men and others in similar position to profiteer, but does not permit of long loans at reasonable rates, which are required for building operations and other such works that tend to economic production, must sooner or later bring destruction upon itself.

Labor organizations have learned their lesson. What difference of position can there be between the Federal Reserve and the A. F. of L? Both appear to be country-wide unions, one supplying labor and the other finance.

Boston, August 13. FREDERICK O. LEWIS.

## Opportunity for Engineers as Farm Appraisers

Sir—The Farm Loan Act creating the federal land banks and the joint stock land banks for the purpose of extending credit to farmers provides that all loans made by these banks must have the security appraised and recommended by federal appraisers. These appraisers are appointed by the Federal Farm Loan Board at Washington. These men, under the act, are absolute judges as to the quality of the security which is later sold to the public in the form of farm loan bonds. Of course, the several banks as well as the federal board have the privilege to reject any loan they may consider improperly secured. However, they have only the appraisers' report to guide them unless they see fit to make additional investigations.

During normal times the farm loan system will issue from one hundred to two hundred million dollars in farm loan bonds, which are advertised and sold as being made under government supervision and as being absolutely the highest class of investments.

In my opinion the duties and responsibilities of an appraiser are far too important to be left in the hands of a varied collection of appraisers such as the system now has—farmers, engineers, lawyers, real estate men, etc. A great many of these men are without farm loan experience of any kind, nor have they the slightest technical training to qualify them as competent judges of first-class security.

I am of the opinion that only a man with engineering training, a man capable of analyzing a farm or a community as he would analyze an industrial plant or a railroad system is capable of determining the value of a farm as security for investment. He will be required to determine the damage done by periodical local overflows, or the benefit of a drainage system as against the improvement tax levied on the land. In irrigated sections he must be able to study the irrigation system as a whole from an engineering standpoint in order to determine what real benefit any particular tract within the district receives. In hilly sections he should know the meaning of contours and terrace construction. He should also know the value of different classes of highway construction, the chemistry of soils and the preparation of maps. In addition to the engineering qualifications he should also know some

thing of banking and investments, as well as farm economics and crops. In fact, as I see it, a man with the broadest possible engineering education is required to properly fulfil the duties as appraiser.

I wish to call the attention of young engineers and engineering schools to the need of engineer-appraisers in the farm loan system. I see no reason why schools having a good course in agricultural engineering should not with a little additional training in banking and finances be able to produce men with the necessary fundamentals for beginners as appraisers. I wish also that the need of engineer-appraisers could be impressed upon the Farm Loan Board, which has the matter of appraisers directly in hand.

Certainly there is room for considerable improvement, and with the growing importance of the farm system I believe it wise that engineers give this subject a little of their attention. F. H. SCHREINER, Appraiser.

5th and 6th Federal Land Bank Districts.

Memphis, Tenn., Aug. 6.

## A. E. F. Used Similar Built-Up Crossing

Sir—In *Engineering News-Record*, July 28, 1921, p. 162, appears a description of an emergency railroad crossing which would apply almost equally well to the first piece of railroad construction performed by the U. S. Army in France, a matter perhaps of some historical interest.

The writer commanded Company "C" of the 15th Engineers, a detail of which company in August, 1917, at Bassens, France, built a standard-gage 71 deg. crossing from French material, doing the cutting with hacksaws and a very poor oxy-acetylene torch. The crossing was designed by Sergeants Martin and Spears and built under their direction, and was completely equipped with guard rails.

Springfield, Ill., Aug. '. L. D. CORNISH.

## More Knowledge Needed of Lime in Concrete

Sir—I notice in the report of the meeting of the American Society for Testing Materials, *Engineering News-Record*, June 30, 1921, a considerable divergency of results obtained by different experimenters on the effect of lime in concrete.

It puts me in mind of my experience some years ago in building a sewage disposal system for one of the institutions under the State Board of Control of the State of Washington. In order to make concrete more dense, 10 per cent of lime was used in the walls of the septic tanks up to water level. I had no accurate testing apparatus with me; but by making bars 2 in. square and 18 in. long, and breaking them by placing them as a beam and gradually loading them, I found the bars with lime to be about 15 per cent weaker than those which had no lime at six weeks time. The bars were poured from concrete as it was placed in the wall, except that it was passed through a screen after mixing to exclude everything over ⅛ in. diameter, before placing in the molds. It was spaded into them with a piece of shingle, just as the concrete was spaded into the wall.

On returning to the job three years later, to satisfy my curiosity I obtained a gad and a hammer and tried the concrete, finding that the concrete poured with lime was distinctly harder than that poured without. This applied not merely in one place, but in every place I tried. Strength in concrete may be considered a function of hardness, so I may say that the concrete with 10 per cent lime included was stronger at the end of three years than was that without. The mixes were in every way identical except that a quantity of lime equal to 10 per cent of the cement was added to the batch before mixing.

I also found that in very wet batches the concrete including lime was very much slower in gaining strength relative to the other than in the comparatively dry batches. This effect was so marked as to warrant the belief that it would extend beyond the 28-day period, though my observations were not carried that far.

The logical conclusion from the above is that the effect of lime on concrete is a much more complicated matter than can be unravelled by simple 28-day tests on specimens. Cement and lime are two different substances, which probably do not enter into chemical union in concrete, except to a very limited extent. They have different periods in which they exert their relative effects, and there are a wide variety of conditions which can accentuate or retard the effect of each of them variously. Portland cement is an exceedingly complex and variable substance. Lime with one brand of cement may act very differently from the way it acts with another. We have in the metallurgy of steel a striking illustration of the way in which a very minute change of composition may bring a wide change of characteristics.

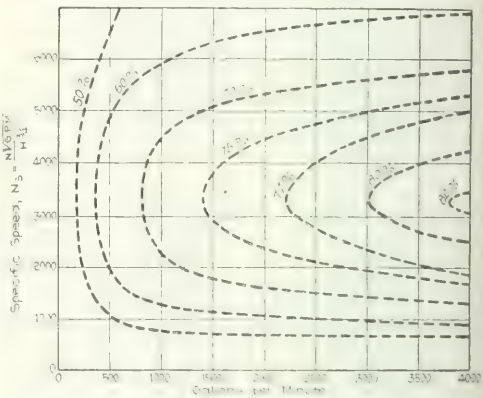
In brief we cannot draw any conclusions on the effect of lime in concrete until we have much more complete information on which to base them. We need long time tests, more data on the composition of the cement and aggregate used, and on the quantity of water.

New York City, July 26. LEO G. HALL.

## Determining Efficiency of Centrifugal Pumps

Sir—I was very much interested in the article, "New Method of Determining Efficiency of Centrifugal Pumps," by Prof. Allen F. Sherzer, in *Engineering News-Record* of June 30, 1921, p. 1114. This method will undoubtedly be of much service in estimating efficiencies of pumping installations, particularly in comparing the power requirements of various projects.

I wish to point out an apparent inconsistency, however, in deriving Fig. 3 from Figs. 1 and 2. It will be noted from




EFFICIENCY CONTOURS FOR CENTRIFUGAL PUMPS IN TERMS OF GALLONS PER MINUTE AND SPECIFIC SPEEDS

Fig. 3 that a pump discharging 200 g.p.m. has the same efficiency (50 per cent) for all values of $N_s$ (specific speed) from 600 to 7,000. Similarly, a pump discharging 400 g.p.m. has the same efficiency (61 per cent) for all values of Ns from 1,000 to 6,500. Furthermore, it would appear from Fig. 3, that all pumps with a specific speed of 1,000 having a discharge of 40 g.p.m. to 4,000 g.p.m. have the same efficiency (63 per cent). These conditions might obtain, but from the discussion in the article it does not seem probable. Apparently Fig. 3 is plotted from Fig. 2, assuming the specific speed-efficiency curve to be exactly the same for any pump regardless of the discharge up to the point of maximum efficiency, as given in Fig. 1 for the corresponding discharge. At this point the specific speed-efficiency curve is assumed to follow a horizontal line until it again intersects the curve on the descending side.

I think it would be nearer to the truth to assume that all specific speed-efficiency curves are similar to the one given, having for their maximum efficiency (efficiency at 3,300 specific speed) the efficiency shown in Fig. 1, and having the efficiency at all other specific speeds pro rated. The accompanying chart has been worked out on this basis, and I believe it gives results which are more nearly correct. It will be noticed that the efficiency for specific speeds of 3,300 is the same in every case as that given in Fig. 3 of the article, but allowance is made in this chart

for a reduction in efficiency for all values of specific speed greater than or less than 3,300.

A. G. HUSTED,
Assistant Sanitary Engineer, Department of Public Service, Cleveland.

Cleveland, Ohio, July 13.

[Prof. Sherzer replies to Mr. Husted's letter as follows: EDITOR]

Sir—I feel that I am in a great measure to blame for the impression Mr. Husted has in regard to the construction of Fig. 3, and that a further word or two may make the point clear. The illustrative problem was perhaps not wisely selected, being taken at random.

From Fig. 1 of my article it may be seen that for a discharge of 200 g.p.m. an average pump would be likely to have an efficiency of about 52 per cent within a rather wide range of specific speed, and that for all values of the capacity beyond 200 g.p.m. the efficiency will be higher. This enables us to fix the left-hand limit of the equal efficiency rectangles, as shown in Fig. 3.

From Fig. 2 it is seen that from the standpoint of specific speed alone the 70 per cent efficiency line cuts the curve at a specific speed of about 1,250 and again at 6,000. In other words, between the specific speeds of 1,250 and 6,000 the efficiency is likely to be 70 per cent or over. This is the case, however, only if the capacity is favorable. Nevertheless, it serves as a means of locating approximately the lower and upper limits of the equal-efficiency rectangle shown in Fig. 3.

As I stated in the article, it is necessary to interpolate both horizontally and vertically in order to obtain the approximate efficiency desired. This I believe is the cause of Mr. Husted's misunderstanding. Another example will make this point clear. Assume that a pump is to be designed for a discharge of 2,400 g.p.m. and that the operating speed is such that the specific speed is to be 1,250. From Fig. 3 we see that from the standpoint of capacity the efficiency would be likely to be about 78 per cent if the specific speed were favorable. We also see that from Fig. 3 the efficiency for that specific speed is likely to be about 70 per cent in the average case. The actual efficiency will probably be somewhere between these two and may be easily determined by interpolation to be about 74 per cent. From my experience this is about what is usually obtained with such pumps.

I presume Mr. Husted has obtained the same result in some other way, which would probably be just as satisfactory. The point I wish to make clear, and which was apparently overlooked by Mr. Husted, is that it is necessary to interpolate both ways to obtain the desired efficiency. It so happened in the original problem selected that this interpolation was unnecessary, as the point fell in the lower corner of the 65 per cent rectangle, which indicates that from either point of view an efficiency of 65 per cent is probable.

ALLEN F. SHERZER.
Ann Arbor, Aug. 1.

## Computing Shear in Wooden Beams

Sir—With reference to letter of A. M. Van Auken, of the American Railway Engineering Association, chairman of subcommittee 2 on Wooden Bridges and Trestles, the following expresses briefly my views on longitudinal shear:

In the formulas use $v_h$ for unit longitudinal shear, $V$ for total vertical shear at section under consideration, $b$ and $d$ for width and depth of beam, and $x$ for distance from point of maximum moment to end of beam. The formula in general use for determining longitudinal shear is $v_h = 3V/2bd$. This formula is correct for a single concentrated load, weight of beam not considered, and agrees with what I consider to be a formula of general application, which is $v_h = 3M/2bdx$, where $M$ is the maximum bending moment developed in the beam. The longitudinal shear is equal to the resisting moment of the beam or $3M/2d$, and as the maximum bending moment is taken this will give the maximum longitudinal shear that can be developed in the beam. The unit longitudinal shear I would consider as uniform between point of $M$ and the end of the beam. Deflection has little to do with longitudinal shear and is dependent only on the elasticity of the material.

From the above it will be seen that the loading to produce maximum longitudinal shear is the loading that will produce maximum bending moment. I believe the method of applying the formula $v_h = 3V/2bd$ to determine the longitudinal shear at different sections of the beam is in error.

In a stress diagram the longitudinal shear would be represented by a horizontal line and the vertical shear in a uniformly loaded beam by an inclined line. The intersection of these lines for a reinforced-concrete beam would be at the point where the angle of "diagonal tension" is 45°. The amount of this "diagonal tension" at any section may be represented by the formula $T_d = \sqrt{v_h^2 b^2 + V^2/d^2}$; the unit tension then is $t_d = T_d/b$.

E. E. BELLINGER,
Senior Civil Engineer,
Interstate Commerce Commission.

San Francisco, Aug. 3.

## Solid vs. Pneumatic Tires for Trucks

Sir—The discussion of solid vs. pneumatic tires on motor trucks in *Engineering News-Record*, July 28, p. 161, is decidedly misleading because the only comparison drawn is between 12-in. pneumatic and 14-in. solid tires for a 7½-ton truck.

In the first place, the selection of a 7½-ton truck as an example of a truck to be fitted with large pneumatics is unfortunate, since this capacity vehicle constitutes less than 3 per cent of the present production of heavy-duty trucks in the United States. Moreover, in road construction, statistics show that, with respect to the number of trucks in service, the 7½-ton vehicle is a very poor third—5 and 3½-ton trucks being in much greater demand.

In the second place, pneumatic truck tires have not been built above the 8-in. size that have satisfactorily proved their commercial worth. Tires of 9 and 10-in. sizes are still in the development stage while the 12-in. size is a curiosity. It is doubtful if a 7½-ton truck has ever been equipped with 12-in. pneumatic tires for regular use in road construction work.

In the third place, in equipping trucks with pneumatics of sizes up to and including 8-in., actual practice requires that a pneumatic tire one nominal size larger than a solid tire be used to carry the same load. For example, 7-in. single solids or 8-in. pneumatics are standard equipment for the rear wheels of a 2-ton truck. On this basis, a 14-in. solid should be compared with a 16-in. pneumatic, not with a 12-in. pneumatic.

The general question of comparing large solids and large pneumatics in their effect on roads is not one of elementary mathematics, even when size comparisons follow standard practice. There are questions of speed, traction, impact and vehicle upkeep that are not measured by static wheel pressures, but which should be considered, nevertheless, in an impartial comparison. Damage to roads is primarily due to impact and impact is not directly proportional to the contact area.

B. J. LEMON,
Technical Service Department,
United States Tire Co.

New York, Aug. 4.

## Traffic Control in London

The London County Council is to press for legislation for setting up a system of unified control of local passenger transport undertakings in Greater London by a municipal traffic authority to be appointed by the local authorities who are affected. The Minister of Transport has announced the decision of the government not to proceed, for the moment, with a bill for the establishment of a London traffic authority. The establishment of such an authority was recommended by two committees appointed to investigate the London traffic. Various members of Parliament have, however, formed a committee and will shortly make recommendations to the Minister of Transport.

# HINTS FOR THE CONTRACTOR

## Keeping Concrete Chutes Clear

BY GEORGE GOODWIN

A simple yet effective method of keeping concrete chutes from jamming is found in the use of an ordinary chain, which is stretched throughout the length of chute. When a jam in the chute threatens, all that is necessary is to pull the chain slightly from the upper end, putting concrete again in motion. The flow of the concrete will then pull the chain back to its normal position.

## Oil Heater, Drawn by Hand, Used in Filling Pavement Joints

A HOMEMADE oil heater designed to be operated and moved, together with all supplies and equipment, by a crew of two men, was used on the concrete paving job recently done by the California Highway Commission in Imperial County. Because of the extreme heat to which this pavement is subjected, expansion joints were made 1½ in. wide. This width of joint made it necessary to use some kind of filler that would not flow as readily as does even heavy asphaltic oil; hence, a grade E asphalt was used in which coarse sawdust was mixed when the oil was hot. By using a means of heating the oil which could be moved along the road by hand, a crew of two men could work independently of the main crew.

OIL HEATER AND EXPANSION JOINT AFTER FILLING

The oil heater consisted of an old gasoline drum mounted on a pair of discarded Ford wheels. The opening cut near one end, as shown in the accompanying illustration, gave access to both the ash chamber and fire-box, these being separated by a grate improvised from reinforcing steel bars. A hole was cut in the top of the drum and an iron kettle was fastened there to serve as a vessel in which to heat the oil. The margin around the rim of the kettle served as a place to drain the dipping cans.

A pan about 30 in. in diameter and 10 in. high was used for mixing the sawdust and hot oil, after which the mixture was well compacted in the joints with iron tamping bars.

To move from joint to joint, one of the men took the supply of sawdust and oil as well as tools and wood fuel on a wheelbarrow while the other man moved the heater.

## Air Compressor Driven by Engine of Truck on Which It Is Mounted

BY MERRILL BUTLER

Bridge Engineer, Arizona Highway Department

THE accompanying photograph illustrates a portable air compressor outfit mounted on a two-ton truck. It was devised by C. R. Bone, general foreman of the Arizona Highway Department road camp engaged in building a portion of the highway joining the mining towns of Superior and Miami. Difficulty in reaching the shallow rock work with air lines prompted Mr. Bone to build this device.

AIR COMPRESSOR MOUNTED ON TWO-TON TRUCK

An 8 x 8-in. compressor, driven by power from the truck, is set up on the chassis and the storage tank is towed along as a trailer. When in operation the rear wheels are blocked up and the driving belts are put in place. The surfaces of the solid rubber tires act as very good pulley faces. The outfit is capable of supplying air for two large jackhammers. By the simple process of removing the blocking and disconnecting the belts the contrivance is ready to move on to the next location.

It has effected a great saving in cost of piping and trouble of setting up, such as is encountered in rigging a more permanent layout.

The truck engine operates without any excessive heating, using 12 gal. of gasoline and 1 qt. of lubricating oil during an 8-hour shift.

## Skid Construction Machinery on Track

IN ASSEMBLING the plant for constructing the Hetch-Hetchy Dam for San Francisco it was occasionally necessary to move motors weighing several hundred pounds from one part of the job to another. Particularly on short hauls, it hardly seemed worth while to raise the motors to flat car level and then lower them to track level again. A means adopted to avoid this consisted of putting a motor on a pair of skids and moving it as a sled to a position on the industrial track with the skids at right angles to the rails, and then dragging it along the rails by means of a chain to the contractor's dinkey. Care was taken to see that the end of the skids which projected over the rails would clear any obstructions that might be met with along the track.

# NEWS OF THE WEEK

New York, August 25, 1921

## Ask Army Engineer Board To Pass on Bay Crossing

Members of the general committee on the San Francisco bay ridge have signed a report on the Davis-Modjeski plan in which the committee recommends that the "east bay cities join with San Francisco in a petition to the War Department asking for a public hearing and a determination by an engineering board of the United States army as to the general problem of bridging San rancisco bay and what would be the most desirable location within the harbor lines." The report states that under present conditions it is impossible to recommend any definite location but that tentative plans in the Davies-Modjeski report present adequate basis for discussion before an army board.

The report is signed by M. M. O'Shaughnessy, city engineer of San rancisco; Clifton E. Hickok, city manager of Alameda; Burnett Hamilton, city engineer of Alameda; George Mattis, city engineer of Oakland; Lochiel M. King, board of state harbor commissioners; Charles Derleth, Jr., Dean, College of Civil Engineering, University of California; and Marston Campbell.

In addition to this report members of the committee from the east bay cities made public a statement in which they point out that all the proposed plans for bridging the bay have been founded upon insufficient data and are only general in their entire layout and that no plan or scheme should be submitted for general discussion until there has been made a complete survey of the physical conditions to be overcome.

"The traffic to be accommodated," the statement continues, "has never received any consideration other than generalities. There never has been prepared a thorough and complete investigation of terminals and their relation to existing means of distribution of travel in the east bay cities. We feel that all these things are fundamental and we could not as engineers at this time pass upon any project which is not founded upon full information of physical conditions and adequate and complete investigation of terminals and traffic conditions."

## Railroad Claims Damages from City for Pittsburgh Slide

A claim for $767,000 has been made by the Pennsylvania R. R. against Pittsburgh for expenses and damages caused by the slide in Jones Hollow below Bigelow Boulevard last November, reported in *Engineering News-Record*, November 25, 1920, p. 1058 and Dec. 2, p. 1076. It is said that there will be further claims by the railroad against the city on this account.

### Exhaustive Study

MOTOR-VEHICLE LEGISLATION

Do you know that less than one-half the states are charging the motor-vehicle fees recommended in the proposed uniform motor-vehicle law? This and other outstanding facts on motor-vehicle legislation will be found in a comprehensive article that will appear in *Engineering News-Record*, Sept. 1.

## Fire in Woodwork Under Floor Damages Boston Bridge

A fire of unknown origin damaged the Dover Street bridge over Fort Point channel between Boston and South Boston on June 1. Details of the accident have just become available. One span of the bridge was seriously affected, this being an 80-ft. deck plate girder, the middle of three forming the approach to the draw.

Woodwork under the floor of the bridge was involved. The damaged span comprises four main longitudinal girders, transverse floorbeams, and steel stringers framed into these. Nailing strips on top of the stringers carry a 4-in. kyanized spruce deck; a granite block pavement is laid on a waterproofing course on this planking. Sidewalks on either side of the bridge are of asphalt wearing surface on plank on wooden stringers supported by steel cantilever brackets. Under the two middle longitudinal girders of the bridge are located water pipes and electric conduits, below which is a wooden walkway for repair purposes, suspended from the girders. This apparently was untreated wood. The space enclosed by the deep longitudinal girders, the deck planking and the wooden floor below the pipes and conduits formed a long gallery with combustible top and bottom; the fire started in this gallery. The deck planking, the walkway below, and some wooden forms that had been left in place around the electric conduit took fire.

The heat, possibly aided by the effect of water which was played on the bridge by the fire department, buckled and distorted the steel stringers and floor beams and in minor degree the two main girders. Of the latter, the upper flanges were bent and the web buckled, so that the whole span deflected somewhat. The span will have to be rebuilt. The deck planking was found to be charred about ¼ to 1-in. deep, but the wooden walkway below was badly burned.

The bridge was built in 1894, and the decking is said to be the same that was put in originally.

## Senate Passes Amended Townsend Bill

### Federal Highway Commission Feature Eliminated—Appropriation Cut to $75,000,000

(*Washington Correspondence*)

The Townsend highway bill passed the Senate Aug. 19 in amended form. The proposal to vest the governmental authority in a Federal highway commission, rather than in a bureau of the Department of Agriculture, was eliminated from the bill and the appropriation was reduced from $100,000,000 to $75,000,000. The reduction was made in the amount to be available during the first six months after the passage of the act. Senator Townsend stated that it would be better to reduce the appropriation during the first six months, than to reduce the amount which would become available during the succeeding period.

The conferees on this legislation, at this writing, fully expect to reach an agreement in time to send the bill to the White House before the Congressional recess.

NO SUPPORT FOR COMMISSION

The most surprising feature of the consideration of the bill was the lack of support in the Senate for the Federal Highway Commission, the feature for which Senator Townsend had worked for several years. In order to retain it in the bill in committee he had made concessions as to the expenditure of federal funds on a secondary system of highways, which, it is believed, he might otherwise not have made. The vote on the amendment eliminating the provision of the bill creating a federal highway commission was 36 to 15. Incidentally the rollcall was an overwhelming vote of confidence for the U. S. Bureau of Public Roads.

The elimination of the commission idea was proposed in an amendment by Senator Curtis, of Kansas. He declared that commissions, as a rule, are not efficient and that it would be particularly unwise to substitute a commission for an agency which is admitted very generally to be doing satisfactory work. Senator Lodge supported the amendment as did Senator Wadsworth. The latter senator announced that he would like to see all public works consolidated in a single department where more businesslike control could be exerted. This statement is of particular significance, coming as it does from the chairman of the committee on military affairs. The most controverted single point in the public works department plan is that it would strip the War Department of certain constructional activities, particularly those pertaining to rivers and harbors.

The Townsend bill as it was re-

ported to the Senate, was the result of a compromise in the committee. There was every prospect of a deadlock, but as each faction in the committee recognized that there must be an agreement if there is to be any legislation at this session, Senator Townsend finally agreed that the states should designate a system of roads, not to exceed 7 per cent of all the highways of the states. Three-sevenths of the roads included in the 7 per cent were to be designated as interstate roads and the remaining four-sevenths as intercounty roads connecting with the interstate roads. In addition, it was agreed in committee that not less than 60 per cent of the federal-aid funds must be expended on the interstate roads. Senator Townsend pointed out that the compromise is a recognition of the principle, at least, that the federal government shall have something to say about the location of the roads, by confining these roads to a system and stating that the interstate roads must be given attention first.

COMPROMISE REACHED

Senator McKellar, of Tennessee, led the minority of the committee which insisted that the state highway commissions should not be deprived of the right of locating and designating the roads within their states which are to be improved. In order to secure greater power for the state highway commissions, Mr. McKellar and the others of the minority agreed to the provision of the bill creating a federal highway com mission. Thus as a result of the com promise, the Townsend bill, as it came onto the floor of the Senate, carried with it no change in the procedure for the approval of highway projects. The provision of the existing law was continued, wherein the states lay out the system subject to the approval of the federal agency.

An amendment was adopted by the Senate, to clarify the spending of the 60 per cent on interstate roads, so that not more than 60 per cent could be expended on such roads, but with the approval of any state highway department, the federal agency may approve the expenditure of more than 60 per cent on the interstate roads. It was revealed in the discussion that the President, in talking with Senator Townsend about the appropriation to be carried by the bill, had said, "Do not make it too large."

## Twin Bascule Spans to Be Built Over Mystic River

A double bascule of the double-leaf Strauss type, spanning 118 ft. between trunnions, is to be constructed over the south channel of the Mystic River on the line of Chelsea St., Boston. Two bascule spans will be placed side by side; each is to carry one electric railway track, a 25-ft. roadway and a 5½-ft. sidewalk. With the fixed spans and foundations, the bridge will cost about $800,000. The work is expected to be advertised this fall.

## International Road Congress Postponed to 1923

At the meeting of the Permanent Commission of the International Association of Road Congresses in Paris, June 11, it was decided to postpone the Fourth International Road Congress, which had been scheduled to meet in Rome in the spring of 1922. This was done because the Italian government pointed out that the gathering of a great international congress in Italy would, for some time to come, be likely to be exposed to unavoidable inconveniences. Following the receipt of this information the executives of the association made inquiries as to the probability of holding the congress in Spain, and in return, received an invitation from the Spanish government to hold the Fourth Congress in that country in the spring of 1923. The commission unanimously decided to accept.

Five subjects were adopted by the commission for discussion at the 1923 congress: (1) Surfacing of roads with concrete; (2) use of bitumen and asphalt for surfacing (the use of tar and its derivatives is not comprised in this subject); (3) development of motor transport; (4) general traffic regulations; (5) the problem of traffic on congested roads and streets. The fourth topic is to deal with dimensions of vehicles, weights and speeds, width of tires, lighting, brakes, drivers' licenses, etc. The fifth topic is to deal with design and design features that have an influence on traffic and also with traffic regulations.

## Apply for Rehearing of Cleveland Union Station Case

The New York Central R.R., the Big Four and the Nickel Plate petitioned the Interstate Commerce Commission Aug. 17, 1921, for a rehearing in the Cleveland terminal case on the ground that the findings are against the weight of evidence. They are not supported by sufficient evidence and are not in accordance with the law. The carriers cite twelve specific instances of error in the opinion and conclude with the statement that the necessity for a union depot, terminal and other facilities in Cleveland is "imminent and vital to the city's future development and progress, as to which there is entire unanimity of sentiment." The application for rehearing is accompanied by a written plea signed by the representatives of civic, labor and other organizations.

## City Managers to Meet in Chicago

The City Managers Association will hold its annual meeting in Chicago Nov. 14 to 16 and the National Municipal League will meet in the same place Nov. 16 to 18. During the same week the American Civic Association will hold its annual meeting in Chicago. H. G. Otis, city manager of Clarksburg, W. Va., is secretary of the City Managers Association and H. W. Dodd, 261 Broadway, New York City, is secretary of the National Municipal League.

## Indianapolis Appoints City Planning Commission

A city planning commission of nine members for the city of Indianapolis has been appointed. There are five citizen members and four city official members. The latter include the presidents of the board of park commissioners and the board of public works, a member of the city council and Frank S. Lingenfelter, city engineer.

## San Francisco Urged to Begin Rincon Hill Regrade

M. M. O'Shaughnessy, city engineer of San Francisco, was recently asked to furnish the board of supervisors a report on the costs of the Rincon Hill regrading project (1) if the entire city were assessed for a portion of the costs, (2) if the project for filling Islais Creek were correlated with it, (3) if part of the entire cost were to be paid out of the tax rate, and (4) whether some of the rock removed from the hill could not be used to advantage in sea-wall construction. A resumé of the proposed regrading project appeared in *Engineering News-Record*, March 24, p. 526.

Mr. O'Shaughnessy reported (1) that for the 140,000 parcels of land involved in the entire city, a 50 per cent addition to the small assessment that would have to be levied against each would be required for bookkeeping and the method in general is not desirable. As to (2) he said the cost of hauling Rincon Hill materials for the Islais Creek fill would be 30 to 40 cents per square yard as against about 15 cents per square yard for pumping mud from the bay and hence the proposed combination is not justified. In regard to the tax rate proposition (3) he said "This policy of financing by committing future administrations to installment obligations without the vote of the people is not in conformity with the spirit of the charter." His report on (4) was to the effect that a soft sandstone formation so generally prevails in the hill that only about 5 per cent could be used in sea-wall construction.

Mr. O'Shaughnessy's plan for financing the work is to levy $1,700,000 of the total $4,000,000 cost on the work against the frontage directly affected by regrading of the hill and the remaining $2,300,000 against the commercial and industrial districts of the city.

In concluding his report Mr O'Shaughnessy says, "Due entirely to the $4,000,000 Twin Peaks tunnel project, the 90-acre area of land beyond Twin Peaks has increased in assessed value in three years by $700,000 and an actual increment of $2,000,000 has occurred. There is thirty-five times this area beyond the tunnel and still available for use and with development it will have a value of $70,000,000. I believe the Rincon Hill removal will have a similar effect and I believe the work should be undertaken at once and completed inside of two years when values of all property in this vicinity are bound to advance.

## California Highway Controversy Debated Before Engineers

Under the auspices of the San Francisco Engineering Council, a meeting was held at the San Francisco Engineers' Club on Aug. 9 at which authorized representatives of the California State Highway Commission and the California State Automobile Association discussed the points at issue in the controversy between these two organizations over the state highway situation. C. D. Marx, chairman of the council, presided. W. C. Howe, consulting engineer and member of the board of engineers, who reported on conditions of the state highway system for the automobile association, spoke for the association. He reviewed in detail the criticisms of past and present policy of the commission and offered suggestions as to changes which were desired. T. E. Stanton, assistant highway engineer, presented the case of the commission setting forth the policies it had followed and the limitations under which it has worked.

After these two presentations had been made a spirited series of questions and discussions ensued, lasting well into the afternoon and in which there was participation by a considerable number of engineers, many of them prominently connected with highway work. It was notable that none of those who criticised the commission made any intimation that there had been any dishonesty or misappropriation of funds.

At the close of the meeting, in summing up the fundamentals underlying various angles of the discussions, Prof. Marx said, "The two factions do not seem to be far apart after all, because the automobile associations appear to be willing to support the highway commission and to aid in raising funds for road work if suitable roads are assured and the highway commission seems to be more than willing to build adequate substantial roads if sufficient funds were made available." No plans were announced for further attempts to get the two sides together and check the present undesirable publicity attending the controversy, but many suggestions to this end were made to Engineering Council officers present.

## Zoning Commission Appointed for Baltimore, Md.

In accordance with a recent zoning ordinance passed by the City Council of Baltimore, Md., Mayor Broening has appointed Edward H. Bouton, president of the Roland Park Co., and three others to serve with the following city officials named in the ordinance: Henry G. Perring, chief engineer of Baltimore; Major Joseph W. Shirley, chief engineer, Topographical Survey Commission, and J. F. Crowther, building inspector. The Mayor has stated that it is his intention to ask the Engineers' Club of Baltimore, the local chapter of the American Institute of Architects, and other similar bodies having particular interest in zoning, to appoint members of an advisory zoning commission. Mr. Perring and Major Shirley have already accumulated zoning data which is to be submitted for the use of the new commission.

## Build 400-Foot Pile Bridge in Fourteen Days

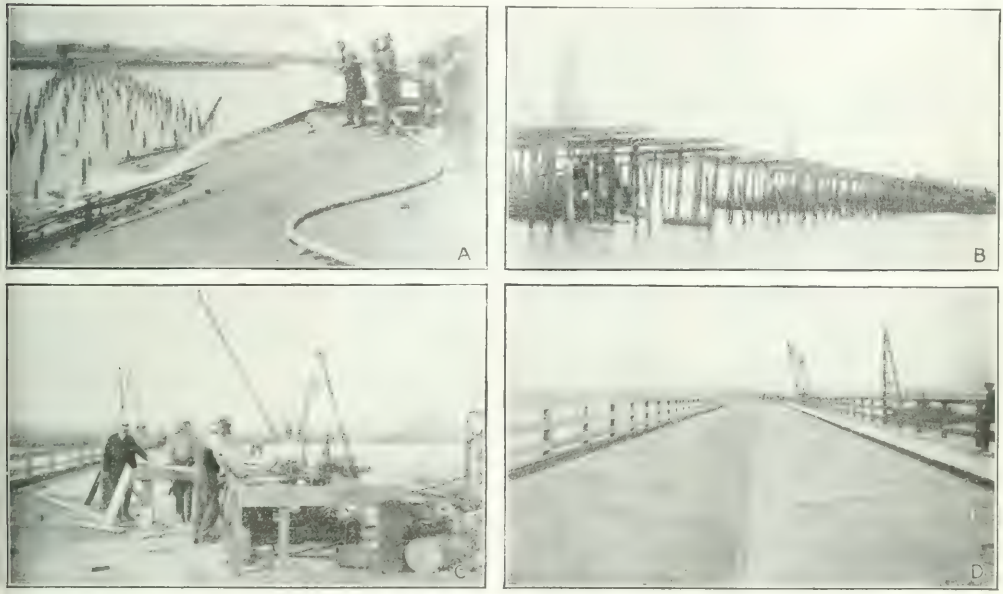
### Replaces Structure at Lynn, Mass., Destroyed by Fire—Red Tape Cut

By E. W. Davidson
General Electric Co., Schenectady, N. Y.

City officials and an industrial works pooled interests, cut red tape, and built a 400-ft. bridge 33 ft. wide, at Lynn, Mass., in ten days' actual working time or fourteen days total time within the past month. Here is a brief record of the case:

Fire on June 17 destroyed the Point of Pines bridge connecting Lynn and Revere, a vital traffic artery. On the following day the Metropolitan District Commission stated that a new bridge would cost between $60,000 and $150,000 and no funds were available except a $50,000 state emergency fund. On the 30th, at a hearing held by the commission, the engineer reported that a new bridge would cost $150,000 and travel would be shut off for six months. The General Electric Co., whose River Works is near the bridge, offered to rebuild the bridge in temporary form at cost, in fifteen days' time, on the assurance of H. S. Baldwin, department engineer of the company, and the commission decided to let the company go ahead.

Lynn appropriated $40,000. On July 2 detail plans for the structure were drawn, a labor contract was let to W. S. Rendle Co., of East Boston, for $14,200, and the furnishing of materials and supervision was undertaken by the company itself for $20,000. Work be-



SAUGUS RIVER BRIDGE RECONSTRUCTED IN FOURTEEN DAYS
A—Old bridge after fire, June 17. B—New superstructure on July 12. C—Sawing diagonal planking, July 17.
D—Formal opening, July 18.

gan on July 4 cleaning up the wreckage of the old bridge and three days later construction started on the new structure.

Night and day work was necessary to complete the job. Floodlights were put up for night work. On July 12 all the caps but six were in position, and on the 14th it was possible to cross the bridge on loose planking.

Laying the diagonal planking of the 2-in. spruce wearing surface promised to cause delay on account of the sawing necessary, but a motor-driven circular saw table sent out on the job by the company took care of this sawing as fast as the planks could be fed to the saw. The last spike was driven by Mayor W. H. Creamer of Lynn, on July 18, and the bridge was opened to traffic.

The new bridge consists of oak piles, long leaf stringers, caps, decking, and hand railing, and spruce wearing surface; the lumber total amounts to 270,000 b.ft.

## ENGINEERING SOCIETIES

### Calendar

**Annual Meetings**

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, New York, N. Y.: Semi-Centennial Anniversary Week. Barre, Pa., September 12-15.

NEW ENGLAND WATER WORKS ASSOCIATION. Boston, Mass.: Annual Convention. Bridgeport, Conn., Sept. 13-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Valparaiso, Ind.: Annual Convention. Baltimore, Md. October 13-18.

**The American Society of Agricultural Engineers** announces the organization of a reclamation section, composed of members who have a common interest in irrigation, drainage, flood control and land clearing.

**The National Drainage Congress** meets Sept 22, 23 and 24 in St. Paul, Minn. Some of the papers by engineers scheduled are as follows: Dr. F. H. Newell, on "Colonization"; F. N. DeWolf, on "Legal and Engineering Aspect of Drainage in Illinois," and L. K. Sherman, on "Outlet Drainage and Flood Control Districts." Other subjects of engineering interest are "Practice in Subsidiary Drainage Works Including Filling and Ditch Maintenance"; "Drainage Pumping Plants—Relative Efficiency of Electricity, Steam and Oil" and "Development in Drainage and Excavating Machinery."

**Seattle Post, American Military Engineers,** held its annual midsummer meeting and outing on August 13, with a visit to Fort Worden and forts guarding the entrance to Puget Sound. When completed in 1911, the works represented the most modern ideas in artillery defense.

**The Duluth (Minn.) Engineers' Club,** at its annual meeting August 2, elected the following officers: President, W. A. Clark; first vice-president, R. S. Huey; second vice-president, A. M. Frazee; secretary, H. P. Haseneye; treasurer, W. E. Hawley.

## PERSONAL NOTES

E. J. BAYER has been appointed engineer maintenance of way of the Evansville, Indianapolis & Terre Haute Ry. (New York Central Lines), with headquarters at Washington, Ind.

D. A. GRANT, formerly assistant engineer in charge of the bituminous construction, Pennsylvania Highway Department, is now general superintendent with Mayer Brothers Construction Co., Oil City, Pa.

GEORGE M. LEHMAN, recently engineer of the Department of Internal Affairs of Pennsylvania, has been appointed chief of the newly formed division of waterways of the bureau of statistics and information of this department. He was chief engineer of the proposed Lake Erie and Ohio River Canal, and still retains his connection with this project in a consulting capacity to the canal board.

PROF. HAROLD J. LOCKWOOD, who has been a member of the faculty of Lafayette College as instructor in physics and electrical engineering; assistant professor in charge of technical physics; in charge of ignition work, vocational section, Lafayette College Motor School, U. S. A.; summer school of surveying, civil engineering department; and the summer school of heat engineering, mechanical engineering department, has been appointed professor of electrical engineering at the Thayer School of Civil Engineering, Dartmouth College, Hanover, N. H.

E. E. ADAMS, assistant to the president, Union Pacific System, has been appointed first vice-president, the Los Angeles & Salt Lake R.R., control of which was recently acquired by the Union Pacific. He will continue as assistant to the president of the Union Pacific in addition to his new duties.

F. G. RANKIN, formerly resident engineer at Hubbard, Tex., with Bryant & Huffman, Austin, Tex., has been appointed assistant resident engineer with this company in Cooke County, Tex.

ALFRED L. KUEHN, vice-president in charge of operation of the American Creosoting Co., Louisville, Ky., has been elected president of the company. He was graduated from the University of Illinois in 1900, and he served for two years as engineer of maintenance of way on the Chicago, Cincinnati & Louisville Ry. and for one year in the same position on the Michigan division of the Big Four Ry. Later he was transferred to the Chicago division with headquarters at Indianapolis, Ind. In 1911 he was appointed general superintendent of the American Creosoting Co., and in 1918 he was promoted to the position of vice-president.

C. A. LATIMER, formerly assistant chief engineer for Francisco & Jacobus, consulting engineers, New York City, and E. G. KAUFMAN have been engaged by the City of Holyoke, Mass., to prepare designs for five new bridges over the canals in that city.

DONALD G. COOMBS has resigned as manager of the production department, C. M. Lovsted & Co., Seattle, Wash., and since August 1 has been connected with the construction department, Shell Co., of California, northern division, with headquarters at Seattle.

J. BLAKE GORDON, senior assistant engineer in the sewer department, District of Columbia, has been appointed sanitary engineer succeeding Asa E. Phillips, resigned. He entered the service of the district in 1900 as assistant to Mr. Phillips and has served for about 14 years. From 1905 to 1910 he was in private engineering practice. During the war he saw service in France as an officer in the Engineer Corps.

W. W. MCCLENDON has been appointed consulting engineer for Navarro County, Tex.

W. S. MAHLIE, of Columbus, Ohio, has been appointed bacteriologist in charge of the filtration plant for the Fort Worth, Tex., water-works.

F. M. CLARK, formerly assistant chief engineer of the Nova Scotia Highways Board, has been appointed construction engineer for the Maine Highway Commission.

ALLAN GARRATT, recently consulting hydraulic engineer to Lockwood, Greene & Co., has opened an office in Boston, Mass., for consultation and advisory work in hydraulic engineering.

W. C. BARBER has resigned as city manager of Dayton Ohio, after serving some six months. He will return to Joliet, Ill., where he was serving as mayor when he accepted the city managership of Dayton.

FRED O. EICHELBERGER, director of public service of Dayton, Ohio, for more than a year past, has been appointed city manager, effective Aug. 1, in place of W. C. Barber, resigned. Mr. Eichelberger has been in the service of the city of Dayton for many years. Beginning as rodman in the engineering division, he worked up to the position of engineer in charge of sewers. He was appointed city engineer early in 1915, which office he retained until he became director of public service.

HENRY T. SHELLEY, chief engineer of the Eastern Clay Products Association, Pittsburgh, Pa., has been appointed secretary and manager to succeed the late George H. Tefft. He was formerly assistant engineer of sewer construction with the Bureau of Surveys, Philadelphia, Pa.

# Equipment and Materials

## Pneumatic Hammer Scoop

To cut down the cost of loosening stiff clay, hard pan and fine gravel in such excavations where steam shovels and trenching machines cannot be used, the Ingersoll-Rand Company, of New York, is putting on the market the "Little David" hammer and scoop. The hammer is of the long-stroke type, fitted with a special handle. The scoop is held in place by a safety retainer.

In a sewer tunnel job now under way in Detroit, where the bore is about 9 ft. 6 in. diameter, the contractor, using these tools, is averaging 17 lineal feet of sewer per day of 8 hours with four miners. This gives about 11 cu.yd. per man per day. The material is a medium-hard blue clay, which is fairly stiff, no bracing or timbering being needed to hold the roof of the tunnel.

## General Purpose Crawling Tractor Cranes

To meet the demand for a full revolving tractor crane which can be operated independently of rails, the Industrial Works, Bay City, Mich., has developed its Type BC and Type BT "Industrial" crawling tractor crane. The former has a capacity of 20,000 lb. at 12-ft. radius and is equipped with continuous crawling tractor belt, while the latter has a capacity of 18,000 lb. at 10- ft. radius

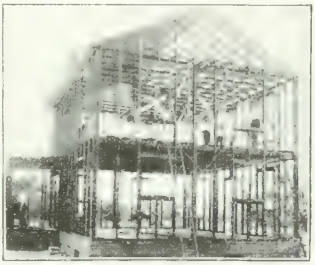
and is equipped with four broad-gage tractor wheels. Both are equipped with 30 ft. booms. The drive is by internal combustion engine.

Special attention has been given to the propelling and steering mechanism and control. The operator can propel and steer the crane independently of all other motions. Either tractor belt can be readily disconnected from the motor while the other belt continues traveling at the normal rate of speed. The disconnected tractor belt can be held stationary by applying the brake, can be allowed to coast with the brake and clutch both disengaged, or the clutch can be allowed to slip, thus allowing the operator to turn as sharp or as wide a corner as he may select. All the clutches, brakes and lever mechanisms for steering are located in the revolving upper works where they are much more accessible than when located on the car body.

## Metal Lumber for Home Building

Metal lumber as a material for home building is demonstrated in a two-story residence just erected at Canton, Ohio, by the Berger Manufacuring Co. Taking this house as a beginning the company expects to develop designs for a series of homes, of varying types, dimensions, and costs to meet the tastes and purses of different home builders. For each standard house every metal joist, stud and channel will be supplied of an exact size, so that all parts will fit quickly and easily.

The framing of the outer walls is of 4 in. channel shapes, with the flanges punched with prongs for the attachment of metal lath, which will hold the plastering for the inside of the house



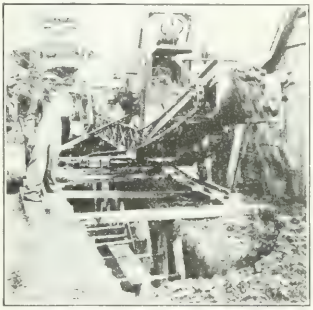
and the stucco for the outside. Partitions are erected of 2 or 4-in. studs on both sides of which metal lath is applied. The floors are built of metal joists, placed 2 ft. apart. To these joists nailing strips are attached so that either wood or composition floors may be installed. Metal-lumber rafters support the roof, to which nailing strips are attached so that any form of roofing may be used. Wood grounds are applied for the installation of windows, door frames, baseboard, picture molding, etc. In the finished house no metal can be seen, inside or outside.

## Backfilling Conveyor for Use in Narrow Alleys

Due to limited width it is difficult to operate a trenching machine satisfactorily in a 16-ft. alley without congesting it badly. The earth is piled on one side only, the other being used for stringing out the pipe. For that reason there is very considerable advantage in operating a continuous backfiller with the trenching machine.

To meet this situation the Austin Machinery Corporation, of Chicago, has designed a backfiller conveyor, which, attached to a trenching machine, can work in an alley only 10 ft. 6 in. wide.

A short conveyor takes the excavated material from the standard cross conveyor belt of the trenching machine and delivers it to the main belt, which, driven by a gasoline engine, and therefore independent of the power of the trenching machine, carries the dirt back and into the trench. The device moves on short, light rail sections and is attached to the trenching machine for



traction purposes. The rear end is raised and lowered with a winch; when used in the open it can be used for loading wagons. The back filler is built in sections of 4 ft. 6 in., so that any reasonable length can be used, the conveyor belt being lengthened or shortened.

## Out-of-the-Ordinary Trade Publications

The sort of information that the designer and draftsmen want to have handy is found in a pamphlet of twenty sheets put out by the FEDERAL CEMENT TILE COMPANY, of Chicago. It shows the application of interlocking, channel and flat tile to different types of roofs. Details as to gutters, ridges, valleys and collars are given and also data for figuring the amount of tile needed for different widths of buildings and with different roof pitches. Included also are sheets showing details of application of the company's cast concrete sills and wall coping.

A second edition of the National Steel Lumber Handbook is being issued as a 183-page 4 x 6¾-in. cloth-bound manual by the NATIONAL PRESSED STEEL COMPANY, Massillon, Ohio. It has been prepared by the Steel Lumber Division of the company, under the direction of H. M. Naugle and Stanley Macomber. It follows the lines of the first edition and contains the sort of data the designers of ordinary steel work are accustomed to find in the various well-known structural-steel handbooks. Since the first edition was published there have been a number of improvements in the product and some changes in the design of National sections. The new edition covers these developments and amplifies in many respects the contents of the first edition. In addition to the information essential in such a handbook—regarding the properties of the sections, details of connections, etc.—there is considerable auxiliary material in the way of comparisons of cost of designs using steel lumber with other well-known types of construction, data on footing designs, loads permitted by building ordinances, etc.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## July Cement Production Exceeds That of June

According to an estimate made by the United States Geological Survey, the production of portland cement in the United States in July was greater than the figure attained in June by 272,000 bbl. The total production for July was 9,568,000 bbl., as compared to the 9,296,000 in June. The report also shows that more cement was shipped than was produced. The investigation was made by the Geological Survey under the direction of Ernest F. Burchard.

The production for the first seven months of 1921 was more than 97 per cent of the quantity manufactured in the corresponding months of 1920 and more than 52 per cent of the total production of 1920. Shipments were more than 96 per cent of those for the corresponding period of 1920 and more than 52 per cent of those for the whole year 1920.

The production of clinker (unground cement) during the seven months amounted to more than 53,000,000 bbl. and the July production exceeded 9,000,000 bbl. July stocks of clinker are reported as more than 4,300,000 bbl.

## Southern Pine in Better Condition Now Than in 1920

According to the weekly reports issued on production, orders received and shipments of southern pine by the Southern Pine Association, the condition of the southern pine mills is much better at the present time than at the corresponding period of 1920. For the week ended Aug. 5, the average production for the preceding six weeks showed an increase of 6 per cent over the production of the corresponding period of 1920. For the same six-weeks period, the shipments of 1921 were 43 per cent in excess of the shipments for 1920 and the orders received 8 per cent over the orders received in 1920. For the past few months the production of southern pine has been hovering between 75 and 80 per cent of normal.

## West Coast Lumber Production

For the week ended August 13, 107 mills reported to the West Coast Lumbermen's Association a production of 55,908,400 ft. b.m., which is 28 per cent below normal production. New business totaled 58,404,876 ft. b.m., and shipments 61,827,379 ft. b.m In the cargo trade, domestic orders totaled 5,542,796 ft. b.m., and export trade 7,560,133 ft. b.m. Coastwise and intercoastal shipments totaled in excess of 14,000,000 ft. b. m. and export shipments in excess of 5,000,000 ft. b. m.

## Unemployment Put at 5,735,000

Pursuant to a resolution passed in the United States Senate on August 5, the Secretary of Labor has, through the Bureau of Labor Statistics, compiled an estimate of the unemployment in the several states. The number of unemployed is put at 5,735,000 in the report issued Aug. 16, the figures relating to the differences in the number of employees carried on payrolls in July, 1921, as compared with the peak of employment in 1920. Figures of the unemployed by industries are:

Manufacturing and mechanical industries (including building trades) 3,900,000; mining, 250,000; transportation, 800,000; trade and clerical workers, 450,000; and domestic and personal service, 335,000. No estimate could be given as to the number of ex-service men unemployed as reports covering payroll data do not segregate them. The same applies to women workers.

The Secretary of Labor in transmitting his report to Congress, made the following statement:

"In consideration of these figures certain conditions must be kept in mind: First, they refer to the change in number of persons employed between the peak of operations in 1920 and the present time, ignoring whatever unemployment there may have been in the spring of 1920; second, that the employment was far above normal in the spring of 1920. Workers' wives, daughters and boys who were not accustomed to work for wages took up gainful work through economic necessity or because of the tempting wages offered. Therefore, the present recession in employment may not be entirely unemployment for regular workers, but a return of many persons from gainful work back to non-gainful home work or schools."

## Paper Mill Wages Cut 15 Per Cent

Wage reductions averaging about 15 per cent for all classes of workers have been fixed by a board of arbitration appointed in July to adjust differences between eleven employers and approximately 12,000 employees of paper mills in the United States who went out on strike last May. The strike was called as a protest against the acceptance of a 30 per cent decrease in wages. In general, the new rates represent a 10 per cent reduction for skilled workers and 25 per cent reduction for unskilled workers. The new rates became effective Aug. 22, and will be in effect until May 1, 1922 unless the board should decide to make a change after the end of this year.

There will be no protesting the new rates by the employees as they agreed to accept the judgment of the arbitration board. The arbitration agreement was signed on June 29 last.

## Wage Reductions Approach Deflated Living Cost

### Chicago Engineers Find Total Cut of 15.9 Per Cent Among 4,540,00 Workers

Average wage reductions of approximately 15.9 per cent since the first of this year for over 4,540,000 workers in industrial concerns in twenty key industries throughout the United States are shown in an analysis of industrial wage tendencies made by the J. L. Jacobs Co., engineers and statisticians of Chicago. The survey made by this agency includes a digest of reports from official documents and reliable periodicals, covering 693 establishments or industrial groups which are typical of the industrial and utility activities of the country and which include every industry of any consequence in the United States.

#### Wage Reduction Analysis

The summary analysis from the 693 individual and group establishments reporting show that approximately 43 per cent of these industries reduced wages 20 per cent or over; that 19.9 per cent of the total reduced wages between 15 per cent and 19 per cent; that 30.4 per cent of the total concerns reporting reduced wages between 10 per cent and 14 per cent; and that about 6.5 per cent of the total concerns reporting reduced wages less than 10 per cent. Wage reductions in the iron and steel industry amount to 20.7 per cent and in the building trades (in cities) 18.1 per cent.

This average wage reduction of 15.9 per cent for industrial workers throughout the country is still below the average reduction in the cost of living as reported by the U. S. Department of Labor, the total reduction in the cost of living from the peak period in June, 1920, to June, 1921, being 16⅞ per cent.

The instances cited do not cover wage reductions made prior to the beginning of the year, nor proposed reductions which have not been made effective. While the reports from the 693 establishments do not purport to cover all wage reductions, the wide range of industries and the large number of instances covered, show the average reductions throughout the industrial field and the relationship of such reductions with the downward industrial and economic trend which began in July, 1920.

The wage reductions considered in the analysis are actual reductions in salaries and wages. In addition, there have been some reductions through elimination of bonuses and of punitive overtime rates, or through the increase in number of working hours, either without changing the compensation, or along with the reduction of wages.

The outstanding reductions that have been made in the last sixty days are among the public utilities, the building trades and the steel industries.

## Clay Products in 1920

The value of clay products marketed in the United States in 1920, as estimated by Jefferson Middleton, of the United States Geological Survey, was $364,220,000, by far the highest value ever recorded. This amount represents an increase of $103,430,000, as compared with 1919; of about $143,000,000 as compared with 1918, and nearly $200,000,000 as compared with 1910. The greater part of this increase is due to the increased cost of production which reached its peak in 1920. However, the quantities of many clay products were greater in 1920 than in 1919.

Common brick was the leading product, the output in 1920 being 4,709,000,000 bricks, an increase of 156,333,000 over the 1919 production. Notwithstanding this gain, the output of 1920 was the smallest recorded, except in 1919 and 1918, and was less than one-half as large as the maximum production which was registered in 1906. The value of this product was $81,330,000, the highest ever recorded and representing an increase of $23,000,000 over 1919. Bricks showed the largest gain recorded by any clay product in 1920. The average price per one thousand in 1920, according to the survey, was $17.27, as compared with $12.79 in 1919.

The quantity of fire brick marketed in 1920 was in excess of 1,000,000,000 9-in. brick, and the average value per one thousand, $46.64. The quantity of hollow tile marketed in 1920 was 2,457,000 tons and the average price per ton was $10.54. Sewer pipe increased approximately 40 per cent in value during 1920 over 1919. Face brick decreased in output, but increased in price. The average price per one thousand was $26.18 in 1920, as compared with $19.58 in 1919.

## Montreal to Build 1,700 Houses

A contract for the construction of 1,700 six-room houses for sale on easy terms to lot owners was recently let to the Anglin Norcross Co., Montreal, by the city of Montreal. The houses are to be sold at about $6,000 each. They are to be of brick, 22 x 30 ft., and of two stories. The total cost of the houses will be well in excess of $10,000,000. Work is to begin on the housing project immediately.

## Buffalo Brick Makers Indicted

The grand jury which took up the inquiry into alleged illegal practices in the Buffalo building industry has returned additional indictments, three brick manufacturers being the defendants. Six individuals identified with the three companies are involved in the indictments. Bail of $2,000 was fixed in each case and the defendants have entered pleas of not guilty. The indictments are a result of the investigation recently carried on by the Lockwood joint legislative committee on housing.

## Supply and Demand for Labor in New York State

The chief statistician of the New York State Department of Labor recently reported through the labor market bulletin that the ratio of workers seeking employment to each 100 places available was 139 in June compared with a ratio of 137 reported in May. Among the cities included in the report increases between May and June in proportion of workers who registered for work to positions open appear Albany, Binghamton, Buffalo and Syracuse. The occupations which show an increase in unemployment during the month are building work, casual labor and clerical work.

## Contractors Get Itemized Bids on Road Job Opening

Every contractor who bid at the New York State Highway Department bid opening held Friday, Aug. 12, and practically every contractor who now has a highway contract in New York, received in the mail August 13, a printed book containing all the unit prices bid the previous day. There were 106 proposals, some with more than thirty items. It was past four o'clock Friday afternoon when the reading was concluded and before midnight the printed book with all the unit prices was in the mail. This enabled the contractors in all the larger cities of the state to get the book in Saturday morning's mail.

The book was sent to the contractors by Fuller & O'Brien, Albany, who represent the Fidelity & Casualty Co., New York City, and who are also sales agents for road materials and equipment. Fuller & O'Brien have a free service bureau for contractors.

## New York Lets Road Contracts to Value of $2,000,000

On August 12 and 16 the New York State Highway Commission let twenty-two highway construction and reconstruction projects upon which the engineer's estimate was $2,245,869 and upon which the total low bid amounted to $1,979,013. Eleven contracts involving the construction and repair of about 25 miles of durable pavements were let on Aug. 12 and eleven more involving 38 miles of roads were let on Aug. 16. There were 140 bidders on the twenty-two projects, and the total low bid was only 90 per cent of the engineer's estimate for the work.

## Is There a Price Level?

A review of the general building situation by R. C. Marshall, Jr., general manager of the Associated General Contractors of America, as abstracted by *Engineering News-Record* and published in the issue of Aug. 18, p. 300, incorrectly noted the fact that the original discussion would appear in the September issue of the A. G. C. *Bulletin*. The article in question appears in the August number.

## Reduced Lumber Rates from South to Middle West

Reduced rates on lumber from the South to the Middle West, as ordered by the Interstate Commerce Commission, went into effect Aug. 19. It is the general purpose of the order to equalize the effects of the recent freight rate increases on shipments to the western and middle western center of consumption, from the Pacific Coast and from the Southern lumber producers. It has been contended by the Southern lumbermen that rates to points in Iowa, Kansas and Nebraska were relatively higher than they should be, with the result that their share of the lumber business in these states has been gradually diminishing. The rates that have gone into effect are from 5 to 15 per cent less from points in Mississippi, Arkansas, Louisiana (west of the Mississippi River), Texas and Oklahoma to destinations in Iowa, Minnesota, Nebraska, Kansas and Oklahoma.

## Twenty-five Projects Entail Expenditure of $60,000,000

Twenty-five construction projects, some of which have been put under contract, reported upon in this issue of *Engineering News-Record*, will entail the expenditure of more than $60,000,000. Each project is over $1,000,000, and the largest is $11,000,000, a transmission line, tunnel, and subsurface installations planned by the Niagara Falls Power Co. Eight contracts that actually have been let will involve a cost of $18,317,000, and nine projects, upon which bids are either being received or soon will be, will cost $17,300,000. Proposed work, totaling $25,000,000 brings the total to $60,617,000. The largest contract let is for the construction of a $6,500,000 hotel at Montreal.

## Iron and Steel Products Reduced

The Link-Belt Co., Philadelphia, Chicago and Indianapolis, has announced a reduction in its price of malleable iron and steel chains, sprockets and other products of 10 per cent. The reduction becomes effective at once. The company also announces that discounts are obtainable upon application.

## Building in New York Cities

According to the labor market bulletin recently issued from the office of the New York State Department of Labor the total value of building operations authorized during the first half of the 1921 was $200,634,300 or 2 per cent greater than the amount reported during the same period in 1920. This gain occurred chiefly in May and June. Due to the decline in cost of building materials the increase in actual amount of building work planned in the first half of 1921 over the corresponding period of 1920 was probably greater than the 2 per cent indicated above, continues the report.

Another important fact brought out in the comparison between the two

years, continues the report, is the fact that the value of new building work authorized in the state as a whole during the first half of 1921 constituted 86 per cent of the total amount reported, while the cost of new buildings authorized during the same period in 1920 was only 79 per cent of the total. This is pointed to as an indication that there is at present a greater tendency to construct new buildings.

## New York Firm Awarded Contract in Australia

Milliken Bros. Mfg. Company, Inc., New York City, has recently been awarded a contract totalling about £75,000, sterling, plus freight, according to an announcement made recently by the electricity commissioners of Melbourne, Australia. The contract covers the erection of a 112-mile transmission line bringing high tension power from Victoria Falls, Australia, to Melbourne and includes a total of 634 steel towers to carry a current of 133,000 volts. German, British and Australian companies all submitted bids. The line is a state enterprise, the power to be sold to manufacturers near Melbourne.

One of the vice-presidents of Milliken Bros. is already en route to Melbourne to start the work.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important changes on the less important materials. Moreover, only the standard grades are quoted. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 4, the next on September 1.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $2.88 | $3.50 | $4.00 | $2.88 | $3.16 | $4.10 | $3.70 | −$4.00 | $5.00 |
| Structural rivets, 100 lb. | 4.40 | 5.25 | −5.50 | 3.88 | 5.20 | 4.25 | 5.50 | 5.25 | 8.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2.78 | 3.20 | 3.50 | 2.78 | 3.18 | 3.97½ | 2.35 | 3.75 | 4.25 |
| Steel pipe, black, ⅜ to 6 in. lap, discount | 51% | 52 65-5% | 45% | 53½% | 53.9–5% | 36% | 46.25% | 47½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 48.80 | 43.33 | −53.30 | 46.10 | 52.80 | 57.50 | 60.00 | 63.00 | 75.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@2.70(del.) | 2.75 | 2.80 | 2.17 | 2.41 | 3.10 | 3.09 | 3.10 | 2.75 |
| Gravel, ¾ in., cu.yd. | 2.25 | 2.25 | 3.00 | 1.80 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1.25 | 1.35 | 2.50 | 1.80 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.90 to 2.00 | 2.25 | 2.80 | 2.00 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | −45.00 | 38.00 | 35.00 | 49.00 | 34.00 | +49.00 | +30.00 | +21.50 | 120.00 |
| Lime, finishing, hydrated, ton | 18.00 | 19.00 | 25.00 | 20.00 | 29.00 | −30.00 | 25.40 | 24.00 | 28.00 |
| Lime common, lump, per bbl | 3.00 | 1.50 | 2.75 | 1.65 | 1.50 | −2.95 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000. | 18.40 | 10.00 | +12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 18.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .13 | .092 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | .105 | .14 | .13 | .07410 | .092 | .10 | .14½ | .12 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | .80 | .86 | +.98 | −.80 | .90 | +.98 | −.95 | .79 | .84 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 1.00 | .50 | .50@.63½ | .81½ | .75 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .40 | .50 | .37½@.50 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45%50 means a range of 45 to 50 per cent. **Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.80 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

## Changes Since Last Week

New York warehouses continue to quote structural steel shapes and plates at $2.88 and soft-steel bars at $2.78. Although the general tone of the warehouse business is encouraging, mill shipments continue inactive. New York quotes mill shipments of structural shapes and plates at $2.18@$2.23, and bars at $2.13. The regular Pittsburgh prices of $1.75 for steel bars and $1.85 for plates and shapes seem to be generally adhered to. Cutting under these prices from 5c. to 15c. per 100 lb. has been rumored, but is not generally practiced. In Dallas, structural shapes have been reduced 20c., to $4, and rivets from $5.755 to $5.50.

Seattle reports lumber demand improving, with a price advance of 50c. per M. ft. b.m. in Douglas fir. Pine has advanced from $47 to $49 per M. ft. in Denver, and from $27 to $30 in San Francisco. The New York wholesale market on pine is off $2 on the base size, the price for 12-in. now being $40; for 10-in., $37, and for 8-in. and under, $34. The larger sizes sell for $46 (14 x 14), and $52 (16 x 16). New York prices are wholesale, the price to contractors being about $5 higher than these quotations.

Denver quotes a reduction in hydrated, finishing lime from $32 to $30 per ton, and in common lump lime from $3.10 to $2.95 per bbl. delivered.

Demand for common brick has been unusually heavy in the New York district during the last week, with prices unchanged. Dallas reports an advance from $12.65 to $12.72.

Fluctuations in linseed oil prices are shown throughout the country. Dallas reports a rise of 1c. and Denver a rise of 2c. per gal.; while the Chicago price drops 4c., and San Francisco 1c. per gal. (5-bbl. lots). Two of the important explosives manufacturers have just announced a decrease of 25c. per 100 lb.

Cleveland quotes the following labor rates: skilled labor, at $1.04 per hr.; pile drivers, at 91c.; hod-carriers, at 60c., and common labor, at 57½c.

San Francisco reports lockout still on, but there seem to be more men at work on the American plan. In Atlanta nonunion, common labor is available at 20c. As giving a line on labor conditions in Philadelphia, on a $200,000 sewer job, the following estimates for the labor were tendered:

| Labor, per hour | A. | B. | C. |
|---|---|---|---|
| Foreman | 0.80 | 0.75 | 1.00 |
| Carpenter | 1.00 | 0.80 | 1.00 |
| Bricklayer | 1.00 | 0.80 | 1.00 |
| Cement finisher | 0.75 | 1.25 | 1.25 |
| Common labor | 0.50 | 0.40 | 0.60 |

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

Volume 87 — NEW YORK, SEPTEMBER 1, 1921 — Number 9

## Automobiles and Ice Cream

LAST week at Atlantic City Samuel Gompers stormed against those who begrudged the worker his automobiles and ice cream. We heartily agree with Sam; the idle rich should have no exclusive claim on gas buses and frozen sweets. Also we hold—and we hope that Sam agrees with us, though he forgets to make mention of the matter in his address—that the worker should *earn* his automobiles and ice cream. Some of them do—but in defiance of the union spirit, as any one will realize who reads the record of time-killing provisions in the national railway working agreements, and the restrictions imposed by labor union rules in the building trades. Automobiles and ice cream in abundance for all of us, workers by brain as well as by hand—but always with the proviso that we *earn* them. Incidentally we have no doubt that Sam and his confreres in the supreme councils of the American Federation of Labor are getting their ice cream—at about 50 cents a plate. Their meeting last week was in the Ambassador—renowned for stiff prices, even in Atlantic City.

## Discounting Efficiency

SEEMINGLY an effort has been made to disparage Henry Ford's operation of the Detroit, Toledo & Ironton Railroad. Wide publicity has been given to statements that revenues were increased largely by hurling all available Ford plant traffic over this line, which crosses practically every trunk line from the Canadian border to the Ohio River. It is probably true enough that the spectacular increase in traffic has been due directly to this cause, and how much has been due to traffic influence through better service is as yet unknown. But the fact remains that Henry Ford is operating this line with about 40 per cent less force than under the old management and is hauling a tremendously greater tonnage than before. This has not been disputed and the remarkable increase in operating efficiency is obvious. The public will be more sympathetic toward willingness of the railroads to profit by the Ford object lesson than it will be toward efforts to discount efficiency that is established.

## Fires and Shipping Piers

UNTIL the board of review prescribed by army regulations makes its report on the Hoboken pier fire of Aug. 24 all of the facts in the case will not be known, but enough is available to make it obvious that here was another of those too-frequent fires in shipping piers of inadequate fire resistance and protection. The piers where the fire centered were the 40-year old remainders of the Hamburg-American group and the only ones of the one-time German section which were not rebuilt following the terrible conflagration of 1900. They were of wooden construction, apparently not sprinklered and only inadequately guarded by water mains and hose. Even though the contents must have been of lower inflammability than usual on commercial piers, the structure itself stood little show once a fire started. Pier fires are notably hard to fight and extremely destructive when once fairly started. There is abundant reason why the design and protection of piers against fire should be given more consideration even than in the ordinary commercial building.

## A New Meetings Plan

A DEPARTURE in the method of conducting its monthly meetings is disclosed in the August *Proceedings* of the American Society of Civil Engineers. During the last two years occasional subjects have been scheduled that were not covered by pre-printed papers. The general rule, however, has been to devote the meetings to submitted papers, if contributions lending themselves to discussion were available. Under the new arrangement all meetings up to and including that of January are preempted by assigned subjects. No opening is left for the scheduling of submitted papers, except, obviously, those pertaining to the five subjects scheduled. Each of the scheduled topics is to be dealt with, it is expected, in several sessions. The new plan has obvious advantages. It will develop important subjects broadly, and, since speakers from outside New York are to be invited, will endow the meetings with more of a national flavor. However, the plan will discourage the writing of papers, for many are attracted to write not merely by the hope of publication but of public presentation. In some way there must be provision for public presentation of such submitted (and accepted) papers as lend themselves to discussion in open meeting.

## Federal Road Bill Delayed

IN THE FORM in which it passed the Senate last month the federal-aid highway bill is radically different from the measure originally drafted by Senator Townsend. Many concessions had been made to the proponents of the House bill, fathered by Representative Dowell, but, in spite of this no agreement on the revised bill was reached before Congress recessed. Most important among the changes in the amended Townsend measure was the recession from what appeared to be an unalterable stand in favor of a federal highway commission and the acceptance of the Secretary of Agriculture and, through him, of the Bureau of Public Roads as the federal administrative agency. Months ago the plan for a national highway system, to be built and maintained entirely with federal funds, was abandoned by Senator Townsend so that the main issues on which there had heretofore been controversy had disappeared. With these bones of contention removed it was thought that agreement would be easy, but that apparently has not been the case. There is a nigger in the woodpile somewhere—possibly in the fact that there is a strong pressure for economy in appropriations.

### Reasons for a Margin of Safety

FUNDAMENTAL conceptions of structural safety are involved very intimately in the notorious case of the Boston molasses tank failure, an accident still on the calendar of unsettled cases, inasmuch as it is yet in the courts. From the start it presented the amazing spectacle of a piece of steel construction in full-load service, with direct stress—which means ideal minimum stress—exceeding 30,000 lb. per square inch, and so built as to give ample opportunity for additions to this stress by secondary effects. However, expert testimony was given to the effect that this stress was safe, a view contrary to precedent and seriously disturbing to all sound instincts of structural design. Fortunately the chances of harmful influence upon structural opinion and practice arising from the favorable testimony on the molasses tank are neutralized by the testimony given by expert witnesses for the other side in the pending litigation. Even in the brief form in which this testimony is reviewed in this issue, it has a wholesome, refreshing influence upon structural ideals.

## Structural Safety Attainable

CRUMPLING up during quiet flight, with no apparent cause from stress of weather or service, a giant dirigible carried down some two-score persons to their death last week. With the shock of the tragic occurrence there comes also the recognition that the accident adds another black chapter to a grim record of disaster. Is the dirigible balloon a safe vehicle of transport? It has a bad history, and those who assert its safety bear a heavy burden of proof. This seems even more evident when the present scanty facts of the disaster are considered: serious trouble from structural weakness some time before the accident, hasty efforts to strengthen the frame, and finally the unprovoked failure of this presumably strengthened vessel—all suggesting that the builders had struggled aimlessly, and unsuccessfully, between the conflicting requirements of strength and lightness.

In order that sound opinions about this branch of aerial navigation may be maintained, one or two of the numerous points of obscurity concerning the Hull disaster should be cleared up as soon as may be practicable. The first is the fundamental question of competence in the construction: Was every opportunity taken to apply the knowledge gathered from past experience? In other words, was the collapse the result of faulty or neglectful design, or does the accident truly represent insufficiency of existing knowledge? Next, but related to the preceding, is the question of whether this dirigible was planned on a scale so far beyond the range of past experience as to make the failure attributable to that fact itself. The danger of an abrupt change of scale of construction is known from many past experiences, and if excessive size is the secret of the present accident, there is less occasion for alarm. But in that event it becomes more surprising that 45 or 50 valuable lives were put at risk in a machine whose safety was still questionable.

One fact of the disaster, in some respects its most damning feature, yet gives reason for a hopeful view as to the possibilities of the dirigible: the fact that the fall was due to a structural failure, not to defects of the lifting or driving equipment. If the constructors of aerial vessels have mastered all their problems other than structural, if they have made gas bags, machinery, and controls quite dependable, the outlook is bright, for nothing remains but to perfect the structural element of the vessel, and the road to this objective is a well explored one. The loading must be determined, and thereafter it is only necessary to apply the resources of a well developed art to obtain completely sound construction. The difficulties which lie in the determination of the loads, may need to be approached by gradual steps; for the phenomena involved in the resistance of a slender bag structure hundreds of feet long to air forces are as indeterminate as those of wave loading on a ship's hull, and at the same time vastly more complex than the latter. But certain it is that every experience in aerial navigation will contribute to building up an increasing body of knowledge, leading constantly closer to the required certainty and safety.

In the infinitely more difficult field of airplane construction, a truly wonderful degree of reliability has been attained—and this during a period much shorter than the history of lighter-than-air navigation. This result was achieved by ceaseless, undismayed work at the solution of the many baffling problems presented. Much of the knowledge had to be gained at the cost of accident, but each accident was used as a step to fuller knowledge and sounder construction. If the only remaining problems of dirigible construction are of the structural kind, a simpler and more rapid development may be forecast.

## Honoring Honorary Members

SAMUEL REA and Ambrose Swasey have been elected honorary members of the American Society of Civil Engineers. The news comes to the profession, two months after the event, in the August *Proceedings*, through a note in the minutes and a five-line paragraph introducing cold, lifeless biographies of the two engineers. We have no doubt that the secretary in apprising them of the board's action did so graciously and humanly, but so far as the members are aware the event gets about as much attention as the routine approval of current expenditures. There is nothing human about it, no effort to raise it to its proper place as a significant event in society affairs.

The colleges do this sort of thing better. They confer degrees publicly, and accompany the ceremony with an appreciative formula setting forth the reasons for the honor.

The latter feature—an appreciative expression—is especially called for in electing to honorary membership. Mr. Rea was not honored for his record as a technical engineer, nor Mr. Swasey for his work as a scientist-manufacturer, but both of them for qualities and achievements that go beyond those generally associated with their special callings—Mr. Rea for his mastery of finance and organization, Mr. Swasey for his broad sympathies (which have always included the civil engineers in their wide embrace) and his encouragement of research. The directors in electing these honorary members did not indulge in a cold, intellectual process, but did it with enthusiasm and warm blood coursing through their veins, sensible of the honor they were conferring and of the luster which, in turn, would be shed on the society, but they have let none of that enthusiasm and warmth escape so that they would carry over to the members the importance of the action.

It is not too late to act—and abandon the old precedent of rigid formality and coldness.

## Motor-Vehicle Legislation

IN THE study of motor-vehicle legislation, which is made a feature of this issue, the outstanding points lie in the wide variations disclosed (1) in the licensing fees of the various states, (2) the basis of determining the fees, and (3) in those elements which have a direct bearing on the cost of highway construction and maintenance, namely, weight and speed of motor trucks. From a study of these variations important dollars and cents lessons can be drawn.

In the matter of fees, for example, in the case of a 5-ton truck the maximum variation is 5,900 per cent, representing fees for the *same* vehicle of $5 per year in one state and $300 in another. This, of course, is an extreme case, but even for a commonly used type of vehicle, the 25-hp., five-passenger car, a range in fees of nearly 600 per cent is shown by the figures.

There is ground for debate as to whether a given class of vehicle should pay the same registration fee in every state. Even so, there can be no sound defense of the wide variations which actually exist. Moreover, the charging of fees that are generally conceded to be too low is occasioning a very heavy loss to the road maintenance funds of the country. In the drafting of the proposed uniform vehicle law the automotive interests were active and it can be fairly assumed that the scale of fees decided upon is none too high. Yet many states are failing to receive from the motor-vehicle users the revenues which their own spokesmen have accepted. American highway practice has often been indicted on the charge of neglect of maintenance after construction has been completed. The answer has often been made that no funds were available. In the case of a state with fees radically lower than those recommended in the uniform law, the problem of increasing their road maintenance funds has a ready solution. The fees in the uniform law should, at the very least, be accepted as minimums.

In the 48 states there are no less than seventeen bases for determining license fees. These range from the simple method of so many dollars per horsepower or per unit of gross weight to an involved computation in which four elements—list price, weight of vehicle, horsepower, and carrying capacity—figure. A standard basis was recommended almost two years ago by a joint committee of motor vehicle and highway interests and involved two factors, horsepower and gross weight, with a differential in favor of pneumatic as against solid rubber tires. While some of the states have accepted the basic principles contained in this proposed uniform law, a great many have acted independently, with the result that a hodge-podge of legislation has been produced.

As to the third element of variation—weight and speed limitations—it is apparent that today the motor truck is the determining factor in the design of interstate and other trunk-line highways, as contrasted with conditions a decade ago when the passenger automobile was the highway designer's main consideration. Gross weight and impact are the two new elements which figure most prominently, and the states are properly beginning to impose gross weight restrictions on motor trucks. Motor vehicle manufacturers and highway engineers, however, are not by any means in agreement as to what the gross weight limit should be. The proposed uniform law specifies 28,000 lb.—which would permit the operation of a 7-ton truck—but it is to be noted that the representatives of the highway officials on the joint committee did not concur in so high a limit. Naturally, the restriction of gross weight should depend to some extent on the character of the highway system; trucks which might operate without undue damage over the hard surface routes of states like New York and Pennsylvania would do irreparable harm in New Hampshire or on the sand-clay roads of certain Southern states. Many highway engineers, however, feel that a 5-ton truck is about all they should be called upon to provide for. The motor-vehicle operator contends, with reason, that shipping costs are reduced by the use of large highway transport units. This statement is true only in so far as it represents the actual cost of haulage. The true cost, of course, must depend not only upon the cost of operating the vehicle itself, but of building and maintaining the road-bed over which it travels. When these latter factors are taken into consideration the case for the excessively large truck unit is decidedly weakened. An ultimate economic loss results when huge trucks, even though they may show a reducton of a few cents per ton-mile, damage a road to an extent which makes necessary the floating of a bond issue of many thousand dollars for road reconstruction purposes. The State of Maryland has had an experience of this sort, the outcome of which has been the refusal to register a truck exceeding five tons' carrying capacity, or a gross weight of 20,000 lb.

Closely associated with gross-weight limitations is the matter of tire equipment and the recent Bureau of Public Roads' impact tests which throw interesting light on the subject. Comparatively few of the states, in their motor-vehicle laws, give pneumatic or cushion tires the concessions which these tests indicate are equitable. As for the solid tire, recent amendments to several state laws prescribe a minimum *thickness* of rubber, in recognition of the fact that serious damage can be done to a highway surface if the rubber on the wheels has been worn so thin as to make the tire practically non-resilient. This is a new feature of motor-vehicle legislation and one which has a direct bearing on lower road-maintenance costs.

By learning what other states are doing in an advanced way in these various directions, which is facilitated by Mr. Tomlin's analysis, it is hoped that there will come about some reasonable agreement regarding these limitations.

In all of these matters it is clear that no solution can be economically sound which is not based upon an equal consideration for the highway builder and the highway user. Many of our existing laws have been fathered by selfish interests, but the narrowness of viewpoint which characterized discussion of the subject half a dozen years ago is fast disappearing, for the leaders in the highway engineering and the motor-vehicle fields have come to a realization that their ultimate aims are identical—the movement of the maximum traffic at a minimum cost. If the latter figure is to serve any useful purpose it must be all-inclusive—not based merely on a few of the many elements of which it should properly be composed.

In all probability the next few years will witness many further radical changes in motor-vehicle legislation. The occasion offers to highway engineers and motor-vehicle manufacturers an opportunity, through mutual understanding and co-operation, for constructive work in the interest of improved highway transport.

# Construction Joints in Concrete Girders of 62½-Ft. Span

## Unique Design Safeguards Reinforced-Concrete Garage Under Williamsburg Bridge Against Cracking in Event of Uneven Pier Settlement

IN DESIGNING a one-story reinforced-concrete garage to be erected under the Williamsburg bridge, New York City, three-span continuous girders were contemplated. Upon excavating for the foundations soil conditions were found to be somewhat unsatisfactory for continuous action, the possibility being present of uneven settlement of piers. As the plans had already been approved by the Bureau of Buildings and the Department of Plant and Structures, New York City, to avoid loss of time in resubmitting new designs the engineer in charge resorted to the expedient of putting two construction joints in the center girders, leaving the reinforcing steel in all the girders as the approved plans called for, except for the shifting of the top bars toward the end girders.

These center girders have a span of 62 ft. 6 in. and the construction joints were placed in the center spans a distance of 14 ft. along the under face of the girder from the center line of columns. The idea of inserting the construction joints was to create two practical hinges, thereby rendering the girders statically determinate, the end spans having their inner ends cantilevered 14 ft. toward the center. The central portion —that part between construction joints—was simply supported at the cantilever end of the end span. The location of the joints was chosen so as not to change the size of the girders or the reinforcement of the original accepted design. The reinforcement of center girders remained as originally planned. At the construction joints three reinforcing bars were left in the bottom of the girders running through the joints. It was thought that in case of uneven settlement of the piers

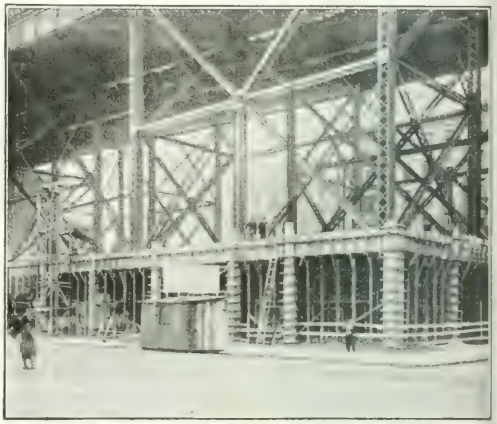


FIG. 1 WEST HALF OF GARAGE SHOWING BRIDGE STEEL

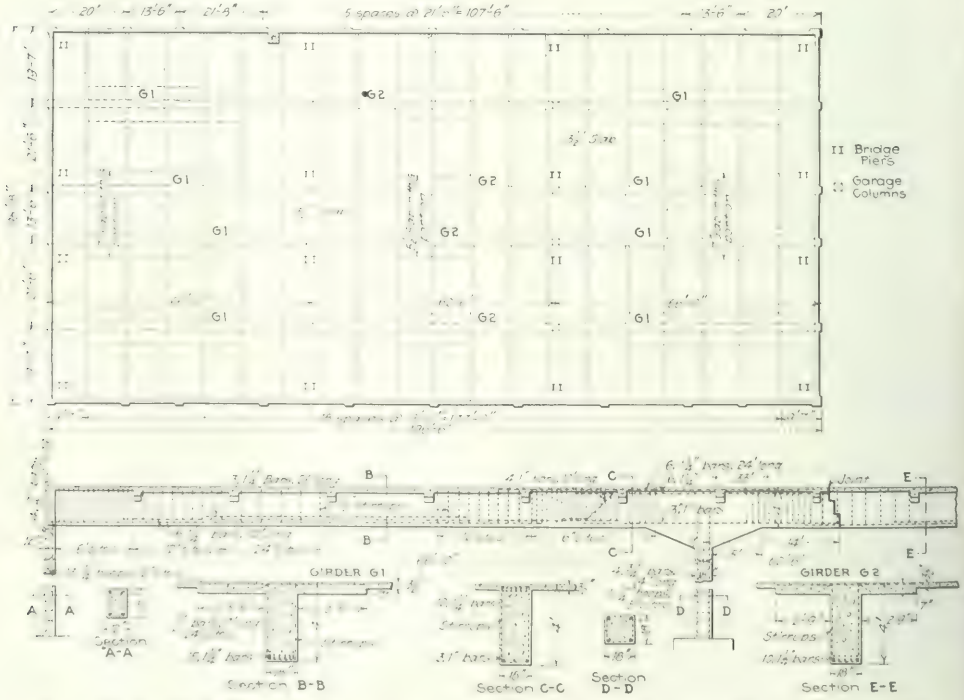



FIG. 2 PLAN AND ELEVATION, SHOWING COLUMNS IN RELATION TO BRIDGE PIERS AND REINFORCING

the joints would be flexible enough even with the three 1-in. bars running through them.

The garage is located under the Manhattan approach to the Williamsburg bridge on the south side of Delancy St., between Mangin and Goerck Sts., and only a few blocks from the East River. Excavation revealed a sandy and gravelly soil of quite widely varying bearing qualities at the different pier locations.

The garage is 196 ft. 6 in. long, 98 ft. 8 in. wide overall, and 16 ft. from the top of the floor slab to the top of the roof slab. The roof has a pitch of 2½ ft. in

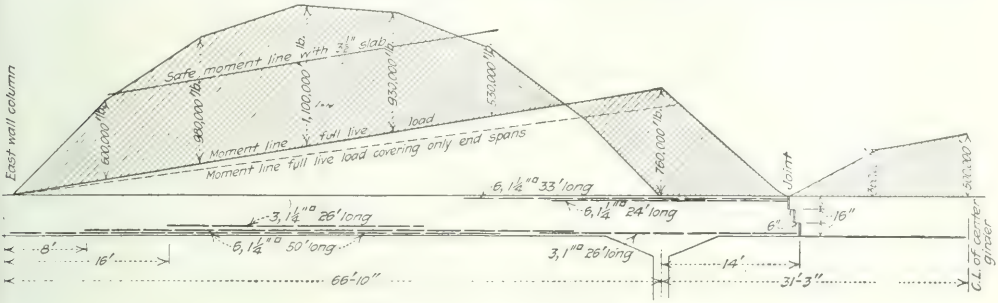



FIG. 3. MOMENT DIAGRAM FOR GIRDERS

47 ft. 10 in. The framing system is of columns 18 in. square surmounted by cantilever brackets, extending out from the column face 5 ft. and tapering from a depth of 24 in. at the column face to 0 at the 5-ft. distance; girders of a maximum span of 66 ft. 10 in., a depth of 4 ft. (including the 3½-in. roof slab) and 18 in. thick; and beams 12 in. deep (including the roof slab), and 8 in. thick.

There is little regularity as to spacing of columns, as the position of the bridge piers had some effect on the placing of garage columns. The plan is mind was to place columns as near to existing bridge piers as possible so that full advantage could be taken of storage area for cars. The garage columns are therefore in the same line, laterally, with the bridge piers. Longitudinally, there are but two interior columns. The center of the first is 66 ft. 10 in. from the outside face of the spandrel wall columns on the Goerck St. end.

FIG. 4. ROOF SLAB LAID AGAINST STEEL COLUMN AND BRACING

The span between the interior columns is 62 ft. 6 in., and the span to the other wall is 67 ft. 2 in. There are eight columns in a lateral direction, the spacing being 19 ft. 7 in. from the spandrel wall column to the first interior column, then 21 ft. 6 in., 13 ft. 6 in., 21 ft. 6 in., and 19 ft. 7 in., to the other wall.

The girders are 4 ft. deep, including the thickness of the slab, and 18 in. thick. This slab is increased to a depth of 7 in. where areas of greatest moment occur. The beams are spaced 9 ft. 10 in. c. to c. The slab is integral with the beam and the beam depth is 12 in., its thickness being 8 in. Reinforcement is as shown in Fig. 2.

The construction joints are stepped, the risers being 1 ft. 4 in. in height and the treads being 6 in. deep. The joints are soaped so that there is no rigid connection with the cantilever ends of the end beams, except through the three reinforcing bars at the bottom.

The footings for the four outside interior columns are 6 ft. square and generally 2 ft. 3 in. deep. Some foundation difficulties were encountered that necessitated deeper footings, the original design calling for both foundation walls and footings to go to undisturbed soil. Each pair of the four inside columns which are on 17½-ft. centers, are built integrally. These footings are 4 ft. wide and 7 ft. long, the slab joining them being 24 in. wide. The design of these footings called for a depth of 2 ft. 2 in. Two 1-in. bars 17 ft. long run through this section to give the twin footing its longitudinal reinforcement. Reinforcement in all footings is of ⅝-in. round corrugated bars placed on 3-in. centers.

The floor slab is of 1:3:6 concrete, 6 in. thick and laid upon an 8-in. cinder base. All concrete in the building is of 1:2:4 concrete. The walls of the garage are of brick filler laid in portland cement mortar and the lighting is secured through three bay steel sash glazed with double thick grade B glass, the steel sash being 14 ft. 11⅛ in. wide and 9 ft. high. The outside face of the piers, lintels and sills are to be rubbed smooth with carborundum stone and finished with white cement.

After the footings were put in no further concreting was done until the formwork for the entire building had been erected. When the pouring began some inconvenience was encountered in pouring around lateral braces of the steel bridge. The concrete was poured flush with the steel and connections between the two thoroughly waterproofed. It will undoubtedly be necessary further to waterproof the joints between the concrete

and steel as the concrete shrinks away from the steel. The roof slab is to be covered with a five-ply tar and gravel roofing.

The garage was designed by Missac Thompson, Brooklyn, N. Y. The Melton-MacDonald Co. were the contractors for the concrete work.

The ground is leased from the New York City Department of Plant and Structures for a term of ten years, with the privilege of renewal for a further period of ten years. At the expiration of the lease the building will be turned over to the city. The garage was built for the Concrete Building Co.

# Tests on Full-Size High-Voltage Transmission Towers

## Vertical, Longitudinal and Transverse Loads Totaling 38.8 Tons Applied to 98-Ft. Towers for New California Line

By Eugen F. Kriegsman
Engineer with F. C. Hamm, Consulting Engineer, San Francisco, Cal.

DECISION to construct a 220,000-volt 201-mi. transmission line to bring power to San Francisco from the Pit River hydro-electric plants now under construction in northern California has led to the design and construction of transmission towers of large size to carry heavy loads. In working out a suitable design for this service many factors were involved. Good practice in transmission tower design calls for rather light members and the result is a total weight of the tower that is only a small fraction of the load to be carried. For these reasons when new designs are proposed it is desirable to make a test of full-sized tower under full load. A test of that sort constitutes a check upon (1) the design, (2) the fit of the various members, (3) the clearance and spacing of bolts and members, and (4) the actual strength of the assembled tower. A series of such tests was recently made at the plant of the Pacific Coast Steel Co., in South San Francisco, where a testing stand had been built, arranged so that not only vertical loads but also large horizontal loads in two directions at right angles to each other could be applied near the tops of the towers. The method of testing, described in the following, was much the same for the various designs of towers tried out.

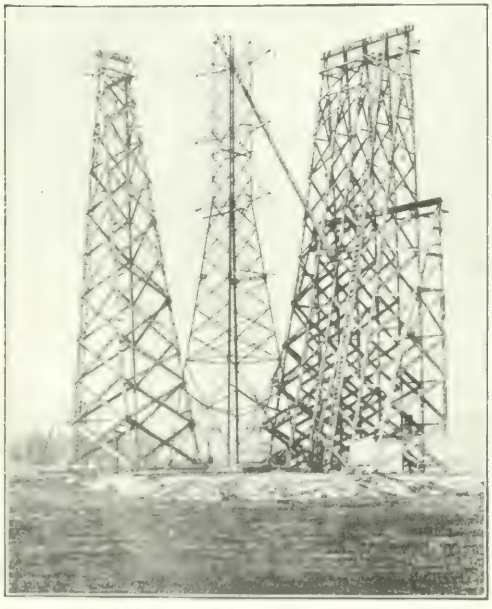


FIG. 2. CHAIN BLOCK, DYNAMOMETER AND REDUCING BEAMS

Standard towers and anchor towers for the open-country line, 98 ft. high, have a base 20 ft. square and three pairs of arms 24 ft. long tip to tip, with 15-ft. vertical spacing between them. Each of the six arms is designed and tested to support copper cable 0.91 in. in diameter weighing 1.54 lb. per lineal foot. Rope-lay cable is used. The load requirements for the test were taken at 1½ times the maximum loading anticipated under extreme conditions of wind, broken conductors and angles in alignment.

The details of the present loading requirements imposed by the Pacific Gas & Electric Co., which is building the 220,000-volt line, are shown in the accompanying illustration, Fig. 2. Case 1 represents a condition in which three wires are broken on one side of the tower, causing a pull of 10,200 lb. on the end of each of the three arms. The vertical loads of 1,400 lb. each represent the weight of the wires and insulators, and the transverse pull of 8,800 lb. is to take care of any load due to wind on the wires and the tower itself, together with an allowance for a 22-deg. in the line.

This test is to determine the strength of the tower in torsion.

Case 2 represents the situation with all six wires

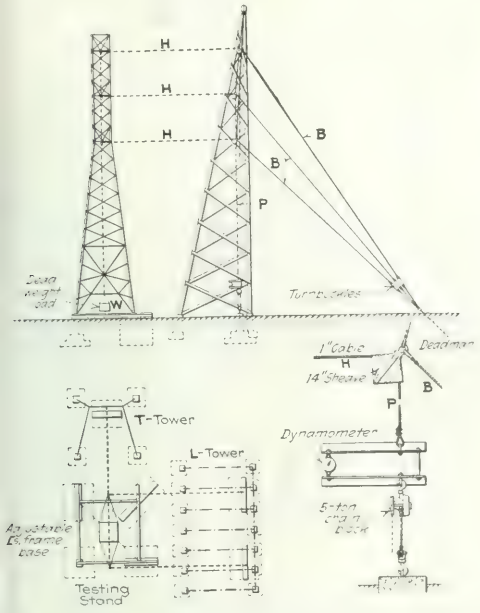



FIG. 3. PLAN AND ELEVATION OF TESTING STAND AND DETAILS OF PULLING DEVICE

roken on one side of the tower, leaving a horizontal oad of 10,200 lb. applied at the end of each arm. The ertical load, as in Case 1, represents the weight of he wire; the transverse pull of 7,900 lb. is the wind oad. Thus, this test, which is to determine the strength f the tower legs, gives a total breast pull of 61,200 lb., total vertical load of 8,400 lb., and a transverse pull f 7,900 lb., or a total load of 38.8 tons not including ne dead weight of the tower itself.

The wooden testing frame shown in the view Fig. 1, hich is the larger of the two frames used, is 100 ft. igh and 40 ft. wide at the base, carrying guys attached o a deadman buried 10 ft. deep. The four piers suporting the test tower are capped with channel beams o arranged that they may be adjusted to varying sizes f tower base up to 26 ft. These piers were designed o resist a maximum uplift of 150,000 lb. per tower g. One-half inch steel cables were used to suspend ne vertical loads, consisting of bundles of angle irons reviously weighed, from the ends of the cross-arms. he horizontal loads, i.e., the longitudinal and transerse pulls, were applied by a chain block and dynamoeter arranged as shown in the illustration.

As it was found that trouble developed in details of he cross-arm more frequently than elsewhere, the rms were tested on the ground before being mounted n the tower. This was found to be a very satisfacory means of rectifying minor defects before the actual ial in the tower itself. Many fine points in detailg were finally adjusted in these supplementary ground sts.

Deflections of the tower under load were read by ttaching fine copper wires to the tower cage the height f the center cross-arms and carrying them over 6-in. heels in both testing frames *T* and *L*, Fig. 3, in the ame manner as the pulling cables *H* and *P* were arranged. A heavy weight was suspended from the end of each copper wire and a carpenter's rule was attached to the wood frame just behind it. By noting the rise and fall of the weight against the carpenter's rule, the relative movements of the tower at the center arm in the directions *L* and *T* were recorded for the various loadings. Loads were usually applied in increments of 1,000 lb. and corresponding deflections noted. A typical tower, for example, gave a maximum deflection of $6\frac{7}{16}$ in. in the direction *L* and $1\frac{7}{16}$ in. in the direction *T* under the maximum loading of Case 2.

As the dynamometers were limited to a capacity of 5,000 lb., they were arranged with reducing beams arranged to give a reduction of 4 to 1. The dynamometers were calibrated by putting them in a string in a testing machine and comparing all readings. Tests were made on the friction loss on the 1-in. cables passing around the 14-in. sheave and an allowance of 2 per cent was made for the friction loss at this point when making the test pull on the towers.

The towers designed for this new 220,000-volt line have a double system of web members and consequently redundant forces occur in some of them. Secondary stresses due to elasticity of material and deflection of the tower often amount to a large fraction of the com-

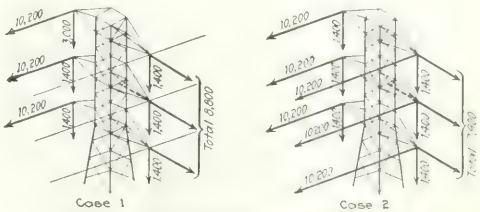



FIG. 4. TWO CASES OF TOWER LOADING

puted stress. The tests give assurance that these have been properly provided for. A series of tests run to determine the usefulness of some redundant members resulted in dispensing with certain members in the final tower.

The steel used in the manufacture of these towers is a special alloy steel, having an elastic limit of 45,000 lb. per sq.in., an elongation of 22 per cent and a cold bend of 180 deg. flat on specimens up to $\frac{3}{8}$ in. thick.

The successful designer of such towers must continually keep in mind their ultimate purpose. Testing full-sized towers, supplemented with tests of details as herein described, is an important part of the engineering of supervoltage heavy-duty transmission lines, which ultimately will make cheaper power possible for consumers and for the rapidly growing industries of the west.

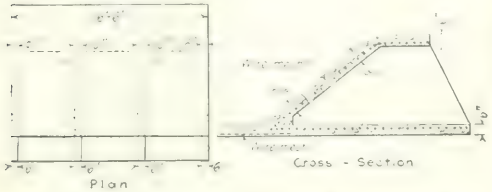
## 1,000-Ft. Steel Masts for Radio Station

A radio transmitting station which is to be completed at Shanghai, China, within the next 18 to 24 months, is to have its antenna supported by six guyed steel masts, each having a height of 1,000 ft. The steel in these masts will total about 200 tons in weight as compared to the 570 tons required for the 820-ft. self-supporting towers of the radio station at Bordeaux—the highest self-supporting radio tower thus far built. The Shanghai station is to be built by the Federal Telegraph Co. for the Chinese Government.

## Precast Concrete Breakwaters Used in Lake Erie

SHORE protection has been installed at a number of points along the south shore of Lake Erie by setting in place precast concrete breakwater sections made by the American Construction Co. at its yard in Cleveland. A breakwater of this kind is shown in the accompanying view. The construction and appearance of a single section are shown separately. As shown, the sections have been built commonly about 4 to 5 ft. high, but the builders say that they can be produced in heights up to 14 ft. A derrick boat can place as much as 125 lin.-ft. of this breakwater in a day.

The design was prepared as the result of long experience with pile jetties, timber crib and stone break-




PLAN AND SECTION THROUGH PRECAST CONCRETE BREAKWATER

water construction along the lake, all of which have proved weak or ineffective. According to L. A. Wells, of the company that builds these structures, the pile jetty fails to break the waves and therefore does not retain the sand, while timber crib construction offers a perpendicular face which results in severe undermining action, so that after a few years the crib either washes away or it sinks below the water level and fails of its purpose. Decay and disintegration of stone-filled cribs are also causes of complaint. Stone breakwaters, built by depositing large quarry stone on brush mattresses, have been found subject to shifting when used as shore protection, and are not tight enough to retain the sand against the washing and sucking action of the waves. In the concrete breakwater a sloping face

END OF THE PRECAST SECTIONS

and a large foundation area are provided, and the advantages of tightness and permanency are secured at the same time. The underlying idea is to offer no resistance to the seas, but to pocket the sand and thereby form a natural protection. In actual experience with the sections placed on brush mattresses the breakwaters are claimed not only to hold sand back of them but build a beach in front.

In construction the width of base is made to vary with the height, maintaining about the proportions shown in the sketch drawing. The length of section is dependent chiefly on the derrick capacity available and on convenience in placing. The cells, between cross-walls spaced about 4 ft., are tapered or wedge shaped, not only so as to permit ready removal of the forms but also to give no opportunity for damage from freezing of water within the pockets.

The shore arm or groin in this construction differs from the sea face or breakwater proper by having a

VIEW OF A TYPICAL BREAKWATER IN PLACE

central wall, with cross-walls exposed on each side. It is said that such a shore arm has a protective effect extending some distance. The effect being credited to the action of the cross-walls in breaking the advance of the waves and thereby facilitating the retention of sand. Patent of this breakwater construction has been applied for by Mr. Wells.

## Oyster Shells as Road Surfacing

By Leo G. Hall
Onekama, Mich.

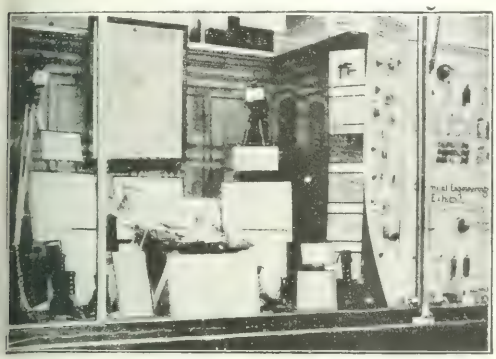
IT IS WELL known that in some of the Southern seaboard districts oyster shells are used for road surfacing with success. An example of such use was brought to the writer's attention in the construction of a cantonment in Virginia, where he had, among other things, the supervision of road construction The cantonment was on an estuary where there was considerable oyster fishing done, and that part of the ground immediately adjacent to the water was pretty well covered with oyster shells.

We built roads in their permanent locations for use in construction some months before the permanent paving was laid, by plowing a few furrows on either side scraping from both sides to the crown, dragging and rolling. It happened that a road which passed through this shell-covered field was the last to be made, and the road roller suffered a bad breakdown just before it was rolled. In the hurly-burly of rush construction we never got back to finish it.

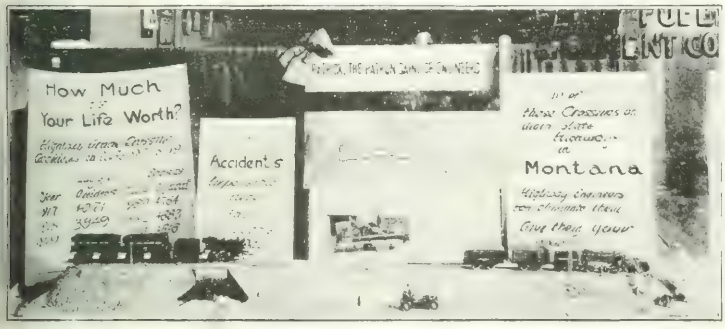
We were very much surprised, however, to find that a few rains, with routine dragging after each rain, compacted it to the point where it was by far the best road in the system. It did not become muddy during rains, nor dusty in dry weather. Heavy army trucks continually passing over it made no ruts. It always presented a hard, dense surface which shed water to the gutters on either side. The regular dragging to which all the roads were subjected was really superfluous on this one. The soil was a very light loam, which became very soft and muddy when wet, caked hard after rains and pulverized under traffic into a very light dust. All of the roads in the system except this one required constant attention to keep them even passable

## Telling the Importance of Engineering in Every-Day Life

EFFECTIVE PUBLICITY informing the public of the importance of engineering in the every-day life of the community was accomplished by window displays, motion pictures of engineering projects, engineering meetings, and newspaper publicity by the Missoula (Mont.) Chapter of the American Association of



ENGINEERING PUBLICITY BY WINDOW DISPLAY




ENGINEERS' WINDOW EXHIBIT PORTRAYS GRADE CROSSING EVIL

Engineers during "Engineers' Week," held in that city last spring. Fifteen window displays were on exhibition during the week, several of which created unusual interest in the community. Two of them are shown herewith. One depicted the importance of railroad grade crossing elimination, and another a combined exhibit illustrating various activities of the engineer and the mineral resources and industries of the state. Motion pictures of the Keokuk dam across the Mississippi, the Washington Power Co.'s hydro-electric development near Spokane, and modern concrete highway construction were shown during the week at the theaters. On each day of the week the newspapers devoted space to engineering articles of general interest, aiming to show the scope of the engineer's activities.

### TNT for Road Construction

TNT, in the opinion of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, is an ideal explosive for use in road construction. Through his bureau 26,000,000 lb. have been distributed for road-building purposes, without a single accident. The fact that TNT does not freeze makes it popular.

## Analytical Data Essential to Run Mechanical Filters

WHAT the sanitarian needs in the way of water analysis data in judging of the character of a water and what the filter operator needs to produce the water are not necessarily the same. Many tests the former would like the latter to obtain for him are useless data for every day operation. C. Arthur Brown in a paper presented to the Southwestern Water-Works Association says the following determinations are more or less valueless:

| Dissolved Oxygen | Oxygen consumed |
|---|---|
| Albuminoid ammonia | Chlorine |
| Nitrates | Nitrites |
| Alumina | Iron |
| Microscopical for algæ and diatoms | Bacterial isolation |

Among the more or less valuable tests he names:

| | |
|---|---|
| Turbidity | Color |
| Total alkalinity | Hardness |
| Caustic alkalinity | Carbonate hardness |
| Monocarbonate alkalinity | Sulphate hardness |
| Bicarbonate alkalinity | Chloride hardness |
| Free carbonic acid | Complete mineral analysis |
| Presumptive B. coli | Gelatin count at 20 deg. C. |
| Agar count at 37½ deg. C. | |

By careful selection of the determinations actually required, according to Mr. Brown, the operator can usually reduce the number to a point where the routine work becomes relatively simple and capable of being carried on without undue burden. It is of no real benefit to clutter up the records with meaningless and useless data requiring valuable time to obtain and more valuable time to set down and transcribe.

Except where the plant is handling a grossly polluted water, such as Bubbly Creek, Chicago, there is no need of determining the ammonias, nitrites, nitrates and chlorines. In most plants there can be no need for making determinations of iron or alumina. There are only a few plants handling water where the tests for micro-organisms are of any value. To effect complete isolation of B. coli is usually merely an excuse for wasting one's time. It is equally ridiculous to report turbidities where the variation in turbidity is negligible. To report color on a water which does not carry more than 10 p.p.m. is a waste of time. Where the alkalinity is of one kind and does not vary enough to affect the results in any way, a general statement to that effect is all that is needed. In plants which do not soften, even where free carbonic acid is found, a long string of data has no meaning, unless perchance the system is in trouble from red water. The hardness cannot be reduced by merely reporting it and unless softening is carried on, it has no place in a report. The agar count at 37½ deg. C. may be of material benefit to the sanitary expert but its value to the operator is small, particularly if he has a count of 20 deg. C. on gelatin.

Counting out the necessary routine chemical tests needed at any one point, there is no determination which requires as much time and skill and which makes as small return to the operator as the 37½ deg. count, nor which, in the absence of the 20 deg. count on gelatin, makes as great and varied difficulties.

# The Trend of Motor-Vehicle Legislation

## Digest of Laws of the 48 States Relating to License Fees and Regulation of Weights, Dimensions and Speeds of Passenger Automobiles and Motor Trucks

By R. K. Tomlin, Jr.
Associate Editor, *Engineering News-Record*

IN THE country-wide revision of motor vehicle legislation which has been in progress this year, a well-defined trend toward higher license fees and more rigid weight restrictions is indicated. An analysis of the amended statutes, however, discloses wide differences among the states, both in the amounts of the annual fees for passenger automobiles and motor trucks and in limitations imposed on weight, size and speed. These features of motor-vehicle laws, of course, are the ones in which highway engineers are most directly concerned, inasmuch as the funds for road maintenance in most of the states are supplied, in whole or in part, by motor vehicle fees, while limitations on gross weight, weight per inch width of tire, speed, and tire equipment are determining factors not only in the life of existing highway surfaces but in the design for new construction. No argument is needed now, however, to support the contention that the regulation of vehicular traffic has taken a place of primary importance in the highway engineering field, for the subject has dominated the meetings of road builders for a year or more past. Nevertheless, the various states, in spite of the promulgation on Jan. 20, 1920, of a proposed uniform motor-vehicle law prepared by a committee representing both motor vehicle and highway interests, have gone their separate ways in making and amending their statutes and the results, in so far as they are of interest to highway engineers, are presented in the accompanying digest which *Engineering News-Record* has prepared from the various state laws and amendments thereto. An effort has been made to have the data correct as of July 1, 1921, but the states are constantly changing their motor-vehicle laws and some of the figures may need revision by the time this article is published.

### Non-Uniformity in Fee Basis

Probably the first thing that a study of state motor-vehicle legislation emphasizes is the lack of uniformity in the *basis* of establishing license fees for both passenger cars and motor trucks. In the 48 states there are no less than 17 different bases or combinations by which the fees are fixed. For passenger cars the horsepower basis (used by 27 states) is the most prevalent, while for motor trucks the commonest form is the rated carrying capacity of the truck (used in 25 states). Other bases are: Gross weight (vehicle and load), weight of vehicle, cost, piston displacement, total tire width, flat rate per vehicle, and various combinations of the foregoing. In fact, the fee basis in one of the states, North Dakota, depends upon no less than four elements—cost of vehicle, weight of unloaded vehicle, horsepower and carrying capacity. In the joint committee's proposed uniform vehicle law, previously referred to, license fees for both passenger automobiles and motor trucks are determined on a basis of horsepower and gross weight, with a scale favoring pneumatic as against solid rubber tires.

With so many different bases of computing the license fee, it is readily understandable that few states make the same charge for the same machine. Thus, in the case of a medium-priced passenger automobile of about 25 hp., costing, say, $1,700, the fees range from a minimum of $5 to a maximum of $34, while in the case of motor trucks far greater variations occur, the range being from $5 to $300 per year for a 5-ton truck. On the other hand, a flat-rate fee per vehicle, irrespective of weight or horsepower, is operative in 3 states for passenger automobiles and in 2 states for motor trucks—obviously an illogical method of taxation in that the big, heavy vehicle is charged exactly the same fee as the light delivery truck, although its destructive effect on the roads may be many times greater.

TABLE I. DIFFERENCES AMONG STATES IN BASIS OF DETERMINING MOTOR VEHICLE FEES

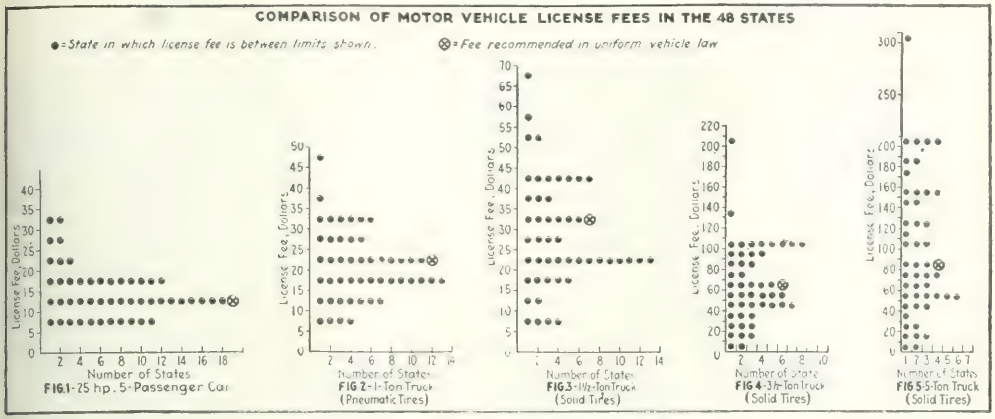
| | Basis of Determining License Fee | Number of States Using this Method for Passenger Cars | Motor Trucks |
|---|---|---|---|
| 1 | Horsepower | 27 | 2 |
| 2 | Carrying capacity | 0 | 25 |
| 3 | Weight (vehicle only) | 5 | 2 |
| 4 | Gross weight (vehicle and load) | 3 | 7 |
| 5 | Cost of vehicle | 2 | 1 |
| 6 | Piston displacement | 1 | 0 |
| 7 | Total tire width | 0 | 1 |
| 8 | Weight of chassis | 0 | 1 |
| 9 | Flat rate per vehicle | 3 | 2 |
| 10 | Horsepower plus gross weight* | 3 | 2 |
| 11 | Horsepower plus weight unloaded | 1 | 2 |
| 12 | Horsepower plus cost | 1 | 0 |
| 13 | Horsepower plus capacity | 0 | 1 |
| 14 | Weight plus cost | 1 | 0 |
| 15 | Weight plus capacity | 0 | 1 |
| 16 | Weight plus horsepower plus cost | 1 | 0 |
| 17 | Weight plus horsepower plus cost plus capacity | 0 | 1 |
| | | 48 | 48 |

* Basis recommended in Uniform Vehicle Law.

Without going into the matter of the same license fee for the same vehicle in all states—involving as it does a host of local considerations—there can be no question as to the desirability of a standard *basis* of determining such fees. Whether it be in California or in Connecticut, the wear and tear on a road by vehicular traffic is governed by the same general principles, and should be paid for on the same general basis. Many of our state legislators, however, have spurned so direct a path to their destination of fee fixing as horsepower and gross weight, and have wandered off along tortuous mathematical routes ending in a veritable maze of figures, for which there is no justification.

### Tire Equipment

If the amount of the license fee is to have definite relationship to the damage done to the road, it would seem that the type of tire should receive more consideration than has been accorded it by most of the state laws. In only 8 states is any reduction in the fee allowed for the use of pneumatic, instead of solid rubber, tires on motor trucks. Impact is now recognized as one of the most destructive agents in the upkeep of surfaced roads and the results of the research work upon which the U. S. Bureau of Public Roads has been engaged for some time past indicate a very marked reduction of impact in the case of pneumatic as against solid tires.


COMPARISON OF MOTOR VEHICLE LICENSE FEES IN THE 48 STATES
●=State in which license fee is between limits shown.
⊗=Fee recommended in uniform vehicle law
License Fee, Dollars
Number of States
FIG 1-25 hp. 5-Passenger Car
FIG 2-1-Ton Truck (Pneumatic Tires)
FIG 3-1½-Ton Truck (Solid Tires)
FIG 4-3½-Ton Truck (Solid Tires)
FIG 5-5-Ton Truck (Solid Tires)

In the report of these tests (see *Engineering News-Record*, March 31, 1921, p. 553) impact values with solid rubber tires are shown to be as high as 7 times the load on one rear wheel encountering a 1-in. obstruction at a speed of 16 miles per hour. The average impact, however, was about 4 times the wheel load when solid tires were employed. With pneumatic tires, on the other hand, the average impact was not more than 1½, and the maximum not more than 1¾, times the static load. Impact, of course, is only one of the elements that enter into the destruction of a road by traffic, but it would seem desirable, in the interests of lower road maintenance costs, for the states further to encourage the use of pneumatic tires on trucks by allowing a lower license fee for vehicles so equipped than is called for in the case of solid rubber tires.

To a less degree these remarks apply also to the so-called "cushion" tires which, according to the U. S. Bureau of Public Roads tests, offer an advantage over solid tires in reducing impact, although it is pointed out by the bureau that the name "cushion" on a tire does not necessarily make it such a tire. In none of the state motor-vehicle laws, however, is consideration given to the cushion type of tire for motor trucks as a reason for lower license fees. In like manner the cushion wheel is neglected.

Tire equipment of motor trucks, however, is recognized in some of the state laws as playing an important part in the effect of the vehicle on the roads. New Jersey, for example, in the revision of its motor-vehicle law, this year, specifies in a detailed table the allowable wheel loads for tires of various widths and wheels of various diameters. The old, worn solid tire is not looked upon with favor in certain states, and minimum tire *thickness* is now being specified in a few cases. Connecticut, in its revised motor vehicle laws, enacted this year, requires a minimum thickness of ⅞ in. for solid rubber tires 5 in. wide, a minimum thickness of 1 in. for widths from 6 to 8 in., and a minimum thickness of 1¼ in. for tires 8 in. or more in width. In California, also, a 1-in. thickness for solid rubber tires is specified as the minimum. Ohio has recently amended its motor-vehicle law by specifying a minimum thickness of ⅞ in. for a solid rubber tire 5 in. wide, 1 in. for a tire width of from 5 to 8 in., and 1⅛ in. for widths exceeding 8 in. In Oregon the weight on the axle of a truck is limited to 6,500 lb. in the case of a tire ¾ in. thick, and for axle loads exceeding 6,500 lb. the tire thickness must be at least 1 in. Generally, however, tire thickness is a neglected feature of motor-vehicle legislation, although the Bureau of Public Roads' impact tests sound a warning to the highway maintenance engineers against such worn-out wheel equipment. Speed, of course, must be considered in connection with thickness of rubber in the indictment of the worn, solid tire as a road-surface destroyer.

TABLE II. DATA ON "AVERAGE" TRUCKS OF FOUR CAPACITIES USED IN DETERMINING AMOUNTS OF LICENSE FEES

| Cap. Tons | No. of Trucks Included in Average | Hp. | Wt. of Chassis, Lb. | Wt. of Body, Lb. | Total Weight Unloaded, Lb. | Total Gross Weight, Lb. | Cost |
|---|---|---|---|---|---|---|---|
| 1 | 6 | 22 | 3,000 | 1,000 | 4,000 | 6,000 | $2,400 |
| 1½ | 5 | 23 | 3,500 | 1,200 | 4,700 | 7,700 | 2,700 |
| 3½ | 6 | 31 | 7,300 | 1,500 | 8,800 | 15,800 | 4,800 |
| 5 | 3 | 34 | 8,700 | 2,000 | 10,700 | 20,700 | 5,800 |

TABLE III. "AVERAGE" MEDIUM-PRICED AUTOMOBILE BASED ON DATA FROM NINE STANDARD CARS

| Hp. | Wt., Lb. | Wt. 5 Passenger, Lb. | Gross Wt., Lb. | Cost |
|---|---|---|---|---|
| 25 | 2,700 | 750 | 3,450 | $1,680 |

For purposes of comparison, based on the data in Tables II and III, there are listed in Table IV license fees in the various states as computed for five types of vehicles: A 25-hp. passenger car; a 1-ton truck equipped with pneumatic tires; a 1½-ton truck (solid tires); a 3½-ton truck (solid tires); and a 5-ton truck (solid tires). Before the license fees for all 48 states could be computed, however, it was necessary to determine for each type of vehicle, its horsepower, cost, tire equipment, weight (unloaded) and gross weight, inasmuch as each of these factors, or a combination of them, enter into the determination of the license fee in some of the states. An "average" vehicle in each class was found by selecting from the "Handbook of Automobiles" (1921 edition) of the National Automobile Chamber of Commerce a number of standard passenger automobiles and motor trucks and averaging in each case the horsepower, cost, weight of vehicle, etc. Following this method the medium-priced 5-passenger car was found to be one of 25 hp., weighing 2,700 lb. (or 3,450 lb. loaded with 5 passengers) and costing $1,680. The 1-ton truck was found to be of 22 hp., to cost $2,400, and to weigh, unloaded, 4,000 lb. The 1½-ton truck

# Comparison of State Motor Vehicle Laws with Reference to License Fees, Weight, Size and Speed Restrictions

*Abbreviations: Cap. = capacity; Hp. = horsepower; Wt. = weight; < = less than; > = greater than.*

| State Motor Vehicle Administrator | Date of Law; Additional Acts | Passenger Cars | Motor Trucks | Trailers | Weight Limits | Dimension Limits | Speed Limits (Miles per Hour) |
|---|---|---|---|---|---|---|---|
| **ALABAMA** (State Tax Commissioner) | Effective Oct. 1, 1919 | *Hp.* — *Fee*<br>Under 25 — $11 25<br>25–29 — 18 75<br>30–39 — 26 25<br>40 or over — 30 00<br>Electric — 20 00<br>Steam — 23 00 | *Cap., Tons* — *Fee*<br>Under 1 — $15 00<br>1 under 2 — 22 50<br>2 under 3 — 37 50<br>3 under 4 — 56 25<br>4 and over — 75 00 | | Max. gross wt., 10 tons | | Max., 30 |
| **ARIZONA** (Secretary of State) | In effect Sept. 9, 1921 | *Hp.* — *Fee*<br>25 and less — $5 00<br>26–40 — 10 00<br>over 40 — 15 00 | *Capac., Tons* — *Fee*<br>1½ and less — $10 00<br>Over 1½ — 15 00<br>Over 3 — 25 00 | | | | City — 10–15<br>Country — 30 |
| **ARKANSAS** (Commissioner of Revenues, State Treasurer, Secretary of State, Auditor of State, Chairman Railroad Commission) | Passed March 26, 1921 | Per hp. — $0 75<br>For 100 lb. gross wt. — 75<br>Min. fee, $10 | *Cap., Tons* — *Fee, Pneu.* — *Fee, Solid*<br>1 or less — $15 00 — $15 00<br>1 — 20 00 — 20 00<br>2 — 25 00 — 25 00<br>2½ — 35 00 — 35 00<br>3 — 50 00 — 50 00<br>3½ — 65 00 — 97 50<br>4 — 80 00 — 120 00<br>4½ — 100 00 — 150 00<br>5 — 125 00 — 187 50<br>6 — 150 00 — 225 00 | *Cap., Tons* — *Tires* — *Fee*<br>1 or less — Pneu — $10 00<br>2 — Pneu — 15 00<br>3 — Pneu — 25 00<br>4 — Pneu — 40 00<br>5 — Pneu — 50 00 | Max. cap., 6 tons | | |
| **CALIFORNIA** (Motor Vehicle Dept.) | Amended 1921 | Per hp. — $0 40<br>Electric — $5 00 | $0 40 per hp. plus the followings:<br>*Gross Wt., Lb.* — *Fee*<br>Less than 4,000 — $5 00<br>4,000–5,999 — 10 00<br>6,000–9,999 — 15 00<br>10,000 and over — 20 00 | Trailers, each — $2 00 | Max. gross wt., 30,000 lb. (for 4 wheels)<br>Max. gross wt., 40,000 lb. for 6 wheels and 3 axles not less than 96 in. apart<br>Per in. width tire brace, 700 lb. (800 lb. for metal tires) | Width, 102 in. | City — 15<br>Country — 35<br>*Tires*<br>*Gross Wt., Lb.* — *Speed*<br>9,000 — 25<br>9,001–12,000 — 15<br>12,001–24,000 — 10<br>Metal tires — 6 |
| **COLORADO** (Secy. of State) | Amended 1921 | *Hp.* — *Fee*<br>20 or less — $2 50<br>21–40 — 5 00<br>41 or more — 10 00 | *Cap., Tons* — *Fee*<br>1 — $10 00<br>> 1–2 — 17 50<br>> 2–3 — 25 00<br>> 3–4 — 37 50<br>> 4–5 — 50 00<br>For each add'l ton over 5 — 25 00 | *Cap., Tons* — *Fee*<br>1 < 2 — $10 00<br>For each additional ton, $5 | Max. gross wt., 8 tons | | Country — 35 |
| **CONNECTICUT** (Commissioner of Motor Vehicles) | Amended 1921 (Fees effective Jan. 1, 1922) | Per cu. in. total piston displacement — $0 08<br>(Min. fee, $15)<br>Electric, per hp. — $0 75<br>Steam, per hp. — 75 | *Cap., Tons* — *Fee, Pneu.* — *Fee, Solid*<br>1 or less — $22 50 — $40 00<br>1½ — 30 00 — 40 00<br>2 — 37 50 — 50 00<br>2½ — 60 00 — 60 00<br>3 — 70 00 — 70 00<br>3½ — 90 00 — 90 00<br>4 — 137 50 — 137 50<br>4½ — 162 50 — 162 50<br>5 — 187 50 — 187 50<br>5½ — 218 75 — 218 75<br>6 — 250 00 — 250 00<br>For each ton over 6 $100 addit'l<br>(Min. fee, $22 50) | | Per in. width of tire, 800 lb.<br>Not less than 20 per cent of gross load on one axle | | City — 30<br>Country — 20<br>Solid tire truck — 15 |
| **DELAWARE** (Secy. of State) | 1919 | Per 500 lb. gross wt. — $2 00<br>(Passengers to be included at 125 lb. each) | Same as for passenger cars | Same as for passenger cars except that for metal tires double fees are charged if gross wt. exceeds 1,500 lb. | Max. gross wt., 26,000 lb.<br>Per in. width of tire, 700 lb.<br>For trailers with metal tires max. gross wt., 6,000 lb. | Width, 96 in.<br>Height, 12 ft., 2 in.<br>(Width for traction engines, 108 in.) | City — 15<br>Country — 30<br>*Gross Wt., Lb.* — *Country* — *City*<br>*Pneumatic Tires*<br>6,000 — 30 — 15<br>8,000 — 25 — 15<br>12,000 — 25 — 15<br>16,000 — 25 — 15<br>20,000 — 22 — 12<br>26,000 — 20 — 12<br>*Solid Tires*<br>6,000 — 25 — 15<br>8,000 — 20 — 12<br>12,000 — 18 — 12<br>16,000 — 16 — 12<br>20,000 — 15 — 12<br>26,000 — 15 — 12 |

| State and Vehicle Authority | Date of Act and Amendments | Passenger Cars | Motor Trucks | Trailers | Weight Limits | Dimension Limits | Speed Limits (Miles per Hour) |
|---|---|---|---|---|---|---|---|
| **FLORIDA**<br>(State Comptroller) | Effective Jan. 1, 1919 | *Hp* — *Fee*<br>22 and less — $5 00<br>> 22–27 — 8 00<br>> 27–35 — 12 00<br>Over 35 — 15 00 | *Cap., Tons* — *Fee*<br>1 or less — $10 00<br>> 1–2 — 25 00<br>> 2–4 — 50 00<br>Over 4 — 100 00 | No license for *one* trailer under 500 lb. capacity. If more than one or over 500 lb. capacity, fees same as trucks | | | 25 |
| **GEORGIA**<br>(Sec'y of State) | Amended 1919 | 23 hp. or less — $11 25<br>Over 23 hp., per hp. — 60 | *Cap., Tons* — *Fee*<br>1 or less — $15 00<br>> 1–1½ — 22 50<br>> 1½–2 — 30 00<br>> 2–2½ — 37 50<br>> 2½–3 — 45 00<br>> 3–3½ — 52 50<br>> 3½–4 — 75 00<br>> 4–5 — 150 00<br>> 5–6 — 375 00<br>> 6–7 — 750 00<br>Over 7 — 1,125 00 | | | | Max. — 30 |
| **IDAHO**<br>(Sec'y of State) | Amended 1921 | *Wt. of Vehicle, Lb* — *Fee*<br>2,000 or less — $15 00<br>2,001–3,000 — 20 00<br>3,001–4,000 — 30 00<br>Over 4,000 — 40 00 | Same as passenger cars | Same as passenger cars | Per in. width tire, 500 lb. (For tires less than 2 in. wide max. load is 350 lb. per in. width)<br>No vehicle load to exceed 50 per cent heavier than mfg'rs. rating | | Max. — 30 |
| **ILLINOIS**<br>(Sec'y of State) | Effective Jan. 1, 1926 | *Hp* — *Fee*<br>25 and less — $8 00<br>26–35 — 12 00<br>36–50 — 20 00<br>Over 50 — 25 00<br><br>Electrics — 12 00 | *Gross Wt., Lb* — *Fee*<br>5,000 or less — $12 00<br>5,001–12,000 — 22 50<br>12,001–15,000 — 35 00<br>Over 15,000 — 60 00<br><br>Tractors — 25 00 | | Per in. width tire, 800 lb.<br>Per axle, 16,000 lb.<br>(Within cities of 20,000 above limits increased 50 per cent) | Width, 8 ft.<br>Length, trailer combination, 65 ft. | *Passenger Cars*<br>City — 10–20<br>Country — 30<br>*Trucks*<br>*Gross Wt., Lb.* — *Tires* — *Max. Sp. H*<br>5,000 — Pneu — 25<br>5,000 — Solid — 20<br>5,001–12,000 — Pneu — 20<br>5,001–12,000 — Solid — 15<br>12,001–15,000 — Pneu — 15<br>12,001–15,000 — Solid — 12<br>Over 15,000 — 12 |
| **INDIANA** | Amended March, 1921 | *Hp* — *Fee*<br>Less than 25 — $5 00<br>25–39 — 8 00<br>40–49 — 20 00<br>50 or more — 30 00<br>Electrics — 5 00 | *Cap., Tons* — *Fee*<br>Less than 1 — $6 00<br>1 < 2 — 15 00<br>2 < 3½ — 25 00<br>3½ < 5 — 50 00<br>5–7½ — 75 00 | *Cap., Tons* — *Fee*<br>Under 1 — $3 00<br>1 < 2 — 6 00<br>2 < 5 — 10 00<br>5–7½ — 20 00 | Max. cap., 7½ tons | | City — 10–15<br>Country — 25 |
| **IOWA**<br>(Motor Vehicle Dept.) | Amended 1921 | Per 100 lb. wt. — $0 40<br>Plus 1% of value of vehicle<br>Minimum fee — $10 00 | *Cap., Tons* — *Pneu.* — *Fee Solid* — *Fee Metal*<br>1 or less — $15 00 — $15 00<br>1½ — 22 50 — 22 50<br>2 — 30 00 — 30 00<br>2½ — 45 00 — 55 00<br>3 — 65 00 — 75 00<br>3½ — 90 00 — 100 00<br>4 — 105 00 — 115 00<br>4½ — 120 00 — 130 00<br>5 — 135 00 — 145 00<br>6 — 165 00 — 175 00<br>Per ton over 6 — 50 00 — 50 00<br>(Note—Trucks over 2-ton capacity in city limits pay two-thirds above fees)<br>For steel tires:<br>1-ton capacity — $40 00<br>1½-ton capacity — 50 00 | *Cap., Tons* — *Fee Pneu.* — *Fee Solid* — *Fee Metal*<br>1 or less — $10 — $10 — $15<br>2 — 15 — 15 — 30<br>3 — 25 — 35<br>4 — 40 — 50<br>5 — 50 } 60<br>6 — 60 — 70 | Per in. width tire, 800 lb.<br>Max. gross wt., 14 tons<br>Max. load, one wheel, 4 tons | Width, 8 ft. | *Gross Wt. Tons* — *Tires* — *Speed*<br>Less than 3 — Pneu — 30<br>Less than 3 — Solid — 25<br>>3–6 — Pneu — 25<br>>3–6 — Solid — 20<br>>6 — Pneu — 16<br>>6 — Solid — 12<br>Metal — 10 |
| **KENTUCKY** | Enacted March, 1920 | Per hp. — $0 60 | *Cap., Lb* — *Fee*<br>1,000 or less — $22 00<br>1,001–2,000 — 30 00<br>2,001–3,000 — 40 00<br>3,001–4,000 — 50 00<br>4,001–5,000 — 60 00<br>5,001–6,000 — 70 00<br>6,001–7,000 — 90 00<br>7,001–8,000 — 110 00<br>8,001–9,000 — 130 00<br>9,001–10,000 — 150 00<br>Over 10,000 — 150 00<br>Plus $50 for each add'l ton. | | Per in. width tire:<br>Rubber, 800 lb.<br>Steel, 500 lb. | | *Passenger Cars*<br>City — 15–20<br>Country — 30<br>*Trucks*—Rubber tires:<br>*Cap., Tons* — *City* — *Country*<br>1 — 10–15 — 25<br>1–2½ — 7–14 — 20<br>>2½ — 7–11 — 15<br>Metal tires — 6–8 — 10 |

| | | Automobiles | Motor Trucks | Trailers | Weight Limits | Dimension Limits | Speed Limits |
|---|---|---|---|---|---|---|---|
| KANSAS | | All cars $3 each | All trucks $3 each | | | | |
| LOUISIANA | Passenger cars, 1/1/21<br>Trucks, 1/1/21 | For hire $0 25<br>Other 5 00 | Per truck $7 50 | | | | |
| MAINE | Passenger cars, 1920 | *Hp.* *Fee.*<br>15 or less $5 00<br>16 to 25 10 00<br>26 to 35 15 00 | *Cap., Tons* *Fee.*<br>1 or less $40 00<br>1–2 60 00<br>2–3 90 00<br>3–4 110 00<br>4–5 140 00<br>5–6 175 00<br>Tractors same as similar freight trucks, $10 each | | Per in. width tire, 800 lb<br>Max. gross wt., 9 tons | | *Passenger Cars*<br>City 15<br>Country 25<br>*Trucks*<br>*Gross Wt., Tons* *Speed*<br>2–4 15<br>>6 5* |
| MARYLAND | Passenger cars, 1/1/21<br>Trucks, 1/1/21 | Per hp. (rated) except as noted $0 60<br>Min. fee $10 | *Solid Tires*<br>*Cap., Tons* *Fee*<br>1 or less $20 00<br>2 or less 40 00<br>3 or less 60 00<br>4 or less 100 00<br>5 or less 150 00<br>6 or less 300 00<br>7 or less 500 00<br>Pneum. Tires same as passenger cars<br>For electric, solid tire vehicles one-half of above fees<br>For tractors $25 00 | *Rubber Tires*<br>For first ton of cap. $10<br>For each additional ton, $20<br>*Metal Tires*<br>Double above fees | Per in. width tire, 650 lb<br>Max. gross wt., trucks, 10 tons | Width, 90 in.<br>(Traction engines may be 100 in. wide) | *Solid Tires*<br>*Gross Wt., Tons* *Max. Speed*<br>2 or less 15<br>2–5 10<br>Over 5 5<br>Motor Buses 15<br>*Pneumatic Tires*<br>City 25<br>Country 30<br>Max. speed, 5 tons, single; 8 tons with trailer; 10 tons truck and gross wt. over 5 tons 20 |
| MASSACHUSETTS | Also 1 HP motorcycle 1 Aug. 1920 | *Hp.* *Fee.*<br>Less than 30 $10 00<br>30–39 15 00<br>40–49 20 00<br>50 and over 25 00 | *Cap., Tons* *Fee.*<br>1 or less $10 00<br>1–2 20 00<br>2–3 30 00<br>3–4 40 00<br>4–5 50 00<br>For each ton over 5 tons 10 00<br>Electric trucks pay one-half above rates | Solid rubber tires, same as trucks<br>Metal tires, double truck rates<br>Pneum. tires, one-half truck rates if reshod tires | Per in. width tire, 800 lb<br>Max. gross wt., 28,000 lb | Width, 96 in.<br>Length, 28 ft<br>Length, trailer combination, 65 ft | *Passenger Cars*<br>City 25<br>Country 30<br>*Trucks and Tractors*<br>*Gross Wt.*<br>*Tons* *Tires* *Speed*<br>Over 4 Rubber 15<br>Over 4 Metal 4 |
| MICHIGAN | Trucks, 1921 | *Gasoline and Steam* *Fee*<br>Per hp. $0 25<br>Per 100 lb. unladen wt. 35<br>*Electric*<br>Per hp. $1 00<br>Per 100 lb. wt. 35 | Same as passenger cars | Per 100 lb. of its wt. $0 50 | *Trucks and Trailers*<br>*Size of Tire, In.* * *Max. Wheel Load, Lb*<br>2 700<br>2½ 900<br>3 1,200<br>3½ 1,600<br>4 1,900<br>5 2,200<br>6 2,700<br>7 3,200<br>* Above scale for 32 in. diam. wheel<br>Add 4/10 for each 2 in. increase in wheel diam.<br>Max. gross wt., 15 tons | Width, 96 in.<br>Height, 12 ft., 6 in.<br>Trailer combin., 60 ft. | *Passenger Cars*<br>City 15<br>Country 35<br>*Trucks*<br>*Single Tire* *Double Tires*<br>*Wheel Load, Lb* *Speed* *Wheel Load, Lb* *Speed*<br>700 20 1,400 18<br>900 20 1,800 18<br>1,200 20 2,400 18<br>1,600 20 3,200 16<br>1,900 18 3,800 14<br>2,200 16 4,400 13<br>2,700 14 5,400 12<br>3,200 12 6,400 10 |
| MINNESOTA | Amended 1921 | Each vehicle, 2 per cent of its value<br>Min. fee for less than 2,000 lb. wt., $12<br>Min. fee for more than 2,000 lb. wt., $15 | Each vehicle, 2 per cent of its value<br>Min. fee for less than 2 tons cap., $15<br>Min. fee for 2 to 4 tons, $30<br>Min. fee over 4 tons, $50 | Min. fee $2 per ton of cap. | Per in. width tire, 800 lb<br>Max. gross wt., 28,000 lb<br>Max. wt., 1 axle, 22,400 lb | Width, 96 in.<br>Height, 12 ft., 6 in.<br>Length, 30 ft.<br>Trailer combination, 85 ft. | |
| MISSISSIPPI | Effective April 2 1920 | For hire $0 50<br>Electric 15 00<br>Min. fee $5 | *Cap., Tons* *Fee*<br>Under 1 $10 00<br>1 and 1½ 15 00<br>2 30 00<br>2½ 35 00<br>3 55 00<br>3½ 75 00<br>4 115 00<br>4½ 155 00<br>5 200 00<br>6 250 00<br>>6 300 00 | | | | City 15<br>Country 30 |

| State and Vehicle Authority | Date of Act and Amendments | License Fees: Passenger Cars | License Fees: Motor Trucks | License Fees: Trailers | Weight Limits | Dimension Limits | Speed Limits (Miles per Hour) |
|---|---|---|---|---|---|---|---|
| **MISSOURI** (Sec'y of State) | | *Hp* — *Fee*<br>2 or less — $2 00<br>> 2–11 — 4 00<br>12–23 — 6 00<br>24–35 — 10 00<br>36–47 — 14 00<br>48–59 — 16 00<br>60–71 — 20.00<br>72 and over — 24 00 | Same as passenger cars | | | | Max . . . . . 25 |
| **MONTANA** (Sec'y of State) | Approved Mar 5, 1921 | *Hp* — *Fee*<br>23 or less — $7 50<br>> 23–37 — 15 00<br>> 37 — 22 50<br>Electric — 15 00 | *Cap, tons* — *Fee*<br>1 or less — $10 00<br>> 1-2 — 22.50<br>> 2-3 — 37.50<br>Over 3 — 60.00 | . . . . . | . | . . | City . . . . . 15<br>Country . . . . . 25 |
| **NEBRASKA** (Motor Vehicle Dept.) | Act of April 11, 1919 | Wt., unladen, 1 ton, $10 00<br>For each additional 100 lb wt. of car — 50<br>(Min. fee $10) | Gross wt. 1 ton — $10.00<br>For each additional 100 lb, gross wt — .50 | . | Per in. width tire, 600 lb<br>*On one wheel, 7,000 lb<br>*D. P. W. traffic regul | *Width, 7½ ft<br>*Height, 12 ft<br>*D. P. W. traffic regul | Max . . . . . 35 |
| **NEVADA** | 1921 | Per 100 lb. factory wt. plus wt. of passengers at 125 lb. each, $0 35 | Per 100 lb. gross wt — $0 35 | Same as motor trucks and buses, if operating on established line | | | |
| **NEW HAMPSHIRE** (Commissioner of Motor Vehicles) | Approved April 13, 1921 | Per 100 lb. gross wt — $0 60<br>(Passengers figured at 150 lb. each)<br>(Min. fee, $15) | *Per 100 Lb. Gross Wt* — *Fee*<br>Pneu. tires — $0 60<br>(Min., $20)<br>Solid tires — 85<br>(Min. $30)<br>Iron or steel tires — 1 00 | *Per 100 Lb. Gross Wt* — *Fee*<br>Pneu. tires — $0 50<br>Solid tires — 65<br>Metal tires — 90 | Per in. width tire, 750 lb<br>Max. gross wt., 20,000 lb<br>Max. wt., one axle, 15,000 lb | Width, 96 in.<br>Length, 30 ft<br>Trailer comb., 85 ft | |
| **NEW JERSEY** (Dept. of Motor Vehicles) | Amended 1921 | *Hp* — *Fee per Hp*<br>0–29 — $0 40<br>30 or more — 50 | *Gross Wt., Lb* — *Fee*<br>1,000 or less — $10 00<br>1,001–2,000 — 12 00<br>2,001–3,000 — 15 00<br>3,001–4,000 — 20 00<br>4,001–5,000 — 24 00<br>(The scale from this point increases $3 for each additional 1,000 lb.)<br>29,001–30,000 — 99 00 | Same as trucks | Per in. width tire, 800 lb<br>Max. gross wt., 30,000 lb<br>(Table compiled for wheel loads for various sizes of tire and wheel) | Width, 96 in.<br>Length, 28 ft<br>Height, 12½ ft<br>Trailer comb., 85 ft | *Passenger Cars*<br>City — 12<br>Country — 30<br>*Trucks*<br>*Gr. Wt., Tons* — *Speed*<br>>4–6 — 16<br>>6–8 — 14<br>>8–15 — 10 |
| **NEW MEXICO** | | Per hp. . . $0 40 | Per hp. . . $0.50 | | | | |
| **NEW YORK** (State Tax Commission) | Amended 1921 | Per hp. . . $0 25<br>*Additional Fee*<br>Years after Date of Mfg. — Per $100 of List Price<br>3 — $0 40<br>4–5 — 20<br>Over 5 — 10<br>Min. fee (4-cyl.) — 5 00<br>Min. fee (6-cyl. or more) — 10 00 | *Gross Wt., Tons* — *Fee*<br>2 or less — $10 00<br>> 2– 3 — 15 00<br>> 3– 4 — 20 00<br>> 4– 5 — 25 00<br>> 5– 6 — 30 00<br>> 6– 7 — 35 00<br>> 7– 8 — 40 00<br>> 8– 9 — 45 00<br>> 9–10 — 50 00<br>> 10–11 — 55 00<br>> 11–12 — 60 00<br>> 12–13 — 65 00<br>> 13–14 — 70 00<br>Over 14 — $70 plus $10 for each ton over 14 | *Gross Wt., Tons* — *Fee*<br>2 or less — $5 00<br>> 2–5 — 10 00<br>> 5–7 — 15 00<br>> 7–10 — 20 00<br>>10–14 — 30 00<br>Over 14 — 30 00<br>Plus $5 for each ton over 14 | Per in. width tire, 800 lb<br>Max. gross wt., 25,000 lb | Width, 8 ft<br>Height, 12 ft., 6 in. | Max . . . . 30 |
| **NORTH CAROLINA** (Sec'y of State) | 1921 (Effective July 1, 1921) | *Hp* — *Fee*<br>24 or less — $12 50<br>25–30 — 20 00<br>31–34 — 30 00<br>35 or more — 40 00 | *Cap., Tons* — *Fee*<br>Under 1 — $12 50<br>1-less than 2 — 15 00<br>2-less than 3 — 25 00<br>3-less than 4 — 75 00<br>4-less than 5 — 200 00 | $15 per ton carrying cap. | | | |

| State and Highway Department | Period Covered and Year Reported | License Fees: Passenger Cars | License Fees: Motor Trucks | License Fees: Trailers | Weight Limit | Dimension Limit | Gasoline Tax (Also Fuel Tax) |
|---|---|---|---|---|---|---|---|
| **NORTH DAKOTA**<br>Highway Commission | Year ended 1920 | *Basis of fee:*<br>Horsepower<br>Electrical self-starter $0.005<br>Per 100 lb wt 20<br>Per hp 10<br>Electrics pay $2 in lieu of hp fee<br>Dealers' license, 10 per cent reduction from base fee<br>Manufacturers' cars, 25 per cent reduction, and thereafter 40 per cent reduction<br>Min fee, ($5) | *Passengers* to passenger car fees<br>Trucks pay following:<br>*Capacity* — *Fee*<br>Per ton (up to 3) $5 00<br>Per ton (3–4) 5 00<br>Per ton (> 4) 10 00 | | | | City 10<br>Country 30 |
| **OHIO**<br>Secretary of State | Year ended 1921 | *hp* — *Fee*<br>24 or less $8 00<br>26–50 12 00<br>Over 50 20 00<br>Trailers 8 00 | *Gasoline*<br>Same as for passenger cars, plus $0 20 per 100 lb gross wt<br>*Fees*<br>A fee of $8, plus 20 cents per 100 lb gross wt | Per 100 lb gross wt $0 20 | Max gross wt, 10 tons for trucks and 12 tons for tractor engines<br>Per in width of tire:<br>Steel (3 in), 500 lb<br>Rubber, 650 lb<br>Per axle, 14,000 lb<br>Load on one wheel not more than 5/8 of total gross wt on one axle, nor more than 9 per cent of gross wt | Width, 96 in<br>Height, 12 ft 6 in<br>Length, 30 ft<br>Trailer combination, 50 ft | *Fees Collected* 15–20<br>City 30<br>Country<br>*Fees* — *Gasoline* — *Kerosene*<br>*Gr Wt, Lb* — *Fees* — *Gasoline* — *Kerosene*<br>*Less than* — 20 — 20<br>4,000 — 20 — 20<br>4,000–8,000 — 15 — 30<br>8,000 and over — 2 — 4 |
| **OKLAHOMA**<br>Dept of Highways | Effective Jan 1 1920 | *Cost Price* — *Fee*<br>$500 or less $10 00<br>Over $500 valuation<br>7% for each $100 additional for price | *Gr Wt, Lb* — *Fee*<br>1,400 or less $15 00<br>1,500–1,999 20 00<br>2,000–2,999 25 00<br>3,000–3,999 40 00<br>4,000–5,999 60 00<br>6,000–7,999 100 00<br>8,000 and over 300 00<br>Reduction of 20 per cent each year for 3 years on vehicles, except of 5 tons or more capacity, which have been licensed for 2 years<br>Min fee, $400 | | | | |
| **OREGON**<br>Dept of State Highway Director | Amended 1921 | *Wt, Lb* — *Fee*<br>1,700 or less $15 00<br>1,701–2,100 21 00<br>2,101–2,500 28 00<br>2,501–2,900 34 00<br>2,901–3,300 40 00<br>3,301–3,700 47 00<br>3,703–4,100 55 00<br>4,101–4,500 62 00<br>4,501–4,900 71 00<br>4,901–5,300 79 00<br>5,301–5,700 88 00<br>Over 5,700 97 00<br>Electrics 25 00 | *Solid Tires*<br>*Load Capacity* — *Fee*<br>14 or less $35 00<br>14–17 42 00<br>17–22 55 00<br>22–26 65 00<br>26–30 105 00<br>30–36 126 00<br>36–40 140 00<br>*Pneumatic Tires*<br>*Total Tire Width, In* — *Fee*<br>20 or less $35 00<br>20–24 42 00<br>24–28 49 00<br>28–32 56 00<br>32–40 70 00<br>Electric trucks 35 00 | *Solid Tires*<br>*Total Tire Width, In* — *Fee*<br>14 or less $17 50<br>14–17 21 00<br>17–22 27 50<br>22–26 32 50<br>26–30 52 50<br>30–36 63 00<br>36–40 70 00<br>*Pneumatic Tires*<br>*Total Tire Width, In* — *Fee*<br>20 or less $17 50<br>20–24 21 00<br>24–28 24 50<br>28–32 28 00<br>32–40 35 00 | Max gross wt, 22,000 lb<br>Max gross wt per axle, 17,600 lb<br>*Per Inch Width of Tire*<br>500 lb if total tire width for all wheels is less than 30 in<br>600 lb if total tire width for all wheels is 30 in or more<br>Max for metal tired vehicle (gross wt), 6,500 lb on hard surfaced highway<br>For device not equipped with wheels, max gr wt, 22,000 lb | Width, 8 ft | City 20<br>Country 30<br>*Fees*<br>*Gr Wt, Lb* — *Pneu* — *Solid* — *Metal*<br>6,500 30 25 8<br>9,500 25 20 8<br>12,500 22 18 8<br>16,500 20 15 8<br>22,000 18 12 8 |
| **PENNSYLVANIA**<br>State Highway Dept | Amended 1921 | Per hp $0 40<br>(Min fee, $10) | *Wt of Chassis, Lb* — *Fee*: *Pneu* — *Solid*<br><2,000 — $15 00 — $15 00<br>2,000–2,999 — 24 00 — 30 00<br>3,000–3,999 — 32 00 — 40 00<br>4,000–4,999 — 40 00 — 50 00<br>5,000–5,999 — 56 00 — 70 00<br>6,000–7,499 — 80 00 — 100 00<br>7,500–8,499 — 100 00 — 125 00<br>8,500 and over — 140 00 — 200 00 | | Per in width tire, 800 lb<br>Max gross wt, 26,000 lb<br>Max wt, 1 axle, 19,500 lb | Width, 96 in<br>Length, 28 ft | *Passenger cars, 90 max*<br>*Trucks*<br>*Wt of Chassis, Lb* — *Pneu* — *Solid*<br><2,000 — 24 — 24<br>2,000–2,999 — 24 — 20<br>3,000–3,999 — 24 — 20<br>4,000–4,999 — 22 — 18<br>5,000–5,999 — 19 — 15<br>6,000–7,499 — 19 — 15<br>7,500–8,499 — 16 — 12<br>8,500 and over — 14 — 10 |

| State and Vehicle Authority | Date of Act and Amendments | License Fees — Passenger Cars | License Fees — Motor Trucks | License Fees — Trailers | Weight Limits | Dimension Limits | Speed Limits (Miles per Hour) |
|---|---|---|---|---|---|---|---|
| **RHODE ISLAND**<br>(State Board of Public Roads) | Passed 1921 | *Fee*<br>*Per Hp* / *Per 100 Lb Gross Wt*<br>Pneu $0.25 / $0.25<br>Solid rub 25 / 35<br>Steel 25 / 50 | Same as passenger cars | *Fee, per 100 Lb. Gross Wt*<br>Pneu . . . $0.15<br>Solid 25<br>Metal 35 | | | |
| **SOUTH CAROLINA** | Effective Jan. 1, 1921 | *Wt of Vehicle, Lb* — *Fee*<br>2,000 or less — $6.00<br>Each additional 500 lb — 2.00 | *Cap., Tons* — *Fee*<br>1 or less — $15.00<br>>1-2 — 30.00<br>>2-3 — 60.00<br>>3-4 — 100.00<br>>4-5 — 200.00<br>>5-6 — 250.00<br>>6-7(+) — 350.00<br>Reduction of 25 per cent for pneu tires | Per trailer, $5<br>Plus $2 per 1,000 lb of capacity | 4-ton truck the limit, except in case of special permit | Width, 7 ft | |
| **SOUTH DAKOTA**<br>(Secretary of State) | Effective Jan. 1, 1920 | All cars, $6 each | *Cap., Tons* — *Fee*<br>2 or less — $6.00<br>>2-3½ — 10.00<br>3½ or more — 15.00 | | | | |
| **TENNESSEE**<br>(State Highway Dept.) | Effective April 21, 1919 | Per hp — $0.50<br>Electric, each — 25.00 | Per hp — $0.50<br>Plus $5 per ton of carrying capacity<br>Electric $25 plus $5 per ton of carrying capacity | | | | |
| **TEXAS**<br>(State Highway Dept.) | Effective Jan. 1, 1922 | Per hp — $0.35<br>(Min. fee $7.50) | *Cap., Lb* — *Fee*<br>2,001-4,000 — $30.00<br>4,001-6,000 — 50.00<br>6,001-8,000 — 80.00<br>8,001-10,000 — 120.00<br>*Tractors*<br>*Tires* — *Per 100 Lb Weight*<br>Pneu — $0.25<br>Solid rub — 35<br>Metal — 50<br>*Mileage Tax (Optional)*<br>*Cap., Lb* — *License Fee, Per Mile*<br>2,001-3,999 — 1c<br>4,000-5,999 — 2c<br>6,000-7,999 — 3c<br>8,000-9,999 — 5c<br>10,000-11,999 — 8c | *Per 100 Lb*<br>*Tires* — *Gross Wt*<br>Pneu — $0.15<br>Solid — 25<br>Metal — 35 | Per in. width tire, 500 lb<br>Per wheel, 5,000 lb | Width, 7 ft | *Gross Wt., Lb* — *Tires* — *Wt. per Hp*<br>4,000 — Pneu — 15<br>4,000 — Solid — 14<br>6,000 — Pneu — 12<br>6,000 — Solid — 10<br>8,000-20,000 — Pneu — 10<br>8,000-20,000 — Solid — 9 |
| **UTAH**<br>(Secy. of State) | Amended 1921 | *Hp* — *Fee*<br>25 or less — $10.00<br>26-40 — 15.00<br>41-50 — 20.00<br>Over 50 — 25.00<br>Electrics — 15.00<br>Steam vehicles of 15 hp or less — 10.00<br>Over 15-25 hp — 15.00 | *Cap., Tons* — *Pneu* — *Solid*<br>1 or less — $20.00 — $27.50<br>1½ — 25.00 — 35.00<br>2 — 30.00 — 45.00<br>2½ — 35.00 — 55.00<br>3 — 45.00 — 65.00<br>3½ — 55.00 — 80.00<br>4 — 65.00 — 100.00<br>4½ — 75.00 — 120.00<br>5 — 90.00 — 140.00<br>Over 5 — $50 per ton additional<br>For metal-tired motor trucks:<br>Cap. 1 ton — $40.00<br>Cap. 1½ ton — 60.00<br>Cap. 2 tons — 80.00 | *Pneumatic Tires*<br>*Cap., Tons* — *Fee*<br>1 or less — $10.00<br>2 or less — 15.00<br>3 or less — 25.00<br>4 or less — 40.00<br>5 or less — 50.00<br>*Solid Tires*<br>*Cap., Tons* — *Fee*<br>1 or less — $15.00<br>2 or less — 25.00<br>3 or less — 40.00<br>4 or less — 60.00<br>5 or less — 75.00<br>*Metal Tires*<br>*Cap., Tons* — *Fee*<br>½ — $15.00<br>1 — 25.00<br>2 — 50.00 | Max. load, one wheel, 3½ tons<br>Max. gross wt., 11 tons<br>*Per in. width tire*<br>Hard surf. pav'ts, 600 lb<br>Earth and gravel, 400 lb | Width, 8 ft | *Gross Wt., Tons* — *Tires* — *Wt. per Hp*<br>Under 3 — Pneu — 30<br>Under 3 — Solid — 20<br>3-4 — Pneu — 25<br>3-4 — Solid — 15<br>Over 4 — Pneu — 16<br>Over 4 — Solid — 8<br>For metal-tired vehicles, max. speed 5 mi. per hr. |
| **VIRGINIA**<br>(Secy. of Commonwealth) | Code of 1919 | Per hp — $0.60<br>(Min. fee $10) | Cap. 1 ton . . . — $15.00<br>Each add'l 1,000 lb cap. . — 5.00 | Cap., 1 ton . . . — $10.00<br>Each add'l 1,000 lb — 3.00 | Max. gross wt., 24,000 lb<br>Per in. width tire, 700 lb | | City — 10<br>Country — 20 |

| State or Authority Governing | Date of Act and Amendments | Passenger Cars | Motor Trucks | Trailers | Weight Limits | Dimensions | Speed Limits (Miles per Hour) |
|---|---|---|---|---|---|---|---|
| **VERMONT** (Secy of State) | Amended 1921 | *Fees for Hp*<br>First year $1 00<br>Second year .75<br>Third year .50<br>Each succeeding year .50 | *Cap., Tons — Fees*<br>? 1 — $20 00<br>1–1½ — 30 00<br>1½–2 — 40 00<br>2–2½ — 50 00<br>2½–3 — 75 00<br>3–4 — 100 00<br>For each additional ton or fraction over 4 — 25 00 | ..... | Per in. width tire, 600 lb<br>Max gross wt., 6½ tons<br>(Except where written permit is granted) | Width, 8 ft<br>Height, 12 ft., 2 in | On bridges — 10<br>Gross Wt — Speed<br>4 tons — 15<br>>6 tons — 12 |
| **WASHINGTON** (Secy of State) | Amended 1921 | *Passenger Cars (Trucks)*<br>Weight — Fee<br>1,500 lb. or less — $10 00<br>Over 1,500 lb. — 10 00<br>Plus 60 cents per 100 lb. over 1,500<br>*Passenger Cars Hired*<br>Wt. — Fee<br>1,500 lb. or less — $20 00<br>Plus $3 per person carrying capacity<br>Over 1,500 lb. — $20 00<br>Plus 60 cents per 100 lb. over 1,500, plus $3 per person carrying capacity | Weight — Fee<br>1,500 lb. or less — $10 00<br>1,500–6,500 — 10 00<br>Plus 40 cents per 100 lb. over 1,500 lb., plus 40 cents per 100 lb. of rated carrying capacity<br>over 6,500 lb. — $10 00<br>Plus 50 cents per 100 lb. over 1,500, plus 50 cents per 100 lb. rated carrying capacity | *Auto Stage Trailers*<br>Wt. 1,500 lb. or less $10 00<br>Plus $3 per person carrying capacity<br>Wt. over 1,500 lb. — $10 00<br>Plus 60 cents per 100 lb. over 1,500 lb., plus $3 per person carrying capacity<br>*Truck Trailers*<br>Same as motor trucks | Per in. width tire, 800 lb<br>Max gross wt 24,000 lb<br>Max wt one axle, 22,400 lb | *Passenger Cars*<br>City — 12 20<br>Country — 30<br>*Motor Trucks (Speed Limit)*<br>Gross Wt., Tons — Speed<br>2 and less — 25<br>2–4 — 20<br>4–6 — 18<br>6–8 — 16<br>8–10 — 14<br>10–12 — 12<br>*Motor Buses (Speed Limit)*<br>25 hp per ton<br>Steel tires (10 Passengers)<br>25 cents per hp |
| **WEST VIRGINIA** (State Road Commissioner) | Enacted 1921 | *Passenger Cars*<br>Per hp — $0 80<br>Per 100 lb. gross wt — 80<br>(Passenger wt. at 125 lb. each) | *Solid Tires*<br>Cap., Tons — Fee<br>1 or less — $25 00<br>1–2 — 50 00<br>2–3 — 75 00<br>3–4 — 100 00<br>4–5 — 150 00<br>Load tires, same as passenger cars<br>*Tractors Drawing Trailers*<br>Gr. Wt. — Fee — Gr. Wt. — Fee<br>Tons — Fee — Tons — Fee<br>2 or less — $20 00 — >6–6½ — $80 00<br>2–2½ — 25 00 — >6½–7 — 90 00<br>2½–3 — 30 00 — >7–7½ — 100 00<br>3–3½ — 35 00 — >7½–8 — 110 00<br>3½–4 — 40 00 — >8–8½ — 120 00<br>4–4½ — 45 00 — >8½–9 — 130 00<br>4½–5 — 50 00 — >9–9½ — 140 00<br>5–5½ — 60 00 — >9½–10 — 160 00<br>>5½–6 — 70 00 — 11 — 180 00 | *Cap., Tons — Fee*<br>1 or less — $10 00<br>Each add ton — 15 00<br>(For pneu tires, fees are one-half above) | Per in. width tire, 600 lb<br>Max gross wt., 22,000 lb<br>Max gross wt., 1 axle, 17,000 lb<br>Max gross wt., 1 wheel, 9,000 lb. | Width, 90 in<br>Height, 12 ft<br>Length, 30 ft<br>Trailer combination, 60 ft | Indoor — Gr. Wt. — (1) (2)<br>7 pers — 6,000 — 5 15<br>Other spaces — — 25 15<br>Solid tires — 4,000 — 20 10<br>Solid tires — >4,000 — 15 10<br>Steel tires — >2,000 — 5 5<br>(1) Country<br>(2) City |
| **WISCONSIN** | | All cars $10 each | *Cap., Lb. — Fee*<br>Under 2,100 — $15 00<br>2,100–5,099 — 20 00<br>5,100 or more — 25 00 | ..... | Per in. width tire, 800 lb<br>Max gross wt., 24,000 lb<br>Max per axle, 18,000 lb | Width, 96 in<br>Length, 30 ft<br>Trailer comb., 100 ft in large cities | |
| **WYOMING** (Secy of State) | Effective Jan. 1, 1921 | Per hp — $0 40 | Per 100 lb. wt. of vehicle, $0 75 | ..... | | | |
| **Proposed Uniform Vehicle Law** (Vehicle Commissioners) | Jan. 20, 1920 | *Motor Vehicles* — *Per 100 Lb. Per Hp* — *Gross Wt.*<br>Pneu. tires — $0 25 — $0 25<br>Solid tires — 25 — 35<br>Metal tires — 25 — 50<br>*Tractors*<br>Pneu. tires — 25 — 25<br>Solid tires — 25 — 35<br>Metal tires — 25 — 50<br>Auto tractor, pas. 1 10 above | Same as for passenger cars | *Per 100 Lb. Gross Wt.*<br>Pneu. tires ..... — $0. 15<br>Solid tires ..... — .25<br>Metal tires ..... — .35 | Per in. width tire, 800 lb.<br>Max. gross wt. (4 wheels), 28,000 lb.<br>Max. wt., 1 axle, 22,400 lb. | Width, 96 in<br>Height, 12 ft., 6 in<br>Length, 30 ft<br>Trailer combination, 85 ft | *Passenger Cars*<br>Under 6,000 lb. gross wt<br>Country — 30<br>City — 15<br>*Trucks*<br>Pneu. tires<br>City — 15<br>Country — 25<br>*Solid tires<br>City — 12–15<br>Country — 15–25<br>*Wts., 4,000 to 28,000 lb. |

developed 23 hp., cost $2,700, and weighed, unloaded, 4,700 lb.; the 3½-ton truck showed a horsepower of 31, cost $4,800, and weighed, unloaded, 8,800 lb.; the 5-ton truck showed 34 hp., cost $5,800, and weighed, unloaded, 10,700 lb. In the case of each truck the weight and cost includes the body.

TABLE IV. COMPARISON OF STATE LICENSE FEES FOR 25-HP PASSENGER CAR AND FOR 1, 1½, 3½ AND 5-TON TRUCKS

| State | 25-Hp Passenger Car | 1-Ton Truck (Pneu. Tires) | 1½-Ton Truck (Solid Tires) | 3½-Ton Truck (Solid Tires) | 5-Ton Truck (Solid Tires) |
|---|---|---|---|---|---|
| Alabama | $18 75 | $22 50 | $22 50 | $56 25 | $75 00 |
| Arizona | 5 00 | 10 00 | 10 00 | 25 00 | 25 00 |
| Arkansas | 14 90 | 15 00 | 20 00 | 97 50 | 187 50 |
| California | 10 00 | 18 80 | 19 20 | 27 40 | 33 60 |
| Colorado | 5 00 | 10 00 | 17 50 | 37 50 | 50 00 |
| Connecticut | 18 00 | 22 50 | 40 00 | 90 00 | 187 50 |
| Delaware | 13 30 | 24 00 | 30 80 | 63 20 | 82 80 |
| Florida | 8 00 | 10 00 | 25 00 | 50 00 | 100 00 |
| Georgia | 15 00 | 15 00 | 22 50 | 52 50 | 150 00 |
| Idaho | 20 00 | 30 00 | 40 00 | 40 00 | 40 00 |
| Illinois | 8 00 | 22 50 | 22 50 | 60 00 | 60 00 |
| Indiana | 8 00 | 15 00 | 15 00 | 50 00 | 75 00 |
| Iowa | 27 60 | 15 00 | 22 50 | 100 00 | 145 00 |
| Kansas | 5 00 | 5 00 | 5 00 | 5 00 | 5 00 |
| Kentucky | 15 00 | 30 00 | 40 00 | 90 00 | 150 00 |
| Louisiana | 6 25 | 7 50 | 7 50 | 7 50 | 7 50 |
| Maine | 10 00 | 10 00 | 20 00 | 40 00 | 50 00 |
| Maryland | 15 00 | 15 00 | 40 00 | 100 00 | 150 00 |
| Massachusetts | 10 00 | 10 00 | 20 00 | 40 00 | 50 00 |
| Michigan | 15 70 | 19 20 | 22 20 | 38 55 | 44 95 |
| Minnesota | 33 60 | 48 00 | 54 00 | 96 00 | 116 00 |
| Mississippi | 12 50 | 15 00 | 15 00 | 75 00 | 200 00 |
| Missouri | 10 00 | 6 00 | 6 00 | 10 00 | 10 00 |
| Montana | 15 00 | 10 00 | 22 50 | 60 00 | 60 00 |
| Nebraska | 13 50 | 30 00 | 38 50 | 79 00 | 103 50 |
| Nevada | 11 65 | 21 00 | 26 95 | 55 30 | 72 45 |
| New Hampshire | 20 70 | 36 00 | 65 45 | 134 30 | 175 95 |
| New Jersey | 10 00 | 27 00 | 33 00 | 57 00 | 72 00 |
| New Mexico | 10 00 | 11 00 | 11 50 | 15 50 | 17 00 |
| New York | 13 00 | 15 00 | 20 00 | 40 00 | 55 00 |
| North Carolina | 20 00 | 25 00 | 25 00 | 200 00 | 200 00 |
| North Dakota | 16 30 | 25 20 | 27 70 | 49 70 | 63 80 |
| Ohio | 8 00 | 20 00 | 23 40 | 43 60 | 53 40 |
| Oklahoma | 18 85 | 25 00 | 40 00 | 100 00 | 300 00 |
| Oregon | 34 00 | 20 00 | 55 00 | 105 00 | 126 00 |
| Pennsylvania | 10 00 | 32 00 | 40 00 | 100 00 | 200 00 |
| Rhode Island | 14 90 | 20 50 | 32 70 | 63 05 | 80 95 |
| South Carolina | 8 80 | 15 00 | 30 00 | 100 00 | 200 00 |
| South Dakota | 6 00 | 6 00 | 6 00 | 15 00 | 15 00 |
| Tennessee | 12 50 | 16 00 | 19 00 | 33 00 | 42 00 |
| Texas | 8 75 | 30 00 | 30 00 | 80 00 | 120 00 |
| Utah | 10 00 | 20 00 | 35 00 | 80 00 | 140 00 |
| Vermont | 25 00 | 20 00 | 30 00 | 100 00 | 125 00 |
| Virginia | 15 00 | 15 00 | 20 00 | 40 00 | 55 00 |
| Washington | 17 20 | 28 00 | 41 00 | 81 50 | 106 00 |
| West Virginia | 17 50 | 24 60 | 50 00 | 100 00 | 150 00 |
| Wisconsin | 10 00 | 15 00 | 20 00 | 25 00 | 25 00 |
| Wyoming | 10 00 | 30 00 | 35 25 | 66 00 | 80 25 |
| Uniform Vehicle Law | 14 90 | 20 50 | 32 70 | 63 05 | 80 95 |

A graphic comparison of the fees for motor vehicles of the several types covered in Table IV, is given in the accompanying diagrams, Figs. 1 to 5. Each dot represents a state in which the license fee for the particular vehicle in question is between the limits shown on the scale at the left of each diagram. There is also plotted on each diagram for purposes of comparison, the fee recommended in the proposed uniform vehicle law. In the case of a 25-hp. 5-passenger automobile it will be observed that the prevailing fee is between $10 and $15. In the case of motor trucks the prevailing fee for the 1-ton unit, equipped with pneumatic tires, is from $15 to $20; for the 1½-ton truck, from $20 to $25; for the 3½-ton truck, from $100 to $110; and for the 5-ton truck, from $50 to $60. The diagrams show convincingly how the range of license fees increases for the heavier capacity trucks.

### Road Maintenance Funds Lost

Another point brought out, inferentially, by these diagrams is the large sum of money that is being lost for highway maintenance by reason of the fact that the scale of fees is frequently much less than that specified in the uniform vehicle law, in the preparation of which the representatives of the motor-vehicle manufacturers and users took a very considerable part. In the case of the 1-ton truck, for example, it will be seen that 24 states have license fees *lower* than those of the uniform vehicle law. For the 1½-ton truck a still greater number of states, 28, are below the uniform vehicle law mark. In the case of both 3½- and 5-ton trucks 24 states are failing to receive as high a fee as the motor vehicle interests themselves concede to be equitable in the uniform law. On the other hand, the fees in other states are considerably higher than the uniform law recommends. In some cases the fees for the heavier trucks, when one takes into consideration the destructive influence of these vehicles on the highway, are ridiculously low.

With $102,546,000 received from motor-vehicle registration and license fees, including those for chauffeurs, operators and dealers, in 1920, the state motor-vehicle fund, as revenue for highway maintenance, has reached considerable proportions. Of this amount, collected last year, according to the U. S. Bureau of Public Roads, $77,527,000 was used by or under the state highway departments and $20,144,000 under the direction of local authorities. Inasmuch as practically all of these funds, except a small percentage required for the administration of the motor-vehicle departments, go into highway work, it behooves the highway engineer to see that a fair scale of registration fees for both passenger automobiles and motor trucks is established. The increase in vehicular traffic has been so enormous during recent years that adequate funds for road maintenance must be supplied and used to best advantage if the staggering investment in the first cost of our highway systems is to be preserved. Motor vehicles are today the chief benefactors of good highways and should pay their just amount in order that the roads may be properly maintained. Motor-vehicle legislation and highway maintenance, therefore, are linked very closely.

### Gross Weight Limitations

On the subject of the maximum gross weight (vehicle and load combined) which should be permitted on highways, state highway officials, motor truck manufacturers and users are far from agreement. The controversy is one of long standing and was one of the two main issues (the other being the measurement of tire width) on which the members of the joint committee on uniform vehicle laws failed to concur. As printed, the uniform law prescribes 28,000 lb. as the maximum gross weight, but to this provision the highway members of the committee dissented. The question is an exceedingly complex one. Truck manufacturers maintain, on the one hand, that lower transport costs are secured by the use of large truck units; highway engineers, on the other, contend that the large heavily loaded vehicles are the chief agents of road destruction and that the apparent lower transport costs with the big units are actually nullified by the higher road maintenance and reconstruction charges which their use creates.

At the annual meeting, May 13, of the National Highway Traffic Association at Ann Arbor, Mich., the committee on speeds, weights and dimensions of motor trucks (George H. Pride, president, Heavy Haulage Co., New York, chairman) reported in favor of a 28,000-lb. maximum gross weight and a 22,000-lb. maximum axle loading. The report states, however, that there was diversity of opinion among the members

of the committee as to permissible weight limits, but that the convention, by a large majority, favored the 14-ton figure.

While it is not possible to quote any weight limit officially representing the consensus of opinion of state highway officials, it is believed that, except in those states where the main highways are largely of gravel or earth, the 5-ton truck is regarded as the heaviest unit for which, in the present state of the art, highways can be economically constructed and maintained. In Maryland, one of the states which have been exceedingly active both in the passage and in the enforcement of motor vehicle laws, a gross-weight limit of 10 tons—measures in Maryland, where loads in excess of the larger limit must be deposited at the road side and collected on a second trip by the truck were described at length in *Engineering News-Record* of April 21, p. 666.

Trucks loaded beyond their rated capacities are recognized by both highway engineers and motor-vehicle manufacturers as a menace to highway transport development. Some of the state laws strike at this objectionable practice. Referring again to the proceedings of the recent annual meeting of the National Highway Traffic Association, D. C. Fenner (of the International Motor Co., and chairman of the committee on truck regulation), condemns the overloaded truck

TABLE V. GROSS WEIGHT LIMITS

| Max. Gross Wt., Tons | States |
|---|---|
| 6½ | Vt. |
| 8 | Colo. |
| 9 | Me. |
| 10 | Ala., Md., N. H., Ohio |
| 11 | Ore., Utah, W. Va. |
| 12 | Va., Wash., Wis. |
| 12½ | N. Y. |
| 13 | Del., Pa. |
| 14 | Ia., Mass., Minn. |
| 15 | Cal., Mich., N. J. |

TABLE VI. AXLE LOAD LIMITS

| Max. Wt., Lb. | States |
|---|---|
| 14,000 | Ohio |
| 15,000 | N. H. |
| 16,000 | Ill. |
| 17,000 | W. Va. |
| 17,600 | Ore. |
| 18,000 | Wis. |
| 19,500 | Pa. |
| 22,400 | Minn., Wash. |

TABLE VII. WEIGHT LIMITS PER INCH WIDTH OF TIRE

| Lb. per In. Width of Tire | States |
|---|---|
| 500 | Idaho, Ore., Tex. |
| 600 | Neb., Utah, Vt., W. Va. |
| 650 | Md., Ohio |
| 700 | Cal., Del., Va. |
| 750 | N. H. |
| 800 | Conn., Ill., Ia., Ky., Me., Mass., Minn., N. J., N. Y., Pa., Wash. Wis. |

TABLE VIII. MAXIMUM WHEEL LOADS

| Wt., Tons | States |
|---|---|
| 2½ | Tex. |
| 3½ | Neb. |
| 4 | Utah |
| 4½ | Ia. |
| 4½ | W. Va. |

TABLE IX. MAXIMUM TRUCK CAPACITIES

| Cap., Tons | States |
|---|---|
| 4 | S. C. |
| 5 | Md. |
| 6 | Ark. |
| 7½ | Ind. |

roughly equivalent to a loaded truck of 5 tons' carrying capacity—is prescribed.

The extreme case of low maximum limit is offered by Vermont, where existing laws limit the gross weight of a vehicle, except when special permits are issued, to 6½ tons. In Colorado the maximum is 8 tons and in Maine, 9 tons. Four states have a 10-ton limit; three states, 11 tons; three states, 12 tons; one state, 12½ tons; two states, 13 tons; three states 14 tons; and three states 15 tons. Fifteen tons is the highest gross weight limit prescribed and is in force in California, Michigan and New Jersey. About twenty states place no restrictions on gross weight.

In addition to, or as a substitute for a maximum gross weight specification, about half the states prescribe a maximum permissible loading per inch width of tire. This loading ranges from a minimum of 500 lb. in Idaho, Oregon, and Texas, up to 800 lb., the value recommended by the joint committee on uniform vehicle laws and adopted in a dozen or so states, including Connecticut, Illinois, Iowa, New Jersey, New York, Pennsylvania, Washington, Wisconsin, Minnesota, Massachusetts, Maine, Kentucky, and Iowa.

Tables V to IX, inclusive, summarize the various weight restrictions in the state laws.

### Overloaded Trucks

The mere specification of a gross weight limit, however, is of little benefit unless some machinery is developed for its enforcement. In this respect many states are deficient. In others, such as Maryland, Connecticut, New Jersey and California, a real effort at enforcement is being made and both stationary roadside scales and traveling crews of inspectors with loadometers are employed to weigh at the roadside trucks suspected of exceeding the legal limit. The enforcement and favors the enactment of laws providing for the weighing of vehicles and penalties for violation, including the removal of the excess load and the registration of the offending vehicle on the basis of the total gross weight of the vehicle at the time it was overloaded.

In some of the states where maximum gross weights are specified the state highway commissioner or other official, as is the case in Ohio, New Hampshire and elsewhere, is given authority to lower the weight limit during certain periods of the year when the frost is leaving the ground and the roads are soft. Without seasonal restrictions of this kind many miles of unsurfaced road would be rendered unfit for use in a comparatively short time if even a few trucks of great weight were allowed to operate over them during the spring thaw.

As a supplement to any discussion of gross-weight truck limits certain statistics are apropos. At the end of the year 1920 the U. S. Bureau of Public Roads reports a registration of 852,362 motor trucks and commercial vehicles. There were produced during 1920, according to the National Automobile Chamber of Commerce, 322,039 motor trucks, as shown in Table X. It is to be noted that the 1-ton truck is the prevalent size, constituting 51 per cent of the 1920 production; that the 5-ton truck constitutes only 2 per cent of the total output; and that trucks exceeding a capacity of 5 tons represent only 1 per cent. While the number of large-capacity trucks is comparatively small, costly damages to road surfaces can be done by only a few of these large units.

Extremely heavy trucks or those loaded beyond their rated capacities have been the main target of legislative revision in the states this year. In Ohio a bitter fight was waged over the Burke bill, limiting gross loads to 10 tons, which was signed by the governor in

TABLE X. PRODUCTION OF MOTOR TRUCKS IN 1920

| Cap., Tons | Number | Per Cent of Total |
|---|---|---|
| ½ | 61,187 | 19 |
| 1 | 164,240 | 51 |
| 1½ | 35,424 | 11 |
| 2 | 25,763 | 8 |
| 2½ | 12,871 | 4 |
| 3½ | 12,893 | 4 |
| 5 | 6,441 | 2 |
| Over 5 | 3,220 | 1 |
| Total | 322,039 | 100 |

spite of objections by the commercial trucking interests. Maryland refuses to register a truck exceeding 10 tons gross weight. In Wisconsin there is now under consideration a bill to designate types of roads which may be used by certain classes of traffic. On class A, or the highest type, the gross load limit would be 12 tons, on class B roads, 7 tons, and on class C roads, 3½ tons. The road classification would be made by the state highway commission, in the case of the state system routes, and by county or other local authorities in other cases. The Utah law specifically limits loadings to 400 lb. per inch width of tire on earth and gravel roads but allows 600 lb. per inch width of tire on hard surface highways.

In a few of the states which have gross-weight limitations for motor trucks, exceptions are made in the case of trucks which operate exclusively within city limits. In such cases the gross-weight limit is raised, on the ground that the comparatively heavy construction of city pavements is adequate to support loads greater than could be safely borne by rural routes. A great many of the laws, however, contain clauses which allow the transportation of a load exceeding the legal limit in certain special cases, where permits are required.

In addition to the license fees, a number of the states place a tax on gasoline. Among them are Colorado, Kentucky, New Mexico, North Carolina, Oregon, Washington, Louisiana and Pennsylvania. In California this year, an attempt to tax gasoline was made, but met with such bitter opposition that it was defeated.

### Form of Law

Irrespective of the subject matter the form in which motor-vehicle regulations are issued to the public leaves much to be desired. A few of the states have prefaced the printed reproduction of the law with a condensed summary, showing at a glance the information the average motor-vehicle user should know about license fees, weight restrictions and speeds. As a general rule, however, the seeker for information must plod through page after page of legal phraseology in small type, unrelieved by subheads indicating the subject under discussion. It is common, too, to find numbers spelled out instead of the much more readable form of figures. Legislators, apparently, have not yet discovered that where a number of figures bear a relationship one to the other, they are much more understandable when presented in the form of a table than as text. In only a few of the laws is matter tabulated. A more general adoption of the tabulation, instead of the text, principle in motor-vehicle laws would simplify them tremendously.

Another serious objection to the booklets which most of the states issue is the lack of an index, although there are notable exceptions. Presumably these laws are issued in printed form in order that the public may become acquainted with them and thus avoid violations of the restrictions imposed. It would seem advisable, therefore, to include an index as part of the booklet. Without it the task of finding what the law prescribes on a given subject, such as weight of vehicle, is discouraging.

Enforcement of motor-vehicle laws has come to be recognized as of equal importance with their passage. This opinion is reflected in the recent legislation of certain states—Virginia, for example—where the powers of sheriff are delegated to the state highway engineer and certain other members of his staff.

### Future Changes Probable

State legislation governing the taxation and licensing of motor vehicles will undoubtedly undergo many further changes during the next few years. A new phase of the situation is looming up in the form of a proposed federal, in addition to state, tax on motor vehicles. Highway engineers, motor-vehicle manufacturers and truck users are, today, in closer agreement on the essentials of motor-vehicle legislation than ever before. Several years ago it was common to hear the motor-truck manufacturer condemn the state highway official because roads were not designed and built to carry any loads that any vehicle operator might see fit to impose upon them. Without, apparently, realizing the inconsistency of his position, the same representative of the motor-truck industry was loud in his abuse of operators who overloaded the trucks supplied to them! Evidences of this narrow attitude on the part of both state highway and motor-vehicle interests are fast disappearing. At meetings of road-building organizations, of state highway officials, of motor-vehicle manufacturers, and at conferences on highway transport there is being shown a conception of the highway transport problem in its broad aspects and not from the point of view of a single selfish interest. It is true, of course, that all the differences between the highway builder and the highway user and vehicle manufacturer have not yet been composed, but progress is being made. The important thing, now, is for highway engineers and motor-vehicle representatives to work together to the end that future changes in state laws may be just and may lead to the best development of highway transport on economic lines.

## Housing Contracts in Britain

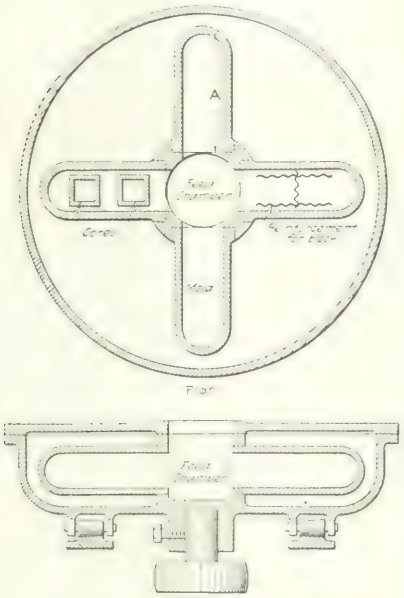
*(London Correspondence)*

The British Ministry of Health had, on May 1, approved tenders for 176,000 houses. Of these contracts had been signed for 150,000 houses and work begun on 102,000 houses. Four hundred and fifty thousand houses have been practically completed, including subsidised houses. In April 6,000 houses were completed, and, at the present rate of building, 7,000 houses will be completed during May. On April 1 130,000 men were employed on contracts with the Ministry. Sixty pounds a year is the estimated loss to the State on each house after allowing for the net rent and the local penny rate. With the number of houses to be erected between 200,000 and 300,000, the burden on the taxpayer will be between £12,000,000 and £18,000,000 while the housing scheme is in operation. The price of building is coming down, for in August, 1920, the average house cost £950 and in March, 1921, this average had been reduced to to £850.

# Centrifugal Machine Casts Solid Concrete Shapes

By Leon Cammen
Cammen Laboratories, New York City

CENTRIFUGAL casting of solid concrete shapes has been successfully accomplished by a machine especially designed for this purpose, the first working model of which was recently sent to England for use on a government contract for houses for workmen in the North. The revolving portion of the machine carries forms or molds, of any shape desired, to which concrete if fed by centrifugal action through a central orifice. It is not considered that an excess of water in the concrete mixture can harm the product since the centrifugal action forcing the concrete into the molds will at the same time force out any excess of water. A sketch indicating the elements of the machine is shown herewith.




CENTRIFUGAL CASTING MACHINE FOR SOLID CONCRETE SHAPES

The sketch indicates the principal features of balanced rotating molds as developed for practical use. The machine has a vertical shaft and concrete is fed into the central chamber from which it is distributed by centrifugal force into the molds. The number of the molds may be determined by the size of the machine and the article cast.

In casting, an excess of water is not only permissible, but desirable, since it tends to make the concrete more plastic in the initial stages of spinning, and is then squeezed out by centrifugal force during the process, the amount of water present in the final product practically being governed by the speed of rotation.

Where the molds are quite large it has been found desirable to provide additional supports in the form of rollers running on tracks to relieve the shoulders of molds from stress. When the molds are small, they may be attached directly to the central structure comprising the feed chamber. With large or heavy molds it has been found advisable to inclose the rotating structure in a casing, as shown in the elevation.

The shape cast may carry reinforcement, as shown in the plan, properly placed in the mold, and about which concrete packs under centrifugal action. Hollow articles also may be cast on the machine by placing cores in the mold, as shown in the left arm in the plan. However, some care is required and if cores are not properly placed, there is a possibility that concrete will not pack solidly about them, and especially between them if there is more than one core.

The time necessary to fill a mold varies from 30 sec. to 90 sec. depending upon the shape and size of the mold, but it is advisable to continue spinning for about 60 sec. more to consolidate the material more closely. The mold is then opened and the cast shape discharged. Several methods of opening may be employed, depending on the shape and size of the article cast, and the presence or absence of cores. The simplest method is to have the mold open its full length from the bottom, permitting the shape to fall onto an endless belt.

When the shape is cast there is usually a finlike part projecting from the mold into the central feed chamber. If desired, a cutter may be provided, sliding up and down along the walls of the feed chamber, and trimming the shape before it is removed from the mold. The handling of the completed shape is very much facilitated by the solidly packed quality of the material which keeps its shape well.

All patent rights on centrifugal casting of solid objects and the machinery for doing it are controlled by the Cammen Laboratories, a research organization of New York City.

## Weekly Map Service for Wisconsin Road Users

A BLUEPRINT map showing routes and road conditions has been published each week this season by the Wisconsin Highway Department. About 16 issues will be furnished for $10 to subscribers which are chambers of commerce, hotels and garages. Each of the nine division officers of the department also receives a copy. At the beginning of July there were 60 subscribers and it was expected that there would be fully 100 before the season for automobile tourists travel was over. Posted by the subscribers where road users can readily consult them, these maps have proved immensely popular.

The blueprint map is made from a tracing of the large Geological Survey map of the state and shows the state trunk highway system, the lakes, streams and places of interest, as well as the larger towns. It also shows the type of road on each part of the system, whether it is plain sand, sand-clay or loam, heavy clay, gravel, concrete or other surfacing. All construction jobs under way are indicated. If the job permits traffic to follow the present road, it is shown on the blueprint map as "Under Construction." If the conditions warrant a detour, it is shown as "Detour." The condition of the road under construction, or the detour, whichever the case may be, is shown as "Good," "Fair," or "Poor."

Division engineers mail to the main office Monday night of each week a statement of the new construction jobs under way and those that have been completed and

opened for traffic. The main office makes the changes on the tracing promptly upon receipt of the information from the division offices and the new blueprint maps, with up to date information are mailed out promptly Wednesday afternoon and get into the hands of the subscribers to the service some time on Thursday. The subscription price just about covers the cost of the blueprints. The information demanded from the division offices is nothing in addition to what they furnish regularly to the home office.

## The Linear City in Theory and Practice

PAPER projects for cities long and narrow in plan, with open country on either side and generally with a central transportation system, have been given publicity at intervals for years past and one such plan has been carried out in considerable part. A similar plan, purporting to be new, is now being circulated by "Walker O. Nettleton, Originator," 1746 Euclid St., Washington, D. C., in the form of a white print showing a "City Layout According to the 'Backbone' Plan." This is further described as "A new and improved method of city building; a city limited in width and unlimited in length, having a business section running throughout its longitudinal center, flanked by residential sections."

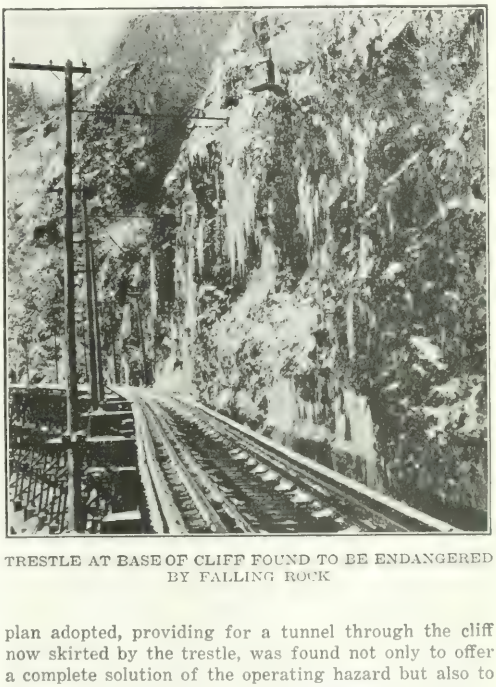
Almost simultaneously with the "Backbone plan" the mail brought the May *Journal* of the American Institute of Architects, containing an article on "The Spanish Linear City," by Edith Elmer Wood. Besides describing this city, which was begun some years ago not far from and concentrically with Madrid, Spain, Mrs. Wood reviews more or less similar plans, outlined from time to time, first in *El Progreso*, by Don Arturo Soria y Mata in 1882-3 and on down to a prize-winning paper by Milo Hastings in the *Journal* of the American Institute of Architects for June, 1919, including "Edgar Chambless' continuous-house idea as set forth in Roadtown (1910)." Similar in principle as regards open country around relatively small urban areas are the garden cities, described by Ebenezer Howard (1898) in "Garden Cities of Tomorrow" and put into practical effect in England by a company incorporated in 1903. The linear city just outside of Madrid, described by Mrs. Wood in the article already named, has been built by the Compañia Madrilena de Urbanizacion, incorporated in 1894, with a capital stock of 2,500,000 pesetas ($500,000 at present exchange), since increased tenfold. Of a projected 50 kilometers in length, about 5.2 km. have been built and 8 km. more started. Besides building streets and houses, the company has provided trolleys, electric light and power, a savings bank, and makes its own brick and tile. The original one-street plan has been modified to give three longitudinal streets, with lot restrictions tending to permit smaller houses on the outer margins and make the lots larger as the central axis is approached.

In 1919, Señor del Castillo, author of a Spanish pamphlet designed to show the superiority of the Spanish linear to the English garden city ("Giudades Jardines y Biudades Lineales") and also of a pamphlet translated by Georges Benoit-Levy as La Cité Linéaire, both published in 1913, prepared for the Brussels Reconstruction Commission, a Project de Cité Linéaire Belge, which shows five longitudinal avenues, use zones, a civic center, and along either side a dairy farm and market garden area.

## Build Long Tunnel to Eliminate Operating Hazard

### Southern Pacific Company's Studies of Various Plans Show Net Annual Profit in That Adopted

CONSTRUCTION of a 1,400-ft. single-track tunnel through solid rock, at a cost of some $230,000, has been undertaken by the Southern Pacific Co. primarily to eliminate the operating hazard from falling rock encountered on the electrified suburban Newburg Branch, at Elk Rock, on the west side of the Willamette River, immediately southward of the city of Portland, Ore., where a trestle over 700 ft. long skirts the base of the cliff. Various plans, including detours, a fill in the river, a three-span bridge, heavy timber sheds, and excavating, wire-netting and guniting the cliff face, were thoroughly analyzed and all showed an increase not only in investment but also in operating cost. The



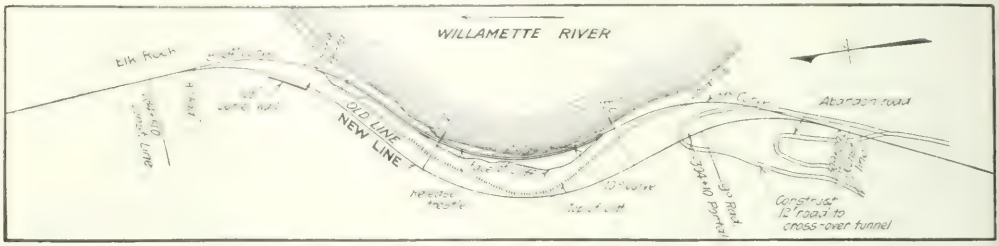
TRESTLE AT BASE OF CLIFF FOUND TO BE ENDANGERED BY FALLING ROCK

plan adopted, providing for a tunnel through the cliff now skirted by the trestle, was found not only to offer a complete solution of the operating hazard but also to represent a decrease in operating cost and an increase in net operating income, while increasing the investment some $175,000. Location of the old and new lines is indicated in the accompanying drawing and a portion of the cliff face adjacent to the trestle is shown in the photograph.

Following the opening of the line it was found that the tendency of the cliff to disintegrate was aggravated by vibration effects of passing trains. Several slides occurred, damaging passenger cars. On one occasion an electric car was badly damaged by a slide carrying a large rock which penetrated the roof, resulting in the injury of six persons. The extent to which the railroad company was prepared to go to eliminate this hazard is

indicated by the radical measures and expense involved in plans which were considered and thoroughly analyzed.

Three of the plans considered involved abandoning the trestle line and rerouting traffic: One, providing for electrification and for operating changes in freight transfer, another for steam operation, and another for diversion of passenger traffic maintaining the trestle for freight service only. These plans were found to involve not only increases in investment from $500,000 to $800,000, but also adverse traffic influences and high maintenance that would be contributing factors towards decreasing net annual operating income in amounts ranging from $90,000 to $200,000.




LINE OVER TRESTLE DIVERTED BY CONSTRUCTING 1400-FT. TUNNEL

Plans were also considered involving replacement of the trestle with a single-track line on embankment, located to provide minimum space of 20 ft. between track center and foot of bluff slope and not less than 50 ft. at points where bluff face is unstable, and replacement of trestle by constructing a bridge between the benches on Elk Rock, for which a structure of three 260-ft. spans would be the most economical. While the hazard from falling rocks would be minimized by the embankment plan, it was considered that it would be necessary to clean the bluff at least yearly but without hazard to traffic and at much less than previous expense. It was also thought probable that excessive maintenance cost would develop from placing the fill in the heavy river eddy. Practically the same advantages would accrue to the bridge plan but it would be directly across navigation downstream and might result in the necessity of providing a channel for navigation on the other side of the small island opposite. The embankment plan was found to involve an increase in investment of some $570,000 and a decrease in annual operating income of about $24,000. The bridge plan showed an increase in investment of about $510,000 and a decrease in net annual operating income of about $27,000.

Plans providing for two types of shed roof protection of heavy timber construction were rejected since only complete relief was considered satisfactory. It was proposed that the trestle might be protected with heavy snowshed type shelter with sloping timber roof anchored to the bluff, 550 ft. of which would be required, or by a modified and cheaper design with a flat roof carried on bents, each design sufficiently strong for protection against rocks of two tons falling 60 ft. The danger of fire hazard under partial steam operation was considered a serious disadvantage, as well as the fact that only partial protection would be afforded.

Plans were also considered involving the following measures: (1) Excavate face of bluff along portion where falling rocks menace the trestle, sloping the bluff to a uniform ¾ to 1 face; (2) cover the face of the bluff where falling rocks may cause damage or accident with wire mesh fastened to vertical cables anchored to the bluff; and (3) cover the face of the bluff with wire mesh (as in 2) and add ⅜-in. coat of cement or gunite. The first plan was rejected on the ground that it would afford complete protection only if the work exposed solid rather than disintegrating rock. It was also thought that too great a hazard would be involved from shooting the rock during construction. Plans 2 and 3 for covering the face of the cliff were rejected on the ground that they would be experimental and would only give relief that might be considered temporary. Both plans were found comparatively inexpensive and it was thought that they should remove the actual hazard, but each showed a net annual decrease in operating income of from $4,000 to $8,000.

The study developed that the plan adopted for constructing the tunnel to replace the trestle, as indicated in the accompanying drawing, would not only remove the operating hazard entirely but would also result in a net increase in operating income of more than $6,000, with an increase in investment of about $175,000, the total investment becoming about $300,000. The annual cost of maintaining the new treated timber bent trestle that would have to be built to replace the old one was estimated at $17,720, including $5,120 for scaling the bluff twice a year as heretofore necessary. The estimated annual maintenance cost for the tunnel line was $2,500, or $15,220 maintenance cost in favor of the tunnel line. With interest on increase of investment figured at 7 per cent the decrease in annual operating cost of the line was estimated at approximately $2,300, since the tunnel plan involved no changes in operation or transportation expense. With traffic influence and future development of territory served, net annual increase in operating income was estimated at upwards of $6,000.

The contract for the construction of the tunnel was recently let to the Hauser Construction Co. of Portland whose bid was $228,000.

### Thirty-Three States Engaged in Forestry

Thirty-three states have provided for some kind of forestry work and 25 of these share in the Federal co-operative fund alloted to the states for fire detection and suppression, according to a circular issued by the United States Department of Agriculture. Pennsylvania, under the direction of Gifford Pinchot, the new commissioner of forestry, leads the states in forest activities, says the circular. Its latest biennial appropriation for forestry work totalled $1,870,000, of which $1,000,000 is for forest fire protection.

# German Sewage Settling Tanks with Separate Sludge Digestion

By M. B. Tark
Engineer, Link-Belt Co., Philadelphia, Pa.

GERMANY built many sewage-works during the war but most of them were for military or semi-military purposes. Some of the plants mentioned in this article were completed or under construction when the war broke out. As usual the principal efforts of the German engineers were directed toward the improvement of the sedimentation tank. This was mainly due to the trouble given by plants in which the sludge digesting chamber is located under the sedimentation chamber and connected to it by a slot, such as the Imhoff, Travis and many other tanks. After the severe criticism of

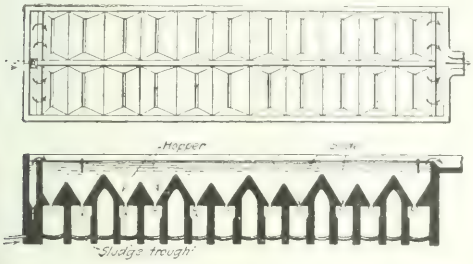



FIG. 1. KOETHEN TANK DESIGNED BY DR. DUNBAR

these tanks Prof. Dr. K. Thumm and Prof. Dr. E. C. Reichle, division superintendents of the National Institute for Water Hygiene, a condensed translation of which appeared in *Engineering News*, Dec. 31, 1914, p. 1306, most designers turned to the sedimentation tank with the separate sludge digesting chamber. Many such plants have been built and some have given splendid results. One of the older and most unique plants is the Koethen tank, Fig. 1, designed by Prof. Dr. Dunbar and described by him in detail in the *Gesundheits Ingenieur*, 1918, No. 30 to 32. His claim—based on the results obtained by the operation of this tank for several years—that a sludge digesting tank is entirely unnecessary, and that the sludge from sedimentation tanks can be dried in from two to four days, if treated according to his directions, has been bitterly attacked by most of the leading engineers in

FIG. 2. NEUSTADT TANK, WITH BEAMS, PISTON AND TROUGHS

Germany. They pointed out that the sewage of Koethen could not be compared with normal city sewage; that 80 per cent of all the sewage has been treated in small domestic plants, before being discharged into the sewers, and that the good results obtained in clarification and drying of the sludge are due to this factor.

The Koethen tank, having a capacity of 0.8 m.g.d., is about 98 ft. long and 26 ft. wide. A partition wall runs the entire length of it and the bottom is divided into 22 hoppers, ending in troughs. Each trough is

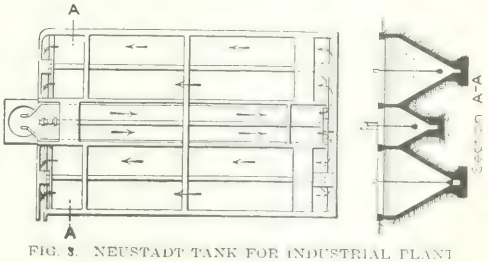



FIG. 3. NEUSTADT TANK FOR INDUSTRIAL PLANT

provided with a slide about 8¾ ft. long, by means of which it can be shut off from the supernatant sewage, and a gate at one end which gives access to the trough. The settled sludge is withdrawn in the following manner: The long slide at the top of the trough is closed and the gate at the end opened. The sludge is removed and the trough washed out. The gate is then closed, the trough filled with sewage and the slide withdrawn. The sludge is left to settle in a common sludge trough for 6 hr. and is then run on the sludge beds, where it becomes spadable in from two to four days. As every one of the 22 troughs has to be emptied once daily and those nearest to the influent end twice daily, the good results obtained by this tank will be more than counterbalanced by the difficulty of operation.

In the Neustadt tank, Fig. 2, the withdrawal of the sludge is a great deal simpler and quicker. This—like the Koethen tank—is a horizontal-flow tank and

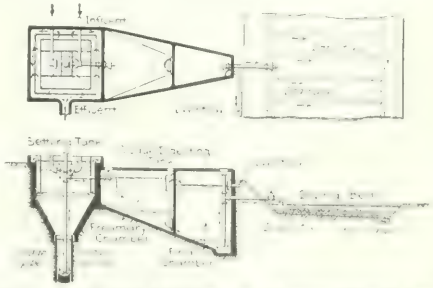


FIG. 4. PLAN AND SECTION OF KREMER-KUSCH TANK

has only one sludge trough, running the entire length of the tank. To withdraw the sludge, one or more beams are lowered onto the top of the trough, the valve at the influent end is opened and the sludge piston moved through the trough, pushing the sludge ahead of it. This sludge piston is operated by the hydraulic head—the sludge discharge pipe is about 3 ft. below the water level in the tank—and returned to its position at the effluent end by a hand winch. The experimental tank at the City of Stuttgart is about 56 ft. long by 6 ft. wide and 7 ft. deep; the detention period 3 hr., the sludge trough 12 in. wide and from 12 to 20 in. deep. This design has been used for several industrial plants (Fig. 3) and apparently has given fair results, although at the experimental plant at Stuttgart the sludge piston has given trouble.

In the Kremer-Kusch tank, Fig. 4, all moving parts have been eliminated. This is the old Kremer tank, always noted for its efficiency, with the addition of the

Kusch sludge cylinder and the Kusch digesting tank. The sedimentation chamber is from 15 to 20 ft. square and has a hopper bottom, terminating in a cylinder about 4½ ft. in diameter and 8 ft. long. The inlet is submerged. It is claimed for this design that through the careful arrangement of the baffles and the long overflow weir every part of the sedimentation chamber is utilized to its fullest extent, and that in several municipal installations 95 to 98 per cent of all settable solids were removed. In the experimental plant at Stuttgart, an Imhoff, a Neustadt and a Kremer tank, each having a 3-hr. detention period, were installed. The test lasted for about a year. The efficiency of the Kremer tank was 12 per cent higher than the Imhoff and 16 per cent higher than the Neustadt tank. As in the Kremer-Kusch tank, the contact area between the sludge in the cylinder and the supernatant sewage is very small. The sludge has to be removed only every third or fourth day. This period of detention at considerable depth reduces the moisture content of the sludge to about 88 per cent and in some places an average as low as 82 per cent has been obtained (Hildesheim). To withdraw the sludge a valve is opened and the hydraulic head forces it up the discharge pipe and into the sludge digesting tank. The present form of the latter has been envolved after years of study and experiment. The digesting tank is usually the same width as the sedimentation tank and up to 55 ft. long. As there are two distinct stages in the process of digestion, the tank is divided into at least two chambers. In the large shallow preliminary digesting chamber the fermenting sludge has ample space to come to the surface, to spread there and get rid of the rapidly developing gases. In the smaller and deeper final digesting chamber the sludge in the quieter stages of digestion retains enough gases to give it the porosity necessary for quick drying.

Such tanks have been installed in a dozen cities and have given uniformly good results, both in the removal of suspended solids and in the thorough digestion of the sludge. The largest of these plants is in the City of Hildesheim and takes care of the sewage of 60,000 inhabitants. After passing through a grit chamber and bar screen the sewage is settled in ten Kremer-Kusch tanks, each 16 ft. square and figured for a 2-hr. detention period. The digesting chambers have a capacity of 23,300 cu.ft. of sludge and of about 2⅔ ft. of supernatant water. The drying beds have an area of 25,800 sq.ft. The sludge is discharged into a common sludge well and pumped to the digesting tanks arranged in a circle. The two sprinkling filters shown in the background treat one-quarter of the flow.

The sedimentation plant for the City of Rottweil was built in 1917. The sewage of a population of 12,000 is treated in two tanks each 18 ft. square. The detention period is 2 hr., the effective capacity of the sludge digesting chambers is 10,594 cu.ft., and the drying beds have an area of 2,700 square feet.

I understand that the installation of a Kremer-Kusch plant near Philadelphia is contemplated in the near future. The results obtained will be looked forward to with the greatest interest. If these digesting tanks should be able to digest activated as well as ordinary tank sludge, they will help to solve the vexed problem of sludge disposal for these plants, especially for the smaller sizes, where the pressing and drying of the sludge is out of the question.

# Felling Two Brick Chimneys by Dynamiting at Base

## Stacks Were Thrown Toward Each Other—Both Broke in Two Places—Top Landed Vertically on Middle Section

By H. B. Hommon
Associate Sanitary Engineer, Public Health Service, Cincinnati

TWO brick chimneys in restricted quarters were recently removed from the site of an abandoned city water-works pumping station in Cincinnati by dynamite. The stacks were 165 ft. high and located about 90 ft. apart on property sold by the water department 13 years ago. They were about 200 ft. from the Ohio River to the south; the east chimney was within 175 ft. of an abandoned brick building. Railroad yards and freight sheds lay 75 ft. to the west and 300 or 350 ft. to the north of one or the other of the two chimneys. About 20 ft. beyond the chimneys and between them and the river was a deep pit of sufficient size to hold all the bricks in the stacks, but as it was desired to recover the whole brick, the chimneys could not be thrown in this direction.

WEST STACK BROKE IN TWO PLACES, FELL DIRECTLY TOWARD EAST STACK

On account of the nearness of the building to the east and the railroad property at the north and west, the only available space on which the stack could be thrown was that lying east and west between the chimneys. There was some leeway to the north but to the south the open pit was within 20 ft. The contractor, J. S. Glassmeyer, of Cincinnati, decided to remove the west stack first and attempted to throw it against the east stack with the hope of knocking the latter down.

At the base of each chimney there was a rectangular section 12 ft. square and 12 ft. high. Four holes were drilled 2 ft. into the 30-in. walls of the base of the first chimney thrown. Two of the holes were 2 ft. from the corners of the wall facing the east chimney, one was placed in the south wall 2 ft. from the southeast corner and one in the north wall 2 ft. back from the northeast corner. Five ½-lb. sticks of 60-per cent dynamite were placed in each hole, packed with moist clay and discharged by a battery removed from the contractors's automobile.

When the dynamite was exploded a large enough section of the base was blown out to cause the chimney to fall in a bee-line with the east chimney. The stack remained intact until it reached an angle of about 45 deg., when it broke in two places. The middle section fell with the lower part while the upper section dropped vertically on top of the middle portion. The section that remained practically intact hit the east chimney near the base but did no more damage than to shake a few

bricks off the top. A circular section 8 ft. high immediately above the rectangular part of the foundation rolled to one side and did not break.

Holes were drilled in the east chimney to throw it directly on top of the one already down. These holes, however, were drilled in the round section in a half circle that cut through the flue opening. Seven of the nine holes were drilled to the south (right) of the flue opening and two to the north. Eight of the nine holes were west of the north and south diameter, the other hole being just east of the south end of the median line. The holes were drilled 2 ft. into the 30-in. shell. Two ½-lb. sticks of 60-per cent dynamite were packed in each hole with moist clay and they were exploded by a battery. This chimney fell just as the first one did. When it reached an angle of 45 deg. the upper quarter section parted from the rest and fell on top of the middle part of the chimney which reached the ground first. The rectangular section below the place where the dynamite was exploded remained intact.

Both chimneys fell almost in the identical space desired, and outside of drilling the holes the entire time in felling them was not over two hours. Moving pictures were taken of both chimneys while they were falling and the films show every detail of what happened. Engineers or societies interested can obtain the use of the films from the contractor at a slight cost.

# Precast Blocks Used Alternately with Concrete in Dam Coping

### Method Less Costly Than Continuous Blocks—Odd Section Gives High Discharge Coefficient—Coping Set Without Dowel Pins

By David C. Finston
Philadelphia, Pennsylvania

In placing the spillway coping for the new concrete dam recently built by the Springfield Water Co. near Media, Pa., a method was devised whereby precast blocks 3 ft. long were set on 6-ft. centers and the intervening spaces filled with concrete. The blocks could then be placed to grade easily. The dam, which was finished in the early part of 1920, is a cyclopean concrete dam with a rough stone masonry face.

The spillway coping which along with the dam was designed by J. W. Ledoux, consulting engineer, Philadelphia, was to be built, quoting from the specifications "of Class A concrete and constructed of precast blocks in lengths of not less than 3 ft. or poured in place in alternate blocks of not less than 5 ft. The exposed surface shall be finished smooth and hard and true to line. Great care shall be taken in placing the blocks that the crest shall be level and exact. If precast

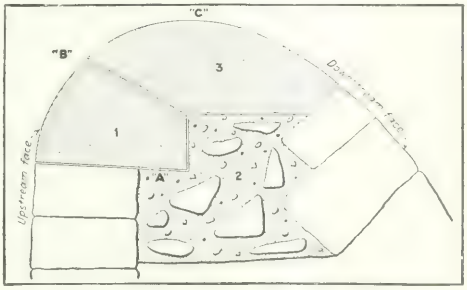



FIG. 1. CROSS-SECTION OF SPILLWAY COPING

blocks are used the mortar bed shall be the same as for the facing stone." From these alternate methods, the contractor chose at first to make precast blocks. However, after about half the blocks were formed he concluded that the cost was prohibitive and therefore he was allowed to place the stone, leaving alternate spaces which were then filled with concrete and which resulted in excellent work.

The dam was built up in 33-ft. lifts as follows: The masonry facing was first built up with large stones handled by derricks and the space between was then filled in with concrete and boulders. When the concrete was set the next 3-ft. lift of masonry facing walls was constructed. When the top course of masonry facing was completed, the back facing of the coping designated 1 (See Fig. 1) was placed in position. This section was all laid up of concrete blocks. A part of each block was allowed to overhang the stone masonry at *A*.

With the first course of coping blocks in place, the concrete forming the core could be poured. This was done and special care was taken to spade the concrete well under the coping block so that there would be no holes. The top of this concrete was leveled off within ½ in. of the top coping blocks to allow for the mortar and the adjustment of the blocks to the proper elevation.

Only the outer edges of the joints were cemented, and after the concrete was placed a cement grout was poured through the opening at *B*. When the grout was poured it not only filled the joints but also any possible space that might have been left beneath the overhang of the first course of the coping blocks.

The next operation—placing the top coping blocks—was done with extreme care. It was in this operation where a great advantage was gained in placing the blocks alternately. One mason on either side could raise or lower the block and move it into place, the proper elevation being secured by taking level readings at either end of the block at the crest.

The final operation was to fill in with concrete the spaces between the blocks. Proper spading and other measures assured a good bond between all coping blocks. It was a simple matter to finish off the poured blocks to the same elevation and line as those previously set

FIG. 2. TOP COURSE OF PRECAST CONCRETE BLOCKS SET ALTERNATELY

and the net result was a uniform coping of pleasing appearance.

In the Crum Creek Dam, where the spillway is 210 ft. long out of a total length of 500 ft., the engineer designed an ogee section of concrete as shown in the accompanying sketch. The unique feature of this coping is its shape, which allows a high coefficient of discharge, and the fact that there are no dowel pins used.

The building of the dam was performed during the war on a strictly contract basis and within the estimated cost. The contractor was Andrew O'Neill of Philadelphia. S. H. Wright, hydraulic engineer with J. W. Ledoux, was directly responsible for the engineering supervision of the construction of the dam.

## Experts Deny Bomb Caused Collapse of Boston Molasses Tank

*Nearly three years have passed since the disastrous bursting of a large molasses-storage tank in Boston on Jan. 15, 1919, but damage suits depending on the cause of the failure are still undecided. Expert testimony in favor of the owners was summarized in* ENGINEERING NEWS-RECORD *of Oct. 7, 1920, p. 691. Now the plaintiffs have presented expert witnesses in rebuttal. These find that the collapse was due to the great overstress of the tank shell; they deny that a bomb explosion was responsible for the failure, as had been claimed by the experts for the defence. Our technical correspondent has prepared a digest of the testimony for the plaintiffs, given below.*—EDITOR.

THE plaintiffs claim that the failure of the tank was due to weakness, and that the head of 48 ft. 9 in. molasses exceeded its capacity. Evidence shows that the tank was 90 ft. in diameter and that the shell was composed of seven rings each approximately 7 ft. high. The nominal thickness of the rings varied from $\frac{1}{2}$ in. at the bottom to $\frac{5}{16}$ in. at the top. The vertical joints in the lowest ring were spliced with double butt-straps, those in the rings above the lowest by lap joints. In the lowest ring there was a manhole 21 in. in diameter, provided with a flanged collar of $\frac{3}{8}$-in. plate and closed with a $\frac{1}{2}$-in. plate attached to the collar by means of an angle ring.

There were two principal fractures through the lowest ring, one being on a vertical line through the manhole and extending up into the second ring, part of the way in a lap joint which was located directly over the manhole. The other was a diagonal break through solid metal, the top of which was near the lap joint in the second ring next to the one over the manhole. The section of the lowest ring between these two principal fractures, together with a portion of the $\frac{3}{8}$-in. plates forming the bottom of the tank, was found at a distance of about 180 ft. from its original position. The plate of the second ring immediately over this fragment was also carried to some distance from the tank in a direction some 45 deg. away from that in which the lowest piece traveled. It was separated from rings 1 and 3 by tearing the single-riveted lap joints which connected them, and at the end farthest from the manhole by a vertical fracture through the outer line of rivets in the lap joint.

It is conceded by both parties that the initial break occurred in the vicinity of these two breaks in the two lowest rings. The defendant claims that an internal explosion must have thrown the fragments out, while the plaintiff claims that the rush of molasses, after the break occurred, was sufficient to have carried the pieces to the point where they were found.

### Secondary Stresses Important

There is no great divergence in the testimony as to the average primary stresses in the ring plates under the static head of molasses, but much divergence as to the secondary stresses caused by the lap joints in the second ring, the effect of the 21-in. hole in ring 1, and the reinforcement that plate received from the collar. The defendant claims that the secondary stresses were "negligible," while the plaintiff claims that they were well above the elastic limit of steel.

It is conceded that the material was open-hearth steel of about 56,000 lb. ultimate strength and in general corresponding (though not uniform) yield point, elongation, and reduction of area. Much stress has been laid by the defendant upon the character of fractures found in the wreck, which were generally "short and sharp." The defendant at the outset claimed that such fractures could only be caused by a very suddenly applied force; but the plaintiff has produced samples of the tank plates, broken in a testing machine, showing the same "short, sharp" fractures. The defendant showed that Neumann bands were found near the edges of the fractures in the lower rings, and claimed that these were indicative of an explosion. The plaintiff claims that the violence of the wreck under pressure of the molasses was sufficient to account for the presence of these bands.

E. E. Pettee, consulting engineer, testified as to stresses which he computed as above the elastic limit of the metal in the manhole plate and in the lap joints of the second ring. He described the deformation in the bottom plate at the point where the defendant claimed that the bomb was placed, as a fold which was produced by the tearing away of the adjoining portion of the plate. He testified that all the rivet holes in the tank were punched full size. He believed that, with varying stresses above the elastic limit and with punched rivet-holes, the fracture was caused by the weight of the molasses, and that the dynamic force of the liquid, when released, would account for all effects noted after the accident.

C. G. Lutts, in charge of the metallurgical laboratory at the Charlestown Navy Yard, testified that the appearances of the metal after the wreck, including the presence of Neumann bands, were consistent with the theory of a break due to the molasses pressure. He produced tests showing Neumann bands caused by what he considered similar conditions, and also a plate from the tank broken in a testing machine after notching by means of a saw cut, which showed the short, sharp fracture with the so-called "herring-bone lines," or ridges characteristic of the tank breaks. He also introduced tests to show that fractures caused by explosions may show great ductility.

### Tank Was Not Strong Enough

Prof. C. E. Fuller of the Massachusets Institute of Technology gave as his opinion that the tank failed from structural weakness which led to a condition where it was not strong enough to resist the stresses produced by its load of molasses. He was inclined to think the initial break occurred in the line of rivets

in the lap joint of the second ring, where secondary stresses from bending, and the hardening effect of punching, were liable to start incipient cracks. He believed that the Neumann bands did not support the explosion theory. He found stresses well above the elastic limit at the edges of the manhole as well as at the lapped joints, and saw nothing in the effects of the wreck inconsistent with his theory of failure. He attributed the fact that the tank did not fail the first time it was filled to the probability that the hardening of the metal had not developed sufficiently at that time.

### Variations in Stresses Shown

Prof. Fuller introduced the results of numerous experiments which he had performed both with steel from the tank and with other similar metal to substantiate his views, including tensile tests of ordinary samples and of riveted and bolted joints, with extensometer measurements and templets showing deformation. He produced the results of extensometer measurements at different points on plates having holes in them of similar proportions to the manhole plate of the tank, which showed great variations in the stresses on the net section between the edge of the plate and the edge of the hole, and that the variation between these stresses was greater in a wide than in a narrow plate. He also showed, by Brinell tests for hardness, the effects of punching holes for rivets. He presented several sections cut through lines of rivets to prove the condition of rivet holes in the tank. He testified that the so-called "dent" in the bottom of the tank could not have been formed when the plate was in position because it was deeper than the layer of sand and cement which separated the steel from the concrete, and the concrete was not broken or dented.

Prof. R. S. Williams of the Massachusetts Institute of Technology testified, as to Neumann bands, that the violence of the accident was in his opinion sufficient to account for their presence without the assumption of an explosion.

### Lapped Joints Were Weak

H. E. Morton, an expert on steam boilers, attributed the accident to the weakness of the lap joints in the second ring and the incipient cracks caused by punching. He made careful examinations of the surroundings immediately after the accident and remarked upon the absence of broken glass and other effects of an explosion. He introduced a cast of a section of the concrete rim of the supporting slab, taken from the part of the circumference under the fragment which was propelled out 180 ft. from the tank, which indicated by grooves made by the rivet heads that instead of moving out in a radial direction the first motion must have been at an angle of about 45 degrees from the radius.

J. R. Worcester, consulting engineer, testified that in his opinion the pressure in the molasses would have overstrained the lap joints enough to have caused a slight stretch which would have transferred a share of the stress naturally coming upon them to the solid metal of the adjacent rings. The effect of this as he figured it would have been to stress most of the rings above the elastic limit, and to make the extreme-fiber stress at the top of ring 1, under the lap joints, between 45,000 and 50,000 lb. per sq.in. This he believed was enough to account for the failure, when taken in connection with a punchtd hole in 1¼-in. plate. He testified that an explosive, sufficient to cause the accident placed where claimed on the bottom of the tank, would have blown through the bottom.

### Speed of Fracture

He introduced calculations to show that the current of molasses would have easily washed the detached fragments to the distance they reached, and he attempted to compute the speed of fracture of the tank, by the recoil of the elastic stretch of the shell. He estimated the tear to have extended at a rate of over 600 ft. per second. This suddenness, he believed, would have accounted for Neumann bands. He claimed that the so-called "dent" in the bottom plate was caused after the section of the bottom plate had swung out from its original position and was resting partly on the ground and partly on the rim of concrete. By photographs taken immediately after the accident he showed the plate in this position with the molasses flowing over it.

Prof. Charles M. Spofford, of the Massachusetts Institute of Technology and a consulting engineer, testified as to secondary stresses in the tank and expressed the opinion that the tank was stressed above the elastic limit in many places. He confirmed the views of the other experts as to the deficiency of strength, and the consistency of all results with the theory that simple overload caused the failure. He attached no important significance to the presence of Neumann bands. He emphasized the entire absence of any reasonable factor of safety, such as would be required by good engineering and by common standards of practice in the erection of steel structures. He expressed the opinion that at the time of the failure the tank was in such a precarious condition that it was likely to give way at any time with or without some slight additional stress.

## Secondary School of Irrigation Established

A SECONDARY school of irrigation with a two-year course and eighth-grade entrance requirement has been established by the University of Nebraska. The course is designed for men who wish practical and theoretical training in the measurement of water, simple surveying and leveling, minor construction and maintenance of ditches, methods of applying water, grading of land and the study and use of instruments employed in these operations. The course includes something of the administrative and legal principles pertaining to irrigation. The training offered qualifies men for the better performance of irrigation construction work, canal superintendence, operation of systems, ditch riding and similar occupations. It is the purpose of the school to increase the earning power of young men in irrigation work by better fitting them to solve many of the problems of irrigation on their own farms, by qualifying them for positions requiring trained employees, and to familiarize them with the best practices underlying irrigation farming. The instruction and training in the several lines mentioned above are of secondary grade. While the work given at the school has to do with the engineering aspects of irrigation rather than the agricultural, it is not the purpose to offer collegiate courses in irrigation engineering.

## Searles—the Author of the Handbook

SOME months ago there died in Elyria, Ohio, a man whose name has been familiar to successive generations of college students and field engineers for forty years but who, in the person, was known to but few of the profession. William Henry Searles, as the author of the small black book all engineers know, has been a somewhat mythical personage. In fact he was an active railway locating and constructing engineer for many years but had long since retired from the active scene. In 1880 the first edition of his "Field Engineering" appeared and Mr. Searles, then a man of 43, took up his residence in Elyria and devoted himself to his books and to a desultory consulting practice. There he lived for 41 years.

Mr. Searles was born at Cincinnati in June, 1837, and was a student in Wesleyan University in 1856-7. He graduated in civil engineering from Rensselaer Polytechnic Institute in 1860, where he served as professor of geodesy and topography from 1862-64, after two years as assistant engineer on the Marietta and Cincinnati R.R. and engineer upon defenses of Cincinnati on the staff of General Mitchell. From 1864 to 1865 he was engaged in railroad construction and location in Ohio, Michigan, Pennsylvania, Indiana and New York. In 1865 he served as chief engineer of the Mineral Range R.R., Michigan, and subsequently as assistant engineer Allegheny Bridge, Pittsburgh, Fort Wayne & Cincinnati Ry. and as principal assistant engineer, Allegheny Valley R.R. The records show that during 1868 and 1869 he was a "manufacturer of petroleum oils, Cleveland, Ohio." In 1870 he became chief engineer of the Indiana North & South Ry. with headquarters at Indianapolis and in 1872 was appointed chief engineer of the New York, W. S. & C. R.R. Afterward he was engaged in New York State canal work as consulting engineer. After the publication of his book "Field Engineering" in 1880, he devoted himself entirely to private practice, though following his first work he wrote the "Railroad Spiral." "Field Engineering" in later years was revised by Mr. Searles and Howard C. Ives, professor of railroad engineering, Worcester Polytechnic Institute. Prof. Ives writes of Mr. Searles as follows:

WILLIAM HENRY SEARLES

It was not my good fortune to have met Professor Searles personally. All the work on the 1915 and 1919 revisions of "Field Engineering" was done through correspondence. Mr. Searles, although advanced in years, took an active part in both revisions.

Mr. Searles was most accurate and painstaking to the minutest detail. The originality, completeness and accuracy of the work enabled "Field Engineering" to hold its place for 35 years without a revision. Each printing in the olden days was called an edition, but no changes were made through a total issue of 50,000 copies.

A born teacher, every letter to me contained helpful suggestions. He counted on one grasping his points without undue discussion. I keenly feel the loss of his wide experience and realize the obligation in endeavoring to keep up his masterpiece.

The following excerpt from a letter gives some light on the inception of "Field Engineering" and its revision. "When 'Field Engineering' was first written I had informed myself as fully as possible on the theory and practice then prevailing, but I catered to no one and gave only what accorded with my own experience and best judgment. One chief function of the book is to educate the rising generation in the best way, and they will create a demand for the book, not only today, but in years to come."

Mr. Searles held his mental vigor to the end as evidenced by the following: "Perfection is a very coy maiden and it takes much patience and devotion to win her." This was taken from a letter written me six weeks before his death, and followed my report to him stating I had finished proof reading 230 pages of the original tables.

## Water-Supply Cross-Connection Rules of Ontario Board of Health

CROSS-CONNECTIONS between municipal and auxiliary water supplies, with the exceptions noted below, are prohibited by an order in council recently issued by the provincial government of Ontario and published in the *Ontario Gazette* (Ontario, Can.). This order makes effective rules and regulations adopted by the Ontario Board of Health and approved by the Minister of Labor.

The order provides that private pipe systems for domestic and manufacturing service must be entirely independent of private pipe systems for fire protection, but that this shall not prevent service connections between "municipal mains and check valves," as covered in Section 4 of the regulations, as follows:

4. A connection may be maintained between a fire protection system, and a municipal water supply, and every such connection shall be protected with dual check valves of approved type, with the proviso that this section applies only to:

(a) Where overhead tanks are used as an auxiliary source for the supply of water for a sprinkler risk fire protection system.

(b) Where storage tanks are used solely for the supply of water for fire protection purposes, provided that on the discharge side of any pump used in connection with such storage tank, and for fire protection there is placed a gate valve, which shall, except in the case of a fire, be closed and sealed with light wire, and between the said pump and sealed valve a connection with a gate valve arranged to discharge to waste for testing purposes.

Where double check valves are required they must be installed within six months of the date of the publication of the order in council. Such valves must be similar to the Factory Mutual; must be approved by the Ontario Board of Health; must be arranged for testing as to water tightness, and must be subject to inspection and properly maintained.

A connection may be maintained between a private and municipal system, where the Ontario Board of Health "upon examination certifies" that the private "source of supply is of satisfactory quality, or satisfactorily protected for domestic consumption."

The order prohibits the connection of any system which circulates water for cooling or other industrial purposes with any fire protection storage tank. Another prohibition is any connection, except for fire protection, "between any auxiliary railway or factory supply, or any storage tank, and a municipal system; but the supply of water for the private purposes just indicated may be obtained through an open discharge to a tank "located above the highest water level."

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## American and European Bridge Practice

Sir—I have read with great interest P. H. Chen's article on "Railway Bridge Construction and Service by American and European Standards" in your issue of July 14, p. 58.

It cannot be said that bridges are designed for a particular type of locomotive, American or European. It is the load effect that governs. American locomotives have undergone many changes in the various types, Atlantic, Pacific, Mikado, Consolidated, Santa Fe and others, with a constantly growing increase in weight. We have been using a standard loading, the Cooper series, which is not a counterpart of actual locomotives but which has given practically equivalent results. It may be said without fear of contradiction that a railroad bridge designed for Cooper's E50 loading, with impact provisions, unit stresses, details of design, material, workmanship, etc., as called for in the last American Railway Engineering Association specifications, will be safe for any locomotive or train load that can be run over it for many years to come.

Committee XV, Iron and Steel Structures, A. R. E. A., has given much attention to the matter of railroad bridges, and the present issue of the specifications represents the best American practice and is applicable universally to the entire world.

There is very little difference in the quality of open-hearth steel used in America and in foreign countries. In America it is generally made by the basic process, while much of the foreign steel is made by the acid process. They both have an elastic limit of about 33,000 lb., with an ultimate of from 55,000 to 65,000 lb., and will bend flat on a radius equal to the thickness of the piece tested. In America we have attempted to get away from slight variations in specifications and get a standard steel, which has tended to bring about a uniform grade of consistent characteristics.

Mr. Chen is not correct in his statement that pony-truss spans are considered unreliable in American railroad practice. It is true that on nearly all heavy-traffic lines the early pony trusses have been taken out. These old trusses had single-web chords, poor floor-beam connections, and weak top-chord bracing. The modern pony truss, double-webbed, properly braced, is a good structure and is freely used where it will show the proper economy. It has to combat, in shorter lengths, the plate girder with its lesser shop cost, and in the longer lengths the through span with its reduced chord sections. In my own practice I have found several places where the pony truss span was the most practicably economical, and have used it in such cases.

The two examples of 150-ft. through spans given for comparison by Mr. Chen tell their own story. In the European span there is a distance of 21 ft. 4 in. out to out of chords, while the American span has a depth of 31 ft. 5 in. center to center of chords. With a standard clearance diagram of 22 ft. 6 in. vertical height above base of rail, which is followed in America for considerations of safety, the reason of the greater depth of the American span is self-evident.

Mr. Chen further says that the European span seems weak and lacking in rigidity. It certainly does. We cannot tell from a line diagram if the American span is too heavily braced. The matter of bracing needed to resist figured stress, and "adventitious" bracing, is one that calls on all the skill and previous experience of the designer. Sometimes the introduction of proper bracing is all that is necessary to allow increased loading to run over a span at fair speed. I have had several cases where such additional bracing constituted the only reinforcement used, after which the bridges gave good service for many years. Too little bracing may render a span absolutely unsafe. On the other hand, an excess, or bracing improperly applied, will be wasteful extravagance and may introduce some bad secondary stresses. Our ideas on bracing have been developed and modified by the observation of spans under traffic, and I believe that the general practice of American designers is now along proper lines.

Mr. Chen makes the broad general statement that American locomotives cause greater impact and vibration on bridges than European locomotives of the same approximate weight. The American locomotives, No. 411 and 272, shown on Mr. Chen's diagram, have weights which should cause greater effect on the bridges than the German locomotive, No. 153. A computation for static deflections would show higher results. It would also appear that the American locomotive should have greater tractive power. The figures for vertical deflection given in the table appear consistent. The figures given for lateral vibration, as corrected in a later issue, show 1.5 mm. for the German locomotive and 4.8 mm. and 7.0 mm. for the American locomotives. If these figures, admittedly roughly taken, are even approximately correct, it would seem to indicate that the American locomotives had been in much harder service than the German locomotive, and that they were long overdue at the shops for overhauling and tightening.

A severe indictment of the American locomotive is made in the statement that on the Pekin-Hankow line two severe bridge accidents resulted from the use of American locomotives that were actually lighter than the French locomotives in regular service on the line.

I have personally examined bridges for many years, extending over 15,000 mi. of track, to determine the necessity of repairs and renewals, not only with regard to the motive power regularly run over them, but also for the imposition of heavier power. I have many times found weak details in old spans, in hangers, truss details and in floorbeams and stringer connections that showed overstrain for many years and called for close watching and early reinforcement. The security of bridges in the United States is safeguarded by careful and critical periodic inspection. If this is not done, defects may develop and may come to a crisis under the passage of a locomotive, causing an accident. Very often the accident should be charged up to the motive power to which the bridge had been subjected for a considerable period of time previous to the accident. On the other hand, particular locomotives occasionally develop particular defects due to being out of balance, flat wheels or other causes. In one case, a great many broken bridge stringers were reported on a line and were traced back to a particular locomotive. At one time on the Pennsylvania R.R. the breakage of about one hundred rails in the track was traced back to one particular locomotive on one trip. In both of these instances the locomotive that caused the damage was of the same type as had been in regular service on the lines.

Bridges on railroads are designed to carry the traffic safely. There has been a great change in the character and weight of locomotives and cars used. With the greater development of railroad operations in America, greater study has been given to the question of specification and design, and great progress has been made. American practice has changed rapidly due to change in conditions, and the change is as great as any possible difference between European and American practice.

The building of a heavier structure does not in itself demonstrate a waste of money. It may, on the other hand, be economy on account of the many conditions of operation, maintenance, repair and future service and availability to be taken into consideration. It must also be borne in mind that in bridge building, as in other major activities, different ideas develop. Every country, every section, every railroad and every engineer has some special practice due to certain ideas and ideals.

Computations for design cover only one particular phase of the matter of bridge work. Well rounded, long continued previous experience on important work is an absolutely essential prerequisite to accomplish the best result. Every individual problem has something special about it

and demands special treatment. Every great engineer has developed a sixth sense in his branch of the profession, and can diagnose the particular problem presented, and determine on the proper treatment.

China's practice and its problems in bridge engineering can only be settled after an intensive study of all antecedent basic conditions to be satisfied, and the exercise of the mature deliberative judgment and decision of properly trained levelheaded engineers who have had long previous experience on important work. I. F. STERN.

Chicago, Aug. 13.

---

Sir—I have looked over P. H. Chen's article in your issue of July 14, p. 58. The information given is entirely insufficient to serve as basis for any reasonable discussion. There is one feature, however, that stands out even in the skeleton diagram shown by the author. In this country we are obliged to build all of our through bridges with an overhead clearance of at least 22 ft., as our trainmen walk over the tops of the cars. In Europe I believe this is not the case, and if their bridges have 16 to 18 ft. clear headroom that is considered sufficient. A. F. ROBINSON.

Bridge Engineer, A. T. & S. F. Ry. System.

Chicago, Aug. 9.

## Protection of River Banks with Spur Dikes

Sir—I wish to add to the discussion which has gone on in your columns for the past two months in regard to the protection of river banks with spur dikes, by giving my experience in this matter.

After testing various forms of spur dikes and other bank protection on the torrential streams in this state, I finally arrived at the conclusion that the best results were obtained by interposing obstructions which did not stop or divert the flow entirely, but which retarded the velocity sufficiently to overcome the scouring action, or to cause deposits of the suspended material, as the case might be. I produced this result in various ways, according to conditions obtaining on the streams with which I dealt.

I had a condition similar to that mentioned by Wm. G. Atwood in his letter, *Engineering News-Record*, July 14, 1921, p. 78, where the river was continually enroaching by undercutting the left bank, and the sand bar on the right was continually extending farther into the river. By running a wire fence with the wire spaced 6 in. apart across this bend, as shown in Fig. 1, and excavating a narrow channel across the bar, the space between the fence and the bank was filled to the height of the top of the fence during one season's flood, and the new channel widened to carry the total flow. It should be stated that the sand carried was very fine and that the river bed, during low water periods, was composed of quicksand.

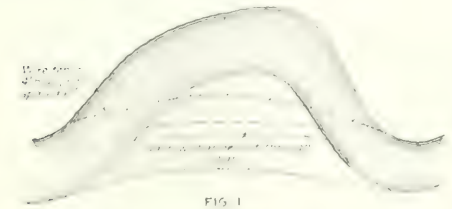


FIG. 1

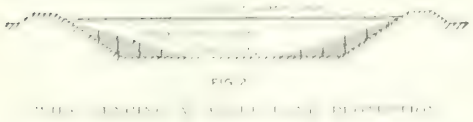


FIG. 2

I have had considerable success in stopping the scouring on the steep banks or levees of flood channels by building spurs at the critical points, consisting either of board fences of one by four rails, nailed to posts at about twelve (12) inch spacing, or by wire mesh, commonly known as hog wire, nailed to the posts. I have caused the slopes of banks to be more gradual, forming good beaches, which are the best bank protection, by means of placing this hog wire in the manner shown in Fig. 2.

I wish to add that on a recent trip over the reclamation works on the Sacramento River, I noted that many banks were efficiently protected by means of mattresses consisting of one by four boards laid as an open grill and weighted with concrete blocks. The proportion of openings was much greater than the area of the lumber, which merely had a retarding effect. This form of bank protection has the advantage of being capable of being launched for emergency protection during the flood.

W. C. HAMMATT,

San Francisco, July 22. Consulting Engineer.

---

## Liberal Studies for the Man from the Ranks

Sir—Professor Burr and his commentators in the pages of the *Engineering News-Record* have, to my mind, touched only upon one phase of the problem.

It is perhaps natural that professional men who are themselves college or engineering school graduates should think of the problem only in terms of the man who has spent from four to six years at college, engineer or otherwise. There is another factor in the problem, the man who has not been able to go to college, but who, through love of engineering work or through other considerations, enters the profession at the foot and works his way up, obtaining such technical education as he may, through the medium of correspondence schools, evening technical schools, or textbooks.

For such men, although a college man myself, I have a very great sympathy, and, in many cases, a hearty admiration.

What may be the proportion of men of this type to the "regular" engineer I do not pretend to know, but I do know that in a local section of one of the national engineering societies, a very large proportion is not college taught. These men, in many cases, call themselves engineers, and, in many cases, Mr. Gustavus to the contrary notwithstanding, have no reason to be ashamed of their work, or their "blunders." It is significant that of the letters printed upon the subject, only Mr. Gustavus mentions the practical man, and he only disparagingly, although the public which come into contact with these men regard them as just as much engineers as their college-taught brethren. Is it not time that something in the way of a broader education, liberal as well as technical, were done for these men?

In every city of any importance there is at least one evening school giving instruction in technical subjects. Most of the courses, however, are arranged so that it is optional with the student to take some of the subjects, and while the faculty advises the student to correlate his studies there is no real compulsion upon him to do so.

There is need for an engineering course to cover four or five years of work of from six to ten hours a week, and comprising every subject that is treated of in the daytime. This may or may not have as prerequisite a high school education, and should not interfere with present courses in elementary subjects or shop work intended for mechanics in various trades.

One could elaborate on this subject indefinitely, but I do not wish to take up more of your space or time.

The editor of *Engineering News-Record* once wrote that "Journeyman engineering is the skeleton of the profession." The men of whom I write are journeymen engineers, they are accepted by the public as engineers, and no project for uplifting the status of the engineer, through education, that does not take these men into consideration, can succeed.

They must be given greater educational facilities, not merely technical, as at present, but with as many of the liberal subjects as may be necessary. JAMES TATE,

Chicago, Ill., Aug. 20, 1921. Mechanical Engineer.

# HINTS FOR THE CONTRACTOR

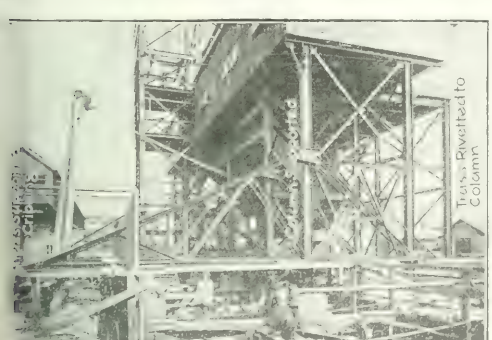
## Temporary Trusses Support Columns

BY EDWARD U. SMITH
Division Engineer, the Austin Co., Philadelphia, Pa.

BY CONSTRUCTING across-pit trusses to support columns over an excavation for a concrete tank, time was saved, which was highly important, and water-tight construction was assured in building a recent sintering plant for the National Analine & Chemical Co., at Marcus Hook, Pa. The alternative method of shoring up the columns and deepening the footings before excavating the tank emplacement would have cost less, but the construction would have taken longer than the permitted 45 working days, and the waterproofing of the pit could not have been guaranteed.

One side and one end of the tank were directly under five steel columns of the sintering plant, as indicated by the view. The original concrete footings were about 4 ft. 6 in. deep. It was therefore necessary to remove the footings from under the columns before any concrete could be poured. Two of the columns, forming a part of the tower, were about 90 ft. high and were designed to support a total load of 200,000 lb. each. The other three columns were a part of the sintering plant proper, were about 50 ft. high and were designed to support a total load of 90,000 lb. each. The sintering plant was not entirely completed. An analysis of the weight of the structure, as it stood, showed that the load on the columns was about 25 per cent of the capacity and the loadings of 200,000 lb. and 90,000 lb. were consequently reduced 75 per cent.

The trusses were designed for a fiber stress of 8,000 lb. per square inch and $l/r$ was taken at 180.




LIGHT STEEL TRUSSES CARRY COLUMNS OVER EXCAVATION

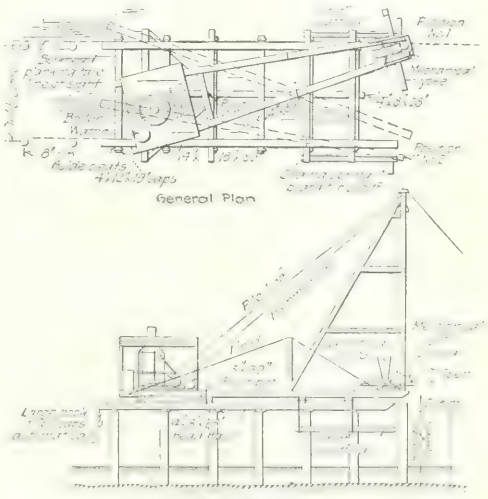
The total length of the bottom chord was 42 ft. 10 in.; one end was connected to one of the sintering building columns 14 ft. away from the column supported, while the other end rested on cribbing placed about 10 ft. away from the side of the caisson. As settlement of the earth was expected under the cribbing, this end was placed 1½ in. above its required elevation. The caisson was 87 ft. long, 24 ft. 6 in. wide and 20 ft. deep. The sheeting was driven by hand. The excavation was handled by a stiff-leg derrick and a one-yard bucket, and the pit was kept dry by a steam pump. The contractors were The Austin Co., Cleveland, Ohio.

## Pivot Piledriver Has Special Features

BY B. E. TORPEN
Aberdeen, Washington

A PIVOT piledriver with a mechanical yoke and several other features was used by the man who devised the equipment, J. S. Creech, in driving bulkhead piling in the development of the port of Grays Harbor, Wash. Included in the devices with which the piledriver are fitted besides the mechanical yoke, are, a special sled on which the driver rests, a device for removing temporary capping as the driver moves forward, and a cut-off scaffold attached to the driver platform.

The mechanical yoke is a simple device adjustable




PLAN AND ELEVATION OF PIVOT PILEDRIVER

under pressure without stopping the hammer. It is operated by levers placed directly behind the leads.

The piledriver is mounted on a special sled to which it is fastened by a 3-in. x 30-in. bolt placed so that the driver can pivot. The sled is the same width as the bent and cleats on caps guide the runners in a true line.

A 6 in. x 8 in. x 28-ft. "ginny stick," on the bottom of which at 8-ft. intervals are cleats and sheet-iron guides, lies on the 4 in. x 12 in. x 18-ft. caps. It is pulled ahead after each move with the haul-back line. The head-haul is attached to this ginny stick, passes back to the spool and pulls the driver ahead on greased caps.

The caps are prevented from pulling off the piling by iron shoes or dogs that sink into the pile heads. As the driver moves ahead a large hook hanging from the rear pulls the cap from the piling behind the runner. The cap is then pulled forward and placed with the pile line. There is a scaffold on each side of the driver platform from which the piles are cut off before capping.

On this job the average day's work has been forty piles of a length of 40 ft., with a penetration of about 30 ft. through tidal flat mud. The best day's run was sixty-five piles. The cost to drive this number was 2 cents per foot, with common labor being paid $6 per day.

# NEWS OF THE WEEK

New York, September 1, 1921

## Senate Resolution Calls for Probe of Federal Road Expenditures

After long delay, Senator King of Utah has introduced his much-heralded resolution providing for an investigation of the expenditure of federal money in connection with highway construction. Senator King takes the position that since Congress has appropriated large sums of money for federal aid and has distributed to the states federal property valued at more than $100,000,000, an official commission should investigate the report that the money and the property "have been used and expended in an extravagant and wasteful manner and that the road construction actually accomplished has not been commensurate with the labor and moneys expended and has otherwise been faulty, insecure, superficial and lacking in permanence."

The commission prescribed in the King resolution is to consist of three specially qualified engineers to be designated by the President. Two of the engineers are to be chosen from the Corps of Engineers, U. S. Army, and one from civilian engineers. The resolution carries an appropriation of $50,000 to be used by the commission in its investigation.

## I. C. C. Approves Idaho Central 90-Mile Cut-Off

A certificate of public convenience authorizing the Idaho Central R.R. to construct a line of railroad 90 miles in length has been issued by the Interstate Commerce Commission. The line will connect Rogerson, Idaho, the southern terminus of a branch of the Oregon Short Line extending from Minidoka, Idaho, and Wells, Nev., the junction point of the Central Pacific line of the Southern Pacific Company and the Western Pacific R.R. The exact location of the proposed line is undetermined and no preliminary survey has been completed. It is stated that the new line will shorten the distance between Twin Falls, Idaho, and San Francisco by 311 miles as in comparison with the present route over the Oregon Short Line and the Southern Pacific.

## Drainage Survey for Indiana

A survey of the streams and drainage districts of Indiana is to be made by the new engineering division of the State Conservation Department, the maps and records being assembled for use in advisory work on future drainage projects. This engineering division was created recently by the legislature, and the drainage survey will be made under the direction of M. J. Stinchfield, Jr., assistant state engineer.

## First Skagit Plant Unit Completed

The initial unit in the Skagit hydroelectric development for the city of Seattle, Wash., the 3,000-hp. plant at Newhalen Creek, on the Skagit River, has been completed and put in operation. This unit is primarily to give power for construction purposes on the rest of the project.

## City Planning Studies to Be Made for Cincinnati

The City Planning Commission of Cincinnati, Ohio, has engaged the Technical Advisory Corporation, consulting engineers, New York City, to make studies preliminary to the carrying out of a proposed unusually complete city plan. A comprehensive outline of the proposed studies has been agreed upon. The main topics are public and private services, circulation, waterways, civic improvements, recreation, municipal control and direction of private property, finance and administration. An "order of urgency" for the various subjects studied is proposed, and it is hoped that something can be worked out for the co-ordination of the Cincinnati city planning work with planning for the entire Cincinnati metropolitan area. W. D. Ennis is vice-president of the Technical Advisory Corporation, and E. P. Goodrich and George B. Ford are included in the staff of city planning experts.

## Fire in Hoboken Shipping Piers

On Aug. 24 a fire practically destroyed two of the piers in the group at Hoboken, N. J., used by the Army since early in the war as an overseas transport base, slightly damaged the steamship "Leviathan" which has been moored at one of the piers for some years and damaged a number of buildings on the marginal street. Early reports much exaggerated the amount of damage done, but the full details must await the report of the army board of review, which is withholding all the evidence in the case.

Piers 5 and 6, which were destroyed, are the most southerly of the group which, before the war, was controlled by the German shipping companies. These two were the property of the Hamburg-American Line and were the only ones of the group not replaced after the fire of 1900 which destroyed all the remaining piers. They were about 40 years old, of timber construction and not well protected against the fire, which originated in one of them and threatened at one time to wipe out the whole reservation as well as a part of the city.

## Federation Makes Plans for Engineering Assembly

### Three-Day Session Probable—Executive Board to Choose Hoover's Successor as President

At the meeting of the executive board of the American Engineering Council, to be held at the Cosmos Club, Washington, D. C., Sept. 30, the most important business will be the election of a president to succeed Herbert Hoover, who resigned after he became Secretary of Commerce. Nominations to fill this vacancy were ordered at the last meeting of the executive board so that they could be reported at the September meeting. Some of the other items which have been before the executive board will come up for further consideration. Special attention will be given the plans for the engineering assembly, extension of employment service, and the licensing and registration of engineers.

The engineering assembly committee has been appointed, with A. P. Davis as chairman; other members are Philip N. Moore, L. P. Alford, John C. Hoyt and F. A. Vaughn. This committee will work out detailed plans for an assembly to be held in conjunction with the annual meeting of the American Engineering Council, the assembly having been authorized by the special vote of the executive board at the Philadelphia meeting. Present plans are to make this assembly a three-day session, starting between the middle and latter part of January. In general, one day will be given to special meetings of the executive boards of member organizations and committees of the council, one day will be given to the sessions of the council, and at least one day will be devoted to the discussion of some special topic such as elimination of waste, licensing or the public works department.

On the question of licensing of engineers it is contemplated that the council's licensing committee will be able to submit a complete report to the board as a result of hearings to be held before the committee on this subject. The executive board instructed its committee to proceed with hearings on this subject as a basis for further reviewing and changing the model licensing law.

It is contemplated that the committee on classification of engineers will report its recommendations to the council at the next meeting.

## New Construction Course

The extension division of the University of Wisconsin has added to its curriculum a course for superintendents of construction, under Professor Hool.

## Minnesota State Registration Board Organizes

The state board for the registration of architects, professional engineers and land surveyors in Minnesota has organized with Paul Doty as chairman and H. T. Downs, Minneapolis, as secretary-treasurer. Applications of those entitled to registration without examination are being received.

## Indiana Board Names Officers

D. V. Moore of Indianapolis, was elected permanent secretary of the Indiana state board for registration of professional engineers and surveyors at the first meeting of the board recently. The secretary is not a member of the board. He will receive a salary of $3,000 a year. R. L. McCornick of Rose Polytechnic, Terre Haute, was elected chairman of the board, and Ray Seely, Lake County surveyor, was named vice-chairman.

## Status of Engineer Registration Board Member in Doubt

Gov. McCray of Indiana has requested an opinion from U. S. Lesh, attorney-general, as to the eligibility of Ray Seely, Lake county surveyor, to serve as a member of the newly-created state board for the registration of professional engineers and surveyors. In an unofficial opinion last March, Mr. Lesh ruled that a county engineer could not serve on the state board because of the provision in the state constitution against the holding by one person of two lucrative public offices at the same time. He said today that in view of the governor's request he was checking up on his former opinion, which he seemed inclined to think was correct.

If the attorney-general decides that appointing Mr. Seely to the board the constitutional provision was violated, the governor will have no other choice than to request Mr. Seely's resignation. It is not expected that the latter will offer any resistance, but that he may even submit his resignation to the governor to end the situation.

## A. N. Johnson Heads Good Roads Essay Board

Three judges will constitute a national committee to award the four years university scholarship offered for the best essay written on the subject "Good Roads and Highway Transport" in a national contest among high school pupils conducted under the auspices of the Highway and Highway Transport Education Committee which has headquarters at Washington, D. C. The judges will be Dean A. N. Johnson, department of engineering, University of Maryland, chairman; Harford Powel, Jr., editor *Collier's Weekly*, and C. H. Huston, assistant secretary, Department of Commerce. The Scholarship, which has a value of about $4,000, is the gift of H. S. Firestone of Akron, Ohio, a member of the committee, offered at the request of his associates.

## Cleveland Mayor Joins Plea for Station Rehearing

Following the action of the New York Central, the Big Four, and the Nickel Plate in filing a plea for a rehearing of the Cleveland Public Square passenger terminal case, recently dismissed by the Interstate Commerce Commission, W. S. Fitzgerald, mayor of Cleveland, has filed a separate plea for a rehearing. Among the reasons which he gives is that Cleveland should not be discriminated against by refusing it adequate freight and passenger facilities.

## U. S. Assistant Engineers' Salaries Now Standardized

Since Nov. 20, 1920, the engineer assistants of the United States Engineer Department have been classified and graded as to salaries. Prior to that time, there were many inequities in the matter of salary. In some cases when additional remuneration would be recommended for an assistant engineer, for instance, the Secretary of War would grant the increase. Perhaps the very next month an increase would be recommended for an equally deserving assistant engineer but would meet with approval.

One of the first things undertaken by Major-General Lansing H. Beach, when he became chief of engineers, was to undertake the classification and standardization of these salaries. His recommendations in this regard were accepted in their entirety by the Secretary of War. In the aggregate, this added nearly half a million dollars to the payroll of the Corps of Engineers.

Under this new scale, six assistant engineers receive a salary of $4,500 a year, twelve receive $4,200, twenty-four $3,900, thirty-six $3,600, forty-eight $3,300, and thirty $3,000.

Superintendents are classified as follows: Two at $3,900, two at $3,600, two at $3,300, two at $3,000, and six at $2,400.

Junior engineers are classified as follows: Three at $3,000, thirty at $2,700, and 100 at $2,400.

Chief clerks, who must be very familiar with engineering matters, are classified as follows: Six at $3,000, twelve at $2,700, and thirty at $2,400.

## Taft Appoints Dean Hayford on Boundary Commission

John F. Hayford, dean, college of engineering, Northwestern University, has been appointed by Chief Justice Taft as a member of the commission to determine the boundary between Costa Rica and Panama which was recently the cause of trouble between the two Central American Republics. The treaty between Costa Rica and Panama provided that each country should name one engineer and the United States two, to determine a boundary which was to be finally adjudged by the Chief Justice of the United States. The other United States appointee is O. M. Leland, dean, college of engineering, University of Minnesota.

## Epes Randolph, Railroad Executive, Dead

### A Pioneer in Development of the West —Averted Colorado River Disaster by Quick Action

Epes Randolph, president of the Arizona Eastern R.R. and the Southern Pacific R.R. of Mexico, died in Tucson, Ariz., Aug. 22, 1921. Although he had been suffering from tuberculosis for years, Mr. Randolph was known as one of the most accomplished engineers and able railroad executives of the time. He was in direct charge of the work successfully carried out by the Southern Pacific Co. in turning back the waters of the Colorado River when the whole of the Imperial Valley was threatened with inundation.

Mr. Randolph had been in the service of the Southern Pacific since 1895, having entered railroad work in 1876. He was assistant, locating, resident, and division engineer of various railways including the Alabama Great Southern, Chesapeake, Ohio & Southwestern, and the Kentucky Central, in location, construction, and maintenance work.

In 1885-1890 he was chief engineer of the Kentucky Central and chief engineer of the Cincinnati Elevated Railway Transfer & Bridge Co., in charge of the construction of the bridge across the Ohio River between Covington and Cincinnati. He then became chief engineer and superintendent of the Newport News & Mississippi Valley Co., Ohio & Big Sandy R.R., and Kentucky & South Atlantic R.R. at Lexington. Afterward he served as chief engineer and superintendent of the Chesapeake, Ohio & Southwestern, and Ohio Valley railroads at Louisville.

#### Served Harriman Interests

In 1894 Mr. Randolph was forced to retire from railroad service on account of ill health and went to California. Soon afterward he became superintendent of Southern Pacific Co. lines in Arizona and New Mexico, with headquarters at Tucson, Ariz., and in 1901 he was appointed vice-president and general manager of the Los Angeles Ry. and the Pacific Electric Ry. in charge of locating, building, and operating some 700 miles of electric railroad. Following the building of the Pacific Electric he acted as the chief executive of the Huntington and Harriman interests in acquiring and consolidating the lines that now comprise the Southern Pacific properties in Arizona. In 1911 he became president of the Southern Pacific Railroad Co. of Mexico and the Arizona Eastern R.R.

In 1905 he was appointed president of the California Development Co. and was in direct charge of the work of turning back the Colorado River into its original channel after it had flowed into the Salton Sink for two years, creating a lake fifty miles long and fifteen miles wide, which threatened to inundate the whole of the Imperial Valley.

An old officer of the Southern Pacific says of Mr. Randolph:

"A born leader of men, Mr. Randolph will always be remembered for his courage, ability, and determination as an engineer and railroad officer. Gripped by tuberculosis in the prime of life, his work and his career were hampered but not checked. In spite of his failing health he was one of the great engineers of the generation, and only his affliction prevented his being one of the greatest railroad operators ever known.

"Remarkable as it may seem, most of his important work was carried out after his health had failed. He was a pioneer in the development of the West and it was he who ran the location line and then the construction of the Southern Pacific westward to meet the line being built by William Hood. Through his foresight and ability the Southern Pacific of Mexico was built and control of the present Southern Pacific lines in Arizona acquired.

"Although suffering severely and believed by his subordinates at the point of death, he remained in active charge at the site of the closure of the new Colorado River channel and turned back the waters when 48 hours more would have meant disaster for the whole of the Imperial Valley.

"Regardless of titles, Mr. Randolph was chief wherever he was. Born a master of men, he was known by everyone for his consideration and courtesy."

## Missouri's $60,000,000 Highway Bill Becomes Law

The bill providing for a state highway system for Missouri to be constructed from the proceeds of the $60,000,000 bond issue, approved at the last general election, became a law late last month. The new act provides for the expenditure of $31,000,000 on 7,300 miles of gravel roads and of $29,000,000 for 1,500 miles of hard-surfaced highways of a more durable type. There is a restriction in the measure which prevents the issuance of any bonds until March 1, 1923, when a total of $10,000,000 is provided for. After that date bonds will be issued in sums of $5,000,000 annually. A state highway commission of four members is to be appointed.

## Am. Soc. C. E. Resumes Publication of Papers and Discussions

In the August issue of its *Proceedings*, just issued, the American Society of Civil Engineers announces a reversion to its practice of publishing papers and all discussions in its monthly journal instead of in pamphlet form. As a measure of economy, during the war period, the publication in the *Proceedings* of the material above mentioned was discontinued and members were supplied with papers and discussions in pamphlet form on request. The change met with widespread objection. The procedure now in force is exactly the same as that followed before the move to cut down on the cost of publication was made.

## No Agreement on Road Bill

After the passage of the highway bill by the Senate, it became evident that the differences between it and the bill passed by the House could not be reconciled without extended conferences. The result was that no effort was made to conduct a conference on the bill prior to the congressional recess. An additional reason is that there is opposition among House leaders to any appropriation at this time for highway construction.

## New Form of Meetings Are Announced for Am. Soc. C. E.

Departing from its former practice of devoting its regular meetings to a single technical paper and discussion thereof, the American Society of Civil Engineers has made an innovation in its program for this fall by announcing five meetings at which important national subjects will be discussed by several speakers at a number of sessions.

The first meeting, according to the announcement of Elbert M. Chandler, acting secretary, will be held in the Engineering Societies Building, New York City, Sept. 7, and will continue during two sessions, afternoon and evening the following day. The subject is "National Port Problems." A list of the speakers and their subjects for the Sept. 7-8 sessions follows:

*Sept. 7, 7:45 p.m.*—Frederic W. Cowie, chief engineer, Harbor Commissioners of Montreal, "National Phases of Port Problems"; Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army, "Terminals"; Frederic H. Fay, of Fay, Spofford & Thorndike, consulting engineers, Boston, "Development of the Smaller Ports"; M. A. Long, of the M. A. Long Co., engineers and constructors, Baltimore, "Relation of Warehouses to Port Development."

*Sept. 8, 2 p.m.*—John Meigs, consulting engineer, Philadelphia, "Unco-ordinated Design in American Ports"; W. Watters Pagon, consulting engineer, Baltimore, "Brief Comparison of American and Foreign Sea Ports"; Edwin J. Clapp, New York City, "Some Observations on Port Finances"; Carrol R. Thompson, assistant director Department of Wharves, Docks and Ferries, Philadelphia, "Improvement and Development of Ports."

*Sept. 8, 7:45 p.m.*—J. A. Bensel, consulting engineer, New York City, "Port Problems in New York"; Colonel W. J. Wilgus, consulting engineer, New York City, "Relationship of Rail and Water Carriers"; B. F. Cresson, Jr., chief engineer, the Port of New York Authority, N. Y., "Port Administration"; H. McL. Harding, designing terminal engineer, New York City, "Pier Designs as Developed from Quay Designs."

The meeting to be held Oct. 5 will deal with the flood problem, water power development and stream control. On Nov. 16 there will be a general conference on the problems of sanitation and the following month the regular meeting of the society, to be held Dec. 7, will be given over to a discussion of the progress report of the joint committee on standard specifications for concrete and reinforced concrete. "The National Housing Problem" will be the subject at the meeting of Jan. 4.

# Engineering Societies

## Calendar

### Annual Meetings

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, New York, N. Y.; Semi-Centennial Anniversary, Wilkes-Barre, Pa., Sept. 12-15.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Bridgeport, Conn., Sept. 13-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

**The New England Water Works Association** announces as a feature of its annual convention, to be held in Bridgeport, Conn., Sept. 13-16, a golf tournament at the Brooklawn Country Club. Prizes have been provided by the Water Works Manufacturers' Association. Entries should be sent to Egbert D. Case, Pitometer Co., 50 Church St., New York.

# Personal Notes

MILTON H. FREEMAN has been designated as acting chief engineer to the New York-New Jersey Tunnel Commissions during the absence of Clifford M. Holland, chief engineer, who is making an inspection of vehicular tunnels in Europe.

W. C. HIGHT, formerly principal assistant engineer, Arkansas Highway Department, has been appointed district engineer, district No. 2, with headquarters at Fayetteville.

ELBERT B. REYNOLDS, for several years connected with the Arkansas Highway Department, has been appointed district engineer, district No. 3, with headquarters at Hope.

G. HUNTER SYKES, formerly U. S. highway engineer, Bureau of Public Roads, Fort Worth, Tex., has been appointed district engineer, district No. 3, with headquarters at Little Rock, Ark.

C. W. KOINER, for 13 years general manager and mechanical and electrical engineer of Pasadena's Municipal Light and Power Department, has been appointed city manager of Pasadena, Cal.

FORD, BACON & DAVIS, engineers, with offices in New York, and

San Francisco, have established an office in Philadelphia.

MONROE DOUGLAS ROBINSON has been made vice-president of the T. C. Desmond Co., engineers and contractors, New York City. Mr. Robinson will devote his attention to the New York office of the company, which has branches in Newburgh, N. Y., and Hartford, Conn.

J. L. CLARKSON, formerly general secretary of the National Federation of Construction Industries, Philadelphia, Pa., has been appointed assistant to the president of the John R. Wiggins Co., Inc., builders, Philadelphia, Pa.

WARNER S. HAYS, consulting engineer of Philadelphia, Pa., has been appointed general secretary of the National Federation of Construction Industries, Philadelphia, Pa.

ARCHER R. NORCROSS, hydraulic and sanitary engineer connected with the civil engineering department, North Dakota Agricultural College, has resigned to accept a similar position with the structural and hydraulic engineering department, University of West Virginia.

JAMES OLIVER HOGG has resigned his position as construction engineer with Collins Bros., general contractors in Kansas City, Mo., to become superintendent of construction for the school board of that city.

CLARENCE E. RIDLEY, who for two and a half years was city engineer and superintendent of the water department at Port Arthur, Tex., has just been appointed city manager of Bluefield, W. Va., and will assume charge Sept. 1. Mr. Ridley has completed on one-year course of training at the National Institute of Public Administration, New York City.

A. B. MCDANIEL, formerly principal engineer of the construction division of the army, has been appointed educational specialist on the advisory board of the general staff of the army.

ALBERT GIVAN has been appointed city engineer of Sacramento, Cal., to succeed Frank C. Miller.

F. O. DUFOUR has resigned as structural engineer of Stone & Webster, Inc., to accept the chair of the Simon Cameron Long professorship of civil engineering at Lafayette College and the directorship of the Testing Laboratory. Mr. Dufour will take up his duties at the beginning of the college year in September.

B. G. DANN, who for the past four years has been connected with the engineering department of the Truscon Steel Co., Youngstown, Ohio, and New York City, has resigned to accept a position as manager of the New York office of the Hendrick Manufacturing Co., makers of perforated metal screens, elevator buckets, general sheet and light structural work, also light and heavy steel plate construction. Mr. Dann is a graduate of the engineering department of Lafayette College.

GEORGE C. D. LENTH, assistant chief engineer, sewers, Board of Local Improvements, Chicago, has been appointed secretary of the Clay Products Association to succeed the late George H. Teft. Mr. Lenth has been with the board for 16 years, since 1911, as assistant chief.

W. W. SCHLECHT, who recently resigned as project manager, Yuma project, U. S. Reclamation Service, has become associated with Dwight P. Robinson & Co. He has been detailed for them on work at Fortaleza, Ceara, Brazil.

PROF. E. G. SMITH, for 40 years professor of chemistry in Beloit College has retired. He was one of the early sanitary chemists of the Middle West who took up bacteriology as a valuable adjunct to chemical constituents as an indicator of the quality of water supplies. More than 100 cities employed him in connection with the quality of their water systems.

WALTER R. SCHEINER, at one time county engineer of Sumner County, Kan., has been appointed city engineer of Salina, Kan., succeeding Paul G. Wakenhut.

COL. CLARENCE S. COE, formerly commanding officer, 17th Engineers (Railway), which was demobilized at Atlanta, Ga., in 1919, after an extended period of service at St. Nazaire, France, and later adviser to the government of the Kingdom of the Serbs, Croats and Slovenes in Servia, has been appointed city manager of Miami, Fla., under the commission manager form of government.

## OBITUARY

PETER COOPER HEWITT, scientist and electrical inventor, died in Paris, Aug. 25. He was born in New York City, 1861. He attended Stevens Institute of Technology and Columbia University and received the honorary degree of Sc. D. from Columbia in 1903 and from Rutgers College in 1916. He was a director of the Cooper Hewitt Electric Co., New York, and Greenwood Lake Ry., Cooper, Hewitt & Co., Midvale Water Co., Hexagon Realty Co., Hewitt Realty Co. He was made vice-president of the Naval Consulting Board in 1915 and was a trustee of Cooper Union for Advancement of Science and Art. Mr. Hewitt was the inventor of the mercury vapor lamp which bears his name.

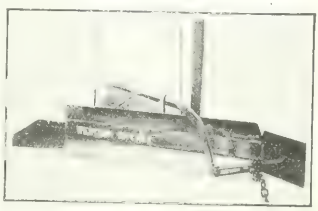
CONRAD FREYTAG, head of the Wayss & Freytag Co., of Neustadt, Germany, one of the pioneers of reinforced concrete in Europe, died July 2 in Wiesbaden at the age of 75. He bought the Monier patents in 1884, and a few years later, with G. A. Wayss, began active development of reinforced-concrete construction. He was one of the founders of the German Concrete Society, which made him an honorary member two years ago.

## EQUIPMENT AND MATERIALS

### Ditch-Cleaning Machine

The machine illustrated has been devised for cleaning small drainage and irrigation ditches. It has a curved blade 5 ft. long, with detachable shares on both edges. The beam is fitted at each end with plow-steel fins which take the side draft.

The blade can be set at any angle and can be adjusted for varying depth



of ditch. To reverse the machine, it is simply turned over, the only adjustment being to disconnect the draft beams and then attach them to the lower edge of the blade. The plow may be hauled by horses or a small farm tractor.

It is built by the Western Wheeled Scraper Co., Aurora, Ill.

### Improved Rapid Computer

The Computer Manufacturing Co., of San Francisco, is putting out a new type of Ross Rapid Computer. Instead of being of celluloid, as was its predecessor, it is an all-metal instrument arranged for desk mounting as well as

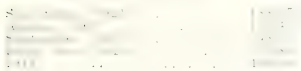
for hand use. It is mounted on aluminum, is ¼ in. thick, and weighs ½ lb. The diameter of the outside scale is 5 in.

In graduation it is like the original instrument, being built on the principle of the polyphase duplex slide rule. Besides the logarithmic scales, it has a 360 deg. protractor, scales of radians and of cubes, and complete trigonometric scales from 0 to 90 deg. for all six functions. An accuracy of 1/20 of 1 per cent can be secured, if the settings are within 4½ min. of arc, which, it is claimed, is easily attained by the practiced hand. The centering, graduations, and hair lines have been made consistent with this accuracy.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

### Engineering News-Record Construction Cost Index Number



**Engineering News-Record's Construction Cost Index Number is 5.2 (2.7 per cent) lower than this time last month, owing to decreases in lumber and labor. The pine base in New York is now $45 (to contractors) as against $47 last month. Lowered rates for common labor in Cleveland and Baltimore have brought down the average for the country from 53½c. per hour in August to 51c. The Pittsburgh base on structural shapes, $1.85, is still effective. Cement still sells for $2.17 net in Chicago. Thus, general construction cost is 24 per cent cheaper than one year ago and 31 per cent under the peak.**

### Large Lumber Shipments Go from Puget Sound to Orient

A recent check by Puget Sound lumbermen shows that 20,000,000 ft. b.m. of lumber for house construction will be carried from Puget Sound to Japan in August and September by Seattle's transpacific fleets. The shipments form one of the greatest movements of the kind in recent years. In addition to the movement to Japan, all the ocean transportation companies in the Northwest are figuring on the transportation of an order of 11,000,000 ft. b.m. of railroad ties for a new railroad in China. Every transpacific ship leaving Puget Sound carries from 250,000 to 1,000,000 ft. b.m. of lumber in her Japanese cargo. The shipments consist of 4 x 4-in. and 5 x 5-in. timbers, in lengths of from 10 to 13 ft.

The movement of lumber to Japan is regarded as a forecast of how the Northwest lumber industry will prosper when other old-world nations adjust their affairs.

### Work for Worcester Unemployed

Additional men are to be employed in Worcester, Mass., as the opportunity arises to put them to work, as a means of relieving unemployment. Permission has been secured from the state civil service commission to employ idle men on emergency work, and acting upon that authority 200 men were put to work recently. It is the plan of the city officials to give the men one week of work followed by a week lay-

[illegible] construction of a sewage disposal plant.

## Value of August 1921 Contracts Exceeds that of the Same Month Last Year by 15 Per Cent

### Miscellaneous Building, 50 Per Cent, Street and Road Work 55 Per Cent More—Month's Total Is $104,644,115

For the first time this year the total value of contracts let, as reported in *Engineering News-Record*, exceeded the total value reported for a corresponding month in 1920, in August. The total value of contracts let in August, 1921, was $104,644,115 as compared to $92,661,818, the value of contracts let during August, 1920. The value of contracts let during the past month is 5 per cent more than the average monthly value for the year so far, whereas the August, 1920, contracts were valued at only 62 per cent of the eight-month average. The total value of contracts let now for the first eight months of the two years are as follows: 1920, $1,180,632,145; 1921, $789,904,941. No account is made of residential building nor of housing projects, except those of an industrial character.

There are several remarkable facts in the comparison of the contracts let for August of the two years. In the first place, it is found that during August, 1921, the total value of miscellaneous building amounted to more than $50,000,000 as compared with $33,000,000 during the same month of 1920, an increase this year over last of approximately 50 per cent. A still greater increase is noted this year over last in street and highway work, the total contract value in these two classes of construction being as follows: 1920, $18,564,595; 1921, $28,692,878. This shows an increase during the past month over the corresponding month of 1920 of 55 per cent.

VALUE OF CONTRACTS LET DURING AUGUST OF 1920 AND 1921

| Classification | August, 1920 | August, 1921 |
|---|---|---|
| Waterworks | $77[illegible]502 | $2,404,364 |
| Sewers | 2,437,384 | 3,988,318 |
| Bridges | 2,172,717 | 2,353,227 |
| Streets and roads | 18,564,595 | 28,692,878 |
| Excavation | 4,179,485 | 89,403 |
| Industrial | 25,941,992 | 7,210,378 |
| Buildings | 33,492,290 | 50,475,001 |
| Federal government | 1,687,499 | 1,355,545 |
| Miscellaneous | 3,410,354 | 8,575,161 |
| Total | $92,661,818 | $104,644,115 |

In only three out of nine classifications of construction work did August, 1920, exceed August, 1921. These three classifications are excavation and dredging work, industrial building and Federal Government work. In industrial work 1920 has always far outdistanced 1921 in the total value of contracts let, as there is comparatively little industrial building going on at the present time. The values of this class of work were, for August, 1921, and 1920, about $7,000,000 and $26,000,000 respectively.

The comparison of the total contracts let for August, 1920, and 1921, indicated above, have not taken into account the decrease in the cost of construction within the past year. Due to the deflation of prices within that period $1,000 will buy a larger proportion of construction materials than it would a year ago. Therefore, $1,000,000 will do a larger construction job now than during August, 1920. This dollar deflation is expressed in the *Engineering-News-Record* Construction Cost Index Number as about 194 now as compared with 251 for August, 1920. In other words, from August, 1920, to August, 1921, there was a deflation of construction costs of about 23 per cent. Applying this differential to the actual dollar values of construction costs for the two years, the correct values are found to be: August 1920, $92,661,818; and August, 1921 $128,712,261. This is a direct comparison between the total contract value figuring that the dollar is worth the same amount in each instance.

There are other interesting points in the comparison of the contract value for the two years, and among them is that following the contract values from month to month for the first eight months of each year, it is found that the trend of values was distinctly downward during last year and is climbing this year. Of course, variations from this general trend occurred at the peak of spring letting.

With the large amount of work proposed and upon which bids are being received, there is every indication that construction work will become increasingly active during the late summer and fall.

### Dallas Contractors Terminate Contracts with Labor

Due partly to the deadlock that has been existing for some time between bricklayers and builders of Dallas, Texas, over the question of wage reductions, contractors of that city have initiated a movement to discontinue the making of verbal or written agreements, or entering into any contract with labor. Twenty-three contractors have already signed the agreement.

### Only Citizens Allowed on Seattle Improvement Projects

Work on virtually all city improvement projects in Seattle was suspended temporarily by a recent order of the Board of Public Works requiring all laborers to be citizens and register-

voters. The order was issued to give employment to approximately 450 day labor jobs to citizens who are now unemployed. The order required all contractors doing street and sewer improvement work for the city to dismiss aliens and laborers holding only first papers, and to replace them by bona fide citizens, holding registration certificates. The order is based on a charter provision that citizens and residents of Seattle, as well as heads of families, shall be given preference in city employment. This rule has not been enforced in the past, with the result that most of the labor now employed is alien. The city at present is carrying on twenty improvement projects.

### West Coast Lumber Production

For the week ended Aug. 20 105 lumber mills reported to the West Coast Lumbermen's Association an output of 60,647,335 ft. b.m. This is almost an 80 per cent normal cut.

### Harding Calls Conference on Unemployment

President Harding has taken a hand in the attempt to solve the unemployment problem and has called a national conference to be held in Washington early in the future. The call for the conference has gone out through the Secretary of Commerce who has issued the following statement covering the situation:

"The President has decided to call a national conference at Washington on unemployment and has instructed the Department of Commerce to formulate a plan for it. Its personnel will be made up so as to represent the country geographically and so far as possible to embrace representatives of the greater employment industries. The Department of Commerce will co-operate with the Department of Labor on representation of labor.

"It is desired for working reasons to keep the number of the conference as small as possible. It is intended to invite representatives of the greater groups of industries and thought, and the co-operation of their national organizations will be sought."

"The object of the conference will be to inquire into the volume of needed employment, the distribution of unemployment, to make recommendations as to measures that can properly be taken in co-ordinated speeding up of employment by industries and public bodies during the next winter, and in addition a broad study of the economic measures desirable to ameliorate the unemployment situation and give impulse to the recovery of business and commerce to normal. Many constructive suggestions have been made to the department by employers, the governors of states, and city officials. While business steadily improves, yet some workers may have exhausted their savings by winter and they must be a matter of extreme solicitude."

It is expected that the full conference plan will be ready for the President in about ten days.

# Labor Rates and Conditions Throughout the Country

Cleveland and Baltimore are the only cities of the nineteen listed showing a decrease in labor rates. In Cleveland, bricklayers, carpenters, hoisting engineers and structural iron-workers receive $1.04; hod-carriers 60c., piledrivers 91c. and common labor 57½c. per hour. Common labor in Baltimore has dropped to 30c. per hour from 35c. Minneapolis reports labor plentiful and no strike difficulties. In Detroit there is a shortage of plasterers, with all other trades plentiful, men in some cases accepting considerably less than the official scale. Housebuilding in New Orleans is much more active than in 1920, but no industrial construction is under way. Open-shop conditions still prevail in Pittsburgh, with labor reported plentiful.

Los Angeles reports employment in all classes of labor except pile-drivers and common laborers. There is practically no demand for pile-drivers and there are more men than jobs among the unskilled. Few structural iron-workers are reported idle. An aggravating feature is that men out of work flock to Los Angeles from the smaller towns. In Oakland, Cal., the building trades unions have voted to reject the "American Plan," but will permit their members to work under whatever terms they may be able to secure as individuals. This concession practically puts the American plan into effect in this territory.

South Carolina reports a marked decrease in rates paid common labor. The lowest figures prevail in Cherokee County, where the bottom rate is $1 and the highest $1.50 per day. The highest price paid anywhere in the states is $2.50 per day; teams, including the driver, bring from $4.50 to $5 per day.

Wages paid common laborers at the mines on the Minnesota ranges have been brought down to 30c. per hour, or about the 1917 basis. These men were receiving $5.55 per day as their top level until last April. The feeling is that miners' wages now ruling are the minimum until factors outside the steel industry are adjusted downwards.

S means scarce, E, enough, P, plentiful. +Higher rates indicated by P, decreases by

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | $0.90P | $0.70P | $1.00P | $0.50P | | $1.00P | $0.20P |
| Baltimore | 1.25P | .80P | .87½P | .54P | $0.74P | 1.00P | —.30P |
| Birmingham | 1.00P | .75P | | .25 | | 1.00P | .15@.25 |
| Boston | .90P | .90P | .90P | .60P | .90P | .90P | .55P |
| Cincinnati | 1.25P | 1.00P | .70E | .85P | 1.00E | 1.25P | .35@.40 |
| Chicago | 1.25 | 1.25 | | | | 1.25 | 1.00 |
| Cleveland | —1.04P | —1.04P | —1.04P | —.60P | —.91P | —1.04P | —.57½P |
| Dallas | 1.00P | 1.00P | 1.00E | .60E | 1.00E | 1.00E | .50@75P |
| Denver | 1.37½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | .50@.60P |
| Detroit | 1.00P | .80P | 1.00P | .50@.60P | 1.00P | .60@.80P | .50P |
| Kansas City | 1.07½ | 1.00 | 1.00 | .50 | 1.07½ | 1.00 | .70 |
| Los Angeles | 1.25P | 1.00P | 1.00P | 1.12½P | 1.00P | 1.00P | 50@.56¼P |
| Minneapolis | 1.00P | .80P | .80P | .65P | | .80P | .50P |
| Montreal | .90P | .90P | .90P | .40P | .50P | .65P | .30P |
| New Orleans | 1.00P | .88P | .90P | .40P | .80P | 1.00P | .30P |
| New York | 1.25 | 1.12½ | 1.25 | .87½ | 1.12½ | | .75@ |
| Pittsburgh | 1.12½P | 1.00P | 1.00P | .80P | | 1.00P | Open |
| St. Louis | 1.25P | 1.25P | 1.25P | .85P | 1.25P | 1.25P | |
| San Francisco | 1.25P | 1.12½P | 1.12½P | 1.00P | 1.12½P | 1.12½P | .81¼P |
| Seattle | 1.00P | 80P | 80P | .70P | 1.00P | .87½P | |

### Contractor Protests Seattle Anti-Alien Labor Bill

The contracting firm of Jahn & Bressi, Seattle, recently awarded a paving contract by the city has obtained an order restraining the city and the board of public works from cancelling the contract or interfering with the firm in carrying out its contract. The complaint of the contractors resulted from the recent order of the board of public works that all alien workers engaged in city improvement work be dismissed and their places given to registered voters and citizens of Seattle.

The contractors allege that their bid was submitted because of their reliance on the former conduct of the city, which permitted them to employ any men who were skilled in their work, as long as the contractor gave preference to those equally skilled in doing the work to the one who was a citizen of the United States and head of a family. The outcome of the case is being watched with considerable interest, as approximately twenty improvements jobs are affected by the order of the board of public works.

### Waterborne Movement of Western Lumber Heavy

When transcontinental rail freight rates rose 33⅓ per cent a year ago, Pacific Northwest lumber began moving to Atlantic Coast markets through the Panama Canal. The break from car to cargo delivery has resulted in an increase of 5,898 per cent in waterborne intercoastal lumber shipments, the first six months of 1921 as compared with the first half of 1920, according to a recently-issued bulletin of the West Coast Lumbermen's Association.

Notwithstanding the tremendous increase in the water movement, the total volume of business of Pacific Northwest mills in Atlantic Coast markets is substantially less than it was a year ago. In addition to showing that Atlantic Coast lumber cargo shipments jumped from 1,564,505 ft. b.m. the first half of last year to 93,843,494 ft. b.m. the first half of this year, the report reveals gains in nine cargo markets and losses in a like number of overseas and coastwise markets, with a net loss of 13 per cent.

The California market, with 347,901,289 ft. b.m. delivered by water the first six months this year compared with 498,649,446 ft. b.m. for the same period last year, shows a loss of 30 per cent. The European markets show a loss of approximately 52 per cent. The west coast of South America 41 per cent. Australia, 58 per cent. China, 12 per cent.

Japan, rebuilding her six larger cities, and being the greatest per capita lumber consuming nation, bought heavily, recording an increase of 3½ over the first six months of 1920. Japan thus far this year has taken 90,850,884 ft. b.m. as against 69,192,371 ft. b.m. last year.

### Number Idle Cars Decrease

Due principally to the increased deman for transportation facilities a further decrease of 13,446 was reported in the number of freight cars temporarily out of service on Aug. 15 because of business conditions, compared with the total on Aug. 8, according to reports just received by the car service division of the American Railway Associations. The number idle on Aug. 15 was 499,594, compared with 513,040 the week before. Tabulations showed that of the total 284,338 were serviceable freight cars, while the remaining 215,256 needed repairs.

A reduction in the care shortage, which has been reported at certain points, was shown by the reports. On Aug. 15, this shortage was 2,125, or 1,239 below what it was on Aug. 8.

### Computers Wanted by Coast and Geodetic Survey

The U. S. Civil Service announces open competitive examinations to be held Sept. 21 and 22 and Nov. 2 and 3, for computer. Vacancies in the Coast and Geodetic Survey for duty in Washington at $1,400 a year and Manila, P. I., at $2,000 a year are to be filled from this examination. Applicants should apply at once for Form 1312, stating the title of the examination desired, to the Civil Service Commission at Washington or to the secretary of the civil service board in any of the certain designated cities.

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Railway Material**—Standard, open-hearth rails in Birmingham $45@$47, as against $47.50, with reduction of 20c. per 100 lb. on light rails, all weights. Ties down 5c. each on white oak and 5@10c. on hardwood and red oak, in Chicago. Standard spikes in Chicago $3, as against $3.40; track bolts have dropped from $4.60 to $4.04 per 100 lb.

**Pipe**—Important decreases in cast-iron pipe in four cities. New York quotes 6-in. at $43.30, a drop of $5; the price in Birmingham is $38; in Chicago, $42.60 as compared with $48.10 last month; San Francisco down from $70 to $60 per net ton. Sewer pipe has advanced in Los Angeles, New Orleans and Baltimore, but is down in Birmingham, St. Louis, Boston, Detroit and New York.

**Paving Materials**—Road oils have declined anotner 1c. in New York, and 1c. per gal. in Chicago. Asphalt down $4 per ton in Chicago; down $10 per ton in packages, Baltimore. Granite paving blocks in Baltimore, $2.15, as against $2.25 per sq.yd. General de- [illegible] per sq.yd., on wood blocks.

**Sand, Gravel and Crushed Stone**—Gravel down 10 to 55c. in five cities. Sand down in Chicago, St. Louis, Los Angeles, Detroit and Birmingham. Crushed stone has advanced in Kansas City and Los Angeles and dropped in Chicago, Detroit and Baltimore.

**Lime**—Hydrated, finishing, down $6.25 in Detroit and $7.25 per ton in Baltimore; common hydrated down $5.25 in Detroit and $4.50 per ton in Baltimore. Common lump lime has declined in Chicago, Boston and New Orleans.

**Cement**—No change in New York, with the price $2.60@$2.70 net delivered. Down in Baltimore, Birmingham and Kansas City, while Los Angeles reports advance from $3.21 to $3.31 per bbl. net. Natural cement reported lower in New Orleans.

**Common Brick and Hollow Tile**—Brick has dropped $5 in Baltimore. Down $1 in Chicago, Boston and Detroit, delivered. Slight declines also in Birmingham and New Orleans. Hollow tile slightly lower in nine of the principal cities. Clay drain tile dropped $10 per 1,000 lin.ft. in New York on [illegible]

**Roofing Materials**—Prepared roofings show average drop of 35c. in New York and 42@50c. per square in Philadelphia. Slate surfaced roofings now at $1.85, as against $2.80 per roll last month; slate finish shingles $5.40, as against $7.95 per square, carload lots f.o.b Philadelphia.

**Structural Material**—Warehouse prices and quotations on mill shipment unchanged in New York. The regular Pittsburgh base of $1.85 and the warehouse base price of $2.88 for plates and shapes, effective. Mill reductions on tin plate and blue-annealed and galvanized steel sheets are reflected in warehouse quotations in Chicago, San Francisco and St. Louis. New York and Chicago prices on shapes, plates and bars are identical. Chicago quotes reduction of 20c. on structural rivets, present price $3.68.

**Lumber**—Sharp declines in price of yellow pine in Baltimore and Birmingham, and of Douglas fir in Los Angeles and New Orleans. Advance of $1@$1 in Kansas City and $1@$2 per M. ft. in Minneapolis.

**Wood Piles**—Pine piles, larger sizes down $1@$1.50 in New York, $1@$2 in St. Louis.

**Explosives**—Reduction 1c. per lb. on all high explosives throughout the country.

**Scrap**—Quotations in New York, Chicago and St. Louis average $1@$ lower per gross ton than last month.

Price advances since last month are indicated by **heavy type**; declines by *italics*

**PIG IRON**—Quotations compiled by The Matthew Addy Co.:

| | Current | One Year Ago |
|---|---|---|
| **CINCINNATI** | | |
| No. 2 Southern Silicon 2.25 @ 2.75 | $24.50† | $45.60 |
| Northern Basic | **21.52†** | 51.30 |
| Southern Ohio No. 2 Silicon 1.75 @ 2.25 | 22.50† | 47.80 |
| **NEW YORK, tidewater delivery** | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | *30.26†* | 49.70 |
| **BIRMINGHAM** | | |
| No. 2 Foundry (Silicon 2.25 @ 2.75) | *20.00** | 42.00@44.00 |
| **PHILADELPHIA** | | |
| Eastern Pa., No. 2X, (2.25 @ 2.75 Silicon) | *21.76†* | 50.00* |
| Virginia No. 2 (Silicon 2.25 @ 2.75) | *28.74†* | 50.00* |
| Basic | *20.26†* | 48.00† |
| Grey Forge | *22.26†* | 45.00* |
| **CHICAGO** | | |
| No. 2 Foundry Local (Silicon 1.75 @ 2.25) | *20.00** | 46.40 |
| No. 2 Foundry Southern (Silicon 2.25 @ 2.75) | *26.66†* | 48.00 |
| **PITTSBURGH, including freight charge from the Valley** | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | *21.96* | 49.00 |
| Basic | *19.96* | 48.50 |
| Bessemer | *21.96* | 50.00 |

*F.o.b. furnace †Delivered

## RAILWAY SUPPLIES

**STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

| | Pittsburgh | | | Chicago |
|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | |
| Standard bessemer rails | $45.00 | $55.00 | | $45.00 |
| Standard openhearth rails | 47.00 | 57.00 | $45@47 | 47.00 |
| Light rails, 8 to 10 lb. | 45.00 | 50.00@55.00 | | 2 45@3.00* |
| Light rails, 12 to 14 lb. | 45.00 | 50.00@55.00 | *2.00** | 2 41@2.95* |
| Light rails, 25 to 45 lb. | 40.00 | 50.00@55.00 | *2.00** | 2 32@2.85* |

*Per 100 lb.

**RAILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8 Ft. | 7 In. x 9 In. by 8 Ft. 6 In. |
|---|---|---|
| Chicago, White Oak | *$1.45* | *$1.40* |
| Chicago, Hardwood and Red Oak | *1.20* | *1.00* |
| Chicago....Empty Cell Creosoting (add'l) | .45 | .50 |
| San Francisco..... Green Douglas Fir | .80 | 1.12 |
| San Francisco, Empty Cell Creosoted, Douglas Fir | 1.76 | 2.48 |

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pine and Sap Cypress |
|---|---|---|---|
| Grade 3 | *$1.25* | *$1.05* | *$.90* |
| Grade 2 | *1.15* | *1.00* | **90** |
| Grade 1 | *1.10* | *.95* | *.80* |

**TRACK SUPPLIES**—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh | | | | | San Francisco | |
|---|---|---|---|---|---|---|---|
| | Current | One Year Ago | Chicago | St. Louis | Birmingham | | Dallas |
| Standard spikes, 9-in. and larger | $3.00 | $4.00@4.25 | *$3.00* | *$3.00* | $3.75 | 4.00 | |
| Track bolts | 4.00 | 6.00@6.50 | *2.90* | *2.90* | 6.25 | 4.15 | |
| Standard section angle bars | 2.75 | 3.60@4.25 | *2.75* | *3.25* | 4.00 | 3.25 | |

## PIPE

**WROUGHT PIPE**—The following discounts are to jobbers for carload lots, Pittsburgh basing card of July 7, 1921:

BUTT WELD

| Inches | Steel Black | Steel Galv. | Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| ⅛ to ¼ | *64½* | *50* | ⅜ to 1½ | *59½* | *44* |

LAP WELD

| Inches | Steel Black | Steel Galv. | Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| 2 | *56½* | *44* | 15 | *41½* | *32* |
| 2½ to 6 | *60* | *47* | 2 | *56* | *44* |
| 7 to 12 | *57½* | *44* | 2½ to 6 | *59* | *46* |
| 13 and 14 | *45* | *37* | 7 to 12 | *55* | *43* |

BUTT WELD EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 1 to 1½ | *62½* | *51* | 1 to 1½ | *59½* | *46½* |
| 2 to 3 | *68½* | *52* | | | |

LAP WELD EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 2 | *54½* | *43* | 2 | *35½* | *24½* |
| 2½ to 4 | *58½* | *47* | 2½ to 4 | *38½* | *26½* |
| 4½ to 6 | *57* | *45* | 4½ to 6 | *37½* | *25½* |
| 7 to 8 | *55½* | *43* | 7 to 8 | *30½* | *18½* |
| 9 to 12 | *48* | *37* | 9 to 12 | *25½* | *13½* |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | *60%* | *62½%* | *54½%* |
| 3½ to 6 in. lap welded | *51%* | *48½%* | *43½%* |

| | Galvanized | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | *46%* | *50%* | *38½%* |
| 3½ to 6 in. lap welded | *37%* | *46%* | *34½%* |

Malleable fittings, Class B and C, from New York stock sell at net list prices. Cast iron, standard sizes, 20-5% off.

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York | | | | | |
|---|---|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
| 4 in. | *$45.50* | $79.30 | *$50.00* | *$45.60* | $49.70 | *$63.00* |
| 6 in. and over | *45.50* | 76.30 | *48.00* | *42.60* | 46.70 | *60.00* |

Gas pipe and Class "A," $3 per ton extra. 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin. ft.:

| | New York | | | | | |
|---|---|---|---|---|---|---|
| Size, In. | Current | One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
| 3 | *$40.00* | $42.50 | $35.00 | $50.00 | | $55.00 |
| 4 | *50.00* | 60.00 | 85.00 | 60.00 | $90.00 | 65.00 |
| 5 | *80.00* | 85.00 | 140.00 | 80.00 | 115.00 | 84.00 |
| 6 | *105.00* | 110.00 | 140.00 | 100.00 | 150.00 | 110.00 |
| 8 | *125.00* | 175.00 | 200.00 | 150.00 | 250.00 | 181.00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots:

| Size, In. | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | *$0.14* | | | *10½* | $0.13 | | |
| 4 | *14* | | *$0.09* | *10½* | 13 | 16½ | $0.18 |
| 5 | *21* | | | *15* | 20½ | 19½ | 16½ |
| 6 | *21* | | *15½* | *15* | 20½ | 22½ | 25 |
| 8 | *36* | | *22½* | *21* | 31½ | 32½ | 35 |
| 10 | *52* | | | *30* | 47½ | 45½ | |
| 12 | *62* | | *38½* | *32* | 60½ | 58½ | 80 |
| 15 | *1.15* | | *56½* | *45* | 81 | 97½ | |
| 18 | *1.55* | | *76½* | *62½* | 1.12½ | 1.36½ | |
| 20 | *1.98* | | *1.12½* | *1.00* | 1.35 | | |
| 22 | *2.64* | | | | 1.80 | | |
| 24 | *3.07* | | *1.46½* | *1.25* | 2.02½ | 2.34 | 2.40 |
| 27 | | | | *2.50* | 3.75 | 3.25 | |
| 30 | | | 4.00 | *3.50* | 4.75 | 3.90 | |
| 33 | | | | *4.75* | 5.50 | | |
| 36 | | | | *6.00* | 6.00 | | |

| | 3 | 5 | 8 | 12 | 24 | 36 |
|---|---|---|---|---|---|---|
| Boston | *$0.11½* | *$0.12½* | *$0.20½* | *$0.30½* | *$1.21* | *$2.42* |
| Minneapolis | | | 40 | 77 | **2.55** | 5.66 |
| Denver | | 15 | 30 | 50 | 1.95 | |
| Seattle | 145 | | 36 | 72 | 2.59 | |
| Los Angeles | 11* | 165* | 275 | **495** | 1.65 | |
| New Orleans | | *108* | **27** | *45* | *1.35* | |
| Cincinnati | *11¼* | *17½* | *25½* | *37½* | *1.50* | *2.81* |
| Atlanta | *09¾* | *13½* | *24½* | *37½* | *1.50* | |
| Montreal, f.o.b. cars | 30* | 45* | 85* | 1.35 | 4.50 | 6.50 |
| Detroit | *.105* | *.155* | *.25* | *.35* | *1.11* | *2.22* |
| Baltimore, f.o.b. | *.125* | **2295** | **357** | **6885** | **2.295** | *5.23* |
| Baltimore, delivered | | | | | | |

*4-in., 6-in., 9-in., 30-in. respectively.

## ROAD AND PAVING MATERIALS

**ROAD OILS**—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45% asphalt.... (at terminal) | *$0.06* | $0.14 |
| New York, 65% asphalt.... (at terminal) | *.05* | 14 |
| New York, binder.... (at terminal) | *.06* | 13 |
| New York, flux.... (at terminal) | *.05½* | 14 |
| New York, refined asphalt.... (at terminal) | *.06½* | 14 |
| St. Louis, 70-60 asphalt | *.02½** | 12 |
| Chicago, 40-50% asphalt | .... | 10 |
| Chicago, 60-70% asphalt | .... | 11 |
| Dallas, 40-50% asphalt | 10 | 08 |
| Dallas, 60-70% asphalt | 13 | 10 |
| Dallas, 75-90% asphalt | 15 | 12 |
| San Francisco, binder, per ton | 15.00 | 14.00 |

*Freight $21.75 per ton to Wilmington

**ASPHALT**—Price per ton in package. [illegible] in bulk in carload lots:

| | Package | Bulk |
|---|---|---|
| New York (Bayonne, N. J.) | $24 00 | $15 00 |
| Boston | No quotations | |
| Chicago | [illegible] | 17 00 |
| San Francisco [illegible] Oleum Gel | 21 50* | 15 00* |
| Dallas | 35 00 | 27 00 |
| Seattle | 27 50 | 21 50 |
| Denver | 45 00 | 65 00 |
| Minneapolis | [illegible] | 20 50 |
| St. Louis | [illegible] | 1921 |
| Baltimore | [illegible] | [illegible] |
| Los Angeles | 22 50 | 15 00 |
| Montreal | 28 00 | 21 00 |
| Atlanta | [illegible] | [illegible] |
| Detroit (petroleum asphalt) | 24 50 | 20 00 |
| Cincinnati | 27 00 | 22 10 |
| Maurer, N. J. (asphalt) | 27@ 38 | [illegible] |
| Maurer, N. J. (asphalt cement) | 29 50 | 25 31 |

*Freight to San Francisco 80c. per ton.

NOTE—Barrels or drums not returned [illegible] About 6 lb. to the ton, and from 4 to 5 drums [illegible] allowed $1 per ton for barrels or drums.

**PAVING STONE**—

| | | |
|---|---|---|
| New York | Soft granite 2[illegible] 2 to [illegible] | $130 00 per M |
| Chicago | About 4x8x4 dressed | 3 35 sq.yd |
| | About 4x8x4 common | 3 00 sq.yd |
| San Francisco | Basalt blocks 4x7x8 | 65 00 per M |
| Boston | Soft granite | 4 20 sq.yd |
| Atlanta | Granite | 2 00 sq.yd |
| Detroit | Granite, 26½ blocks per sq.yd. | 107.00 per M |
| Baltimore | Granite | 2 15 sq.yd. |
| Montreal | Granite | 130 00 per M |
| New Orleans | Granite 4 x 8 x 4 | 3.25 sq.yd. |
| Cincinnati | Granite | 4 50 sq.yd. |
| St. Louis | 4x8x4 dressed | 3 35 sq.yd. |
| | 4x8x4x common | 3 00 sq.yd. |
| Kansas City | No. 1 Granite | 3.95 sq.yd. |

**FLAGGING**—

| | | | |
|---|---|---|---|
| New York | Bronx | $0.25 | sq.ft. |
| | Manhattan, 4 ft. | .26 | sq.ft. |
| | Queens, 5 ft. | .26 | sq.ft. |
| | 6x20-in. crosswalk | 1 00 | lin.ft. |
| Chicago | 18 in. wide | .70 | lin.ft. |

**CURBING**—Bluestone per lineal foot in New York, costs 77c. for 5x16 in., 88c. for 5x18 in. in carge lots.

**WOOD BLOCK PAVING**—

| | Size of Block | Treatment | Per Sq.Yd. |
|---|---|---|---|
| New York | 3 | Io | $[illegible] |
| New York | 3½ | Io | 2 17 |
| New York | 4 | Io | 2 37 |
| Boston | 3 | Io | 2 17 |
| Chicago | 4 | Io | [illegible] 2 25 |
| Chicago | 3½ | Io | [illegible] 2 25 |
| St. Louis | 3 | Io | 3 25 |
| St. Louis | 4 | Io | 3 75 |
| Seattle | 4 | Io | Off market |
| Minneapolis | 3½ | Io | [illegible] |
| Atlanta | 3 | Io | 2 30 |
| New Orleans | 3 | Io | 2 00 |
| New Orleans | 3½ | Io | 2 35 |
| New Orleans | 4 | Io | 2 65 |
| Dallas | 4 | I8 | 3 90 |
| Baltimore | 3 | Io | [illegible] |
| Montreal, [illegible] | 4 | Io | 4 50 |
| Detroit | 3 | Io | 2 84 |
| Detroit | 4 | Io | 3 00 |
| Cincinnati | 4 | Io | 3 30 |
| Kansas City | 4 | Io | 2 00@2 25 |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots at works, as follows, per cu.yd.:

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago | Sand Current | Sand One Year Ago |
|---|---|---|---|---|---|---|
| New York | $2 25 | $3 00 | $2 25 | $3 00 | $1 25 | $1 50 |
| Denver | 2 00 | 1 40 | 1 80 | 1 80 | 1 60 | 1 00 |
| Chicago | [illegible] | 2 15 | [illegible] | 2 15 | [illegible] | 2 15 |
| St. Louis | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 55 |
| Seattle | 1 50 | 1 25 | 1 50 | 1 25 | 1 50 | 1 25 |
| Dallas, delivered | 3 00 | 2 50 | [illegible] | 2 50 | [illegible] | 2 00 |
| Minneapolis | 2 00 | 2 00 | [illegible] | [illegible] | 1 [illegible] | 1 25 |
| Cincinnati | 2 25 | [illegible] | 3 25 | 1 [illegible] | [illegible] | 1 45 |
| San Francisco | [illegible] | 2 [illegible] | 2 50 | 1 50 | [illegible] | 1 50 |
| Boston, per ton | 2 65 | 3 50 | [illegible] | 3 00 | 2 00 | 2 75 |
| New Orleans | 2 85 | [illegible] | [illegible] | [illegible] | [illegible] | 1 65 |
| Los Angeles | [illegible] | 1 25 | 1 45† | [illegible] | [illegible] | 1 15 |
| Atlanta, per ton | 2 25 | 2 25 | 2 25 | 1 35 | [illegible] | 1 15 |
| Detroit | 2 00 | 2 50 | [illegible] | 2 50 | [illegible] | 50 |
| Baltimore, per ton | 1 40 | [illegible] | [illegible] | [illegible] | 2 40 | 70 |
| Montreal, per ton | 1 50 | 1 45 | 1 50 | [illegible] | 1 25 | 1 30 |
| Birmingham, per ton | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1 25‡ |

* Fine white sand, Lonsdale [illegible] Crushed, $4 [illegible]

† Freight from [illegible] to Los Angeles [illegible]

‡ Per cu. yd.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1 90@2 00 | $1 90@2 00 | $1 90@2 00 | $2 15 |
| Chicago | *2.00* | 2.35 | *2.00* | 2.50 |
| St. Louis [illegible] | 1 60* | 1 90 | 1 [illegible] | 1 90 |
| Dallas | 2.80 | 3.50 | 2 80 | 3.50 |
| San Francisco | 2.25 | 1.50 | 2 50 | 1.50 |
| Boston [illegible] | 3 00 | 3 00 | 3 00 | 3 00 |
| Minneapolis, *at plant* | 2.00 | 2.25 | 2.25 | 2.25 |
| Kansas City† | **1 50** | 2 35 | **1 50** | 2 35 |
| Denver | [illegible] | 3.75 | [illegible] | 3.75 |
| Seattle *delivered* | 3.00 | 3 50 | 3.50 | 3.50 |
| Atlanta | 2.25* | 3 10 | 2 25* | 3 10* |
| Cincinnati *delivered* | 2.06 | [illegible] | *2.06* | 1.65 |
| Los Angeles | **1 60*** | 1 60* | **1 70*** | 1 60* |
| Detroit | *1.90** | 2.00* | *1.90** | 2 00* |
| Baltimore | 1 75* | 1 80* | *1.65** | 1 80* |
| Montreal | 2 00* | 2.30* | 2.10* | 2.30* |
| Birmingham, *delivered* | 3 20 | | 3 10 | |

*Per ton. †F.o.b. Joplin, Mo

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants:

| | ½-In | ¾-In | Roofing | Sand |
|---|---|---|---|---|
| Lebanon or Bethlehem, Pa | $1.00 | $1.00 | $2.50 | $0.90 |
| Easton or Catasauqua, Pa | 1 00 | 1 00 | 2 00 | .90 |
| Buffalo, N. Y. and Erie, Pa | 1.25 | 1.25 | 2.25 | 1.25 |
| Emporium, Pa | 1 25 | 1 25 | | 1 25 |
| East Canaan, Conn. | 1 25 | 1 35 | 4 00 | 1 10 |
| Birmingham, Ala | .90 | 1.15 | 2.05 | .80 |
| Toledo, Ohio | 1.50 | 1.50 | 2.35 | |
| Atlanta, Ga | [illegible] | 2.10 | | |
| Eastern Pennsylvania and New Jersey | 1 20 | 1 20 | 2 50 | 90 |
| Western Pennsylvania and New Jersey | 1 25 | 1 25 | 2 50 | 1 25 |

Birmingham, f.o.b. sidings, $1.15 or $1.45 per cu.yd. waste).

**LIME**—Warehouse prices

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per 180-Lb. Barrel (re- Finishing | Lump, per 180-Lb. Barrel (re- Common |
|---|---|---|---|---|
| New York | $16 99 | | | $3 69* |
| Chicago | 20 00 | | [illegible] | 1 [illegible] |
| St. Louis | 24 00 | $20 00 | [illegible] | 2 [illegible] |
| Boston | 24.25 | 20.25 | $3.40 | 3.10 |
| Dallas | [illegible] | [illegible] | [illegible] | [illegible] |
| Cincinnati | 16 70 | 14 50 | [illegible] | 12 25‡ |
| San Francisco | 25 40 | 22 00 | [illegible] | 2.25 |
| Minneapolis | 29 00 | 22 00 (white) | [illegible] | 1 80 |
| Denver | 30 00 | [illegible] 95 (bbl.) | 95 (bu.) | |
| Detroit | 15 25 | 13 25 | 12 00 (ton) | 11 00 (ton) |
| Seattle | 27 00 | [illegible] | 3.50 | 3 25 |
| Los Angeles | [illegible] | 30 00 | 3 00* | 3 00* |
| Baltimore | 15 00 | 13 00 | [illegible] | 12 00‡ |
| Montreal | 28 00 | [illegible] | 15.00‡ | [illegible] |
| Atlanta | [illegible] | 16.00 | 2.00 | 1.50 |
| New Orleans | [illegible] | 17 50 | [illegible] | 1 75 |

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.

Minneapolis quotes common lump lime Kelly Is, white; brown is $1.50.

NOTE—Refund of 10c. per barrel.

**NATURAL CEMENT**—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

| | Current | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2 80 | $2 60 |
| Kansas City (Ft. Scott) | 1 60 | 1 60 |
| New Orleans | 4 [illegible] | 3 [illegible] |
| Atlanta (Magnolia) | 11 00 [illegible] | 1 90 |
| Cincinnati (Utica) | 1 87 | 2 85 |
| Boston (Rosendale) | 1 05@ 95 | 2 35 |

**PORTLAND CEMENT**—Current prices are for barrels in carload lots, *with* or *without* bags, to contractors:

| | Current With Bags | Current Without Bags | One Month Ago With Bags | One Month Ago Without Bags | One Year Ago With Bags | One Year Ago Without Bags |
|---|---|---|---|---|---|---|
| New York, delivered | $2 60 | 2 70 | $2 60@ 2 70 | | $4 22@ 4 25 | |
| New York, alongside dock to dealers | [illegible] | 2 40 | [illegible] | 2 40 | [illegible] | |
| Jersey City, delivered | [illegible] | 2 89 | [illegible] | 2 89 | [illegible] | 4 25 |
| Boston | [illegible] | 2 86 | [illegible] | 2 86 | [illegible] | 3 32 |
| Chicago | [illegible] | 2 17 | [illegible] | 2 17 | [illegible] | 2 15 |
| Philadelphia | [illegible] | 2 17 | [illegible] | 2 17 | [illegible] | 2 20 |
| Cleveland | [illegible] | 2 43 | [illegible] | 2 42 | [illegible] | 2 42 |
| Detroit | [illegible] | 2 43 | [illegible] | 3 00 | [illegible] | 3 00 |
| Indianapolis | [illegible] | 2 43 | [illegible] | 2 43 | [illegible] | 2 42 |
| Toledo | [illegible] | 2 49 | [illegible] | 2 49 | [illegible] | 2 28 |
| Milwaukee | [illegible] | 2 39 | [illegible] | 2 39 | [illegible] | 2 20 |
| Duluth | [illegible] | 2 10 | [illegible] | 2 10 | [illegible] | 2 20 |
| Peoria | [illegible] | 2 45 | [illegible] | 2 45 | [illegible] | 2 32 |
| Cedar Rapids | [illegible] | 2 51 | [illegible] | 2 51 | [illegible] | 2 43 |
| Davenport | [illegible] | 2 47 | [illegible] | 2 47 | [illegible] | 2 36 |
| St. Louis | [illegible] | 2 90 | [illegible] | 2 90 | [illegible] | 2 85 |
| San Francisco | [illegible] | 3 09 | [illegible] | 3 09 | [illegible] | 2 88 |
| New Orleans | [illegible] | 3 20 | [illegible] | 3 20 | [illegible] | 3 32 |
| Minneapolis | [illegible] | 2 40 | [illegible] | 2 41 | [illegible] | 3 30 |
| Denver | [illegible] | 3 10 | [illegible] | 3 10 | [illegible] | 3 80 |
| Seattle | [illegible] | 3 10 | [illegible] | 3 10 | [illegible] | 3 03 |
| Dallas | 2 80 | 2 80 | 2 60 | 2 60 | 2 92 | 2 92 |
| Atlanta | [illegible] | 2 75 | [illegible] | 2 75 | [illegible] | 2 70 |
| Cincinnati | [illegible] | 2 62 | [illegible] | 2 62 | [illegible] | 2 85 |
| Los Angeles | 3 31 | 3 21 | [illegible] | 3 21 | [illegible] | 3 10 |
| Baltimore (delivered) | [illegible] | 2 58 | [illegible] | 2 58 | [illegible] | 4 56 |
| Detroit | 2 43 | 2 43 | [illegible] | 2 43 | [illegible] | 5 00 |
| Jacksonville | [illegible] | 3 05 | [illegible] | 3 05 | [illegible] | |
| Kansas City | [illegible] | 3 20 | [illegible] | 3 20 | 2 76 | |
| Montreal | 2 75 | 2 75 | [illegible] | 2 75 | [illegible] | |

NOTE—Bags 10 cents each; 40 cents per bbl. 80c. per bbl. to Montreal, 60c. [illegible] in Los Angeles.

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots.

PLAIN 4-INCH BY 4-INCH MESH

| Style Number | Weight in Pound | Pittsburgh, Mill | New York (Warehouse) | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|---|
| 032 | 0 022 | $0 74 | 1 16 | | $1 15 | $1 24 |
| 049 | 0 028 | 94 | 1 45 | | 1 46 | 1 56 |
| 068 | 0 035 | 1 14 | 1 74 | | 1 80 | 1 92 |
| 093 | 0 045 | 1 46 | 2 20 | | 2 30 | 2 46 |
| 126 | 0 057 | 1 80 | 2 69 | | 2 86 | 3 07 |
| 153 | 0 068 | 2 14 | 3 18 | | 3 40 | |
| 180 | 0 078 | 2 46 | 3 63 | | 3 93 | |
| 245 | 0 103 | 3 24 | 4 74 | | 5 15 | |
| 287 | 0 119 | 3 75 | 5 46 | | 5 96 | 6 41 |
| 336 | 0 138 | 4 35 | 6 33 | | 7 32 | |
| 395 | 0 160 | 5 04 | 7 30 | | 8 00 | |

PAVING

| | | | | | | |
|---|---|---|---|---|---|---|
| 036P | 0 017 | $0 56 | | | $0 88 | |
| 053P | 0 024 | 79 | | | 1 24 | |
| 072P | 0 031 | 99 | | | 1 57 | |
| 097P | 0 040 | 1 28 | | | 2 02 | |
| 049R | 0 024 | 79 | | | 1 24 | |
| 067R | 0 031 | 99 | | | 1 57 | |
| 089R | 0. 040 | 1 28 | | | 2 02 | |

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | $23 25 | $23 89 | $27 50 | $34 20 | $25 50 |
| 26 | 250 | 24 65 | 24 93 | 28 90 | 28 75 | 27 56 |
| 25 | 300 | 27 30 | 27 45 | 31 15 | | 30 71 |
| 24 | 340 | 29 10 | 29 33 | 33 10 | 33 06 | 33 16 |
| 22 | 433 | 33 80 | 34 06 | | | 35 10 |

* Material shipped from mill, freight allowed, or at warehouse. Delivery charge is 1c. per sq.yd.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.:

ROLLED FROM BILLETS

| Inches | Pittsburgh Mill | New York (Warehouse, Uncut) | Birmingham Mill | Chicago (Warehouse, Uncut) | St. Louis (Warehouse, Uncut) | Dallas (Warehouse, Uncut) | San Francisco (Warehouse, Uncut) |
|---|---|---|---|---|---|---|---|
| and larger | $1 75 | $2 78 | $2 00 | $2 78 | $3 02 | $3 50 | $2 35 |
| and larger | 1 80 | 2 83 | 2 55 | 2 83 | 3 07 | 3 55 | 2 40 |
| and larger | 1 85 | 2 88 | 2 35 | 2 88 | 3 12 | 3 60 | 2 45 |
| and larger | 2 00 | 2 93 | 2 35 | 3 03 | 3 27 | 3 75 | 2 60 |
| and larger | 2 25 | 2 98 | 2 35 | 3 48 | 3 52 | 4 00 | 2 85 |

* Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| and larger | $1 90 | $2 00 | $3 25 | ½ | $2 30 | $2 25 | $3 50 |
| in | 1 95 | 2 05 | 3 30 | ¼ | 2 30 | 2 50 | 3 75 |
| | 2 05 | 2 10 | 3 35 | | | | |

**BRICK**—Contractors price per 1,000 in cargo or carload lots as follows:

| | Common (Current) | Common (One Month Ago) | Common (One Year Ago) | Paving Block 3-inch* | Paving Block 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $18 40 | $18 40 | $30 75 | $47 00 | $42 50 |
| New York (at dock) | 15@15 50 | 15@15 50 | 25 00 | | |
| Chicago | 11 00 | 12 00 | 16 00 | 34 00 | 42 50 |
| St. Louis, salmon | 17 00 | 17 00 | 16 00 | | |
| Denver, salmon | 14 00 | 14 00 | 17 00 | | |
| Dallas | 12 72 | 12 50 | 22 07 | 44 00 | |
| San Francisco | 18 00 | 18 00 | 18 00 | | 44 38 |
| Los Angeles | 15 50 | 15 50 | 13 50 | (not quoted) | |
| Boston (del.) | 17 00 | 18 00 | 30 00 | 46 00 | 56 25 |
| Minneapolis (del.) | 17 00 | 17 00 | 24@26 | 37 00 | 43 00 |
| Kansas City | 15 50 | 15 50 | 22 00 | | |
| Seattle | 14 00 | 14 00 | 15 00 | 48 00 | 53 50 |
| Cincinnati | 19 00 | 19 00 | 24 00 | 42 00 | |
| Montreal (del.) | 18 00 | 18 00 | 16 00 | 100 00 | 120 00 |
| Detroit (del.) | 17 00 | 16 25@18 | 23 00 | 41 30 | 44 00 |
| Baltimore (del.) | 20 00 | 25 00 | 20@25 | 40 00‡ | |
| Atlanta | 10 00 | 10 00 | | 40 00 | |
| New Orleans | 14 00 | 14 50 | 25 00 | | |
| Birmingham | 11 50 | 12 00 | | | |

* For paving blocks 3¼x8x3 and 3¼x8x4 respectively. † Vitrified fire. ‡ Fire, Baltimore.

**HOLLOW TILE**—Price per block in carload lots for hollow building tile:

| | New York—Current on Trucks* | New York—One Year Ago | Chicago | St. Louis | San Francisco | Perth Amboy, N. J., Factory |
|---|---|---|---|---|---|---|
| 8x12x12 | $0 1150 | $0 2444 | $0 0996 | $0 090 | $0 145 | |
| 10x12x12 | 1440 | 3259 | 1245 | 121 | 12 | |
| 12x12x12 | 2040 | 4345 | 1755 | 165 | 29 | $0 17810 |
| 10x12x12 | | | 1854 | 218 | | |
| 8x12x12 | | | 2408 | 250 | | |

* 5 per cent off for cash.

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Atlanta | $0 102 | $0 190 | $0 285 |
| Minneapolis (f.o.b. cars) | 084 | 161 | 230 |
| Minneapolis (delivered) | 092 | 175 | 246 |
| Montreal | 0682 | 128 | 192 |
| Kansas City | 100 | 17 | 225 |
| Denver | 09 | 16 | 23 |
| Seattle | 10 | 17 | 30 |
| Los Angeles factory | 105 | 18 | |
| New Orleans | 14 | 25 | 42 |
| Detroit (delivered) | 070 | 13 | |
| Cincinnati | 20 | 36 | 53 |
| Baltimore | 16 | | 42 |
| Omaha | 0765 | 136 | |
| Boise | 124 | | |
| Portland, Ore. | 095 | | |

**STRUCTURAL MATERIAL**—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named.

| | Pittsburgh, Mill | New York (del.) | Birmingham | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | 1 85 | $2 88 | $2 10 | $4 00 | $3 12½ | $2 88 | $3 85 |
| Channel 3 to 15 in. | 1 85 | 2 88 | 2 10 | 4 00 | 3 12½ | 2 88 | 3 85 |
| Angles, 3 to 6 in., ¼ in thick | 1 85 | 2 88 | 2 10 | 4 00 | 3 12½ | 2 88 | 3 85 |
| Tees, 3 in. and larger | 1 85 | 2 88 | 2 10 | 4 00 | 3 12½ | 2 88 | 3 85 |
| Plates | 1 85 | 2 88 | 2 10 | 4 00 | 3 12½ | 2 88 | 3 85 |

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Pittsburgh, Mill | New York—Current (Warehouse) | New York—One Yr. Ago (Warehouse) | Chicago (Warehouse) | St. Louis (Warehouse) | San Francisco (Warehouse) | Dallas |
|---|---|---|---|---|---|---|---|
| ¾ in. and larger | $2 65 | $4 40 | $6 00 | $3 68 | $4 12½ | $5 50 | $7 50 |

CONE HEAD BOILER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | 2 75 | 4 50 | 7 10 | 3 78 | 4 22½ | 5 60 | 7 65 |
| ⅝ and ¾ | 2 90 | 4 65 | 7 25 | 3 93 | 4 22½ | 5 75 | 7 80 |
| ⅞ and 1 | 3 15 | 4 90 | 7 50 | 4 18 | 4 22½ | 6 00 | 8 05 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2 75@$3 00 | $3 50 | $4 75 | $5 00 | $3 50 | $4 95 |
| Cut | 3 00@ 3 25 | 3 45 | 6 25 | 7 75 | 4 08 | 5 00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows at manufacturing points:

| | New York 1-Ply l.c.l. | New York 2-Ply l.c.l. | New York 3-Ply l.c.l. | Philadelphia 1-Ply l.c.l. | Philadelphia 2-Ply l.c.l. | Philadelphia 3-Ply l.c.l. |
|---|---|---|---|---|---|---|
| No. 1 grade | $1 72 | $2 08 | $2 50 | $1 55 | $1 90 | $2 25 |
| No. 2 grade | 1 12 | 1 58 | 2 10 | 1 25 | 1 55 | 1 85 |

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.85 per roll in carload lots and $2.10 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.40 per square in carloads; $5.65 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices per ton f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft. | $3 25 |
| Tar pitch (in 400-lb. bbl.), per 100 lb. | 1 52 |
| Asphalt pitch (in barrels), per ton | 47 50 |
| Asphalt felt (light), per ton | 80 50 |
| Asphalt felt (heavy), per ton | 84 50 |

**SHEETS**—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

| | Pittsburgh, Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| Blue, Annealed | | | | | |
| No. 10 | $3 25 | 3 25 | 3 25 | $3 25 | $3 53 |
| No. 12 | 3 30 | 3 30 | 3 30 | 3 30 | 3 58 |
| No. 14 | 3 35 | 3 35 | 3 35 | 3 35 | 3 63 |
| No. 16 | 3 40 | 3 40 | 3 40 | 3 40 | 3 73 |
| Black | | | | | |
| *Nos. 18 and 20 | 3 80 | 4 80 | 3 80 | 3 80 | 4 05 |
| *Nos. 22 and 24 | 3 85 | 4 85 | 3 85 | 3 85 | 4 10 |
| *Nos. 26 | 3 90 | 4 90 | 3 90 | 3 90 | 4 15 |
| *Nos. 28 | 3 90 | 5 00 | 3 90 | 3 90 | 4 25 |
| Galvanized | | | | | |
| No. 10 | 4 50 | 5 00 | 4 50 | 4 50 | 4 25 |
| No. 12 | 4 50 | 5 10 | 4 50 | 4 50 | 4 35 |
| No. 14 | 4 50 | 5 10 | 4 50 | 4 50 | 4 35 |
| Nos. 17 to 21 | 4 60 | 5 40 | 4 60 | 4 60 | 4 65 |
| Nos. 22 and 24 | 4 75 | 5 55 | 4 75 | 4 75 | 4 80 |
| *Nos. 25 and 26 | 4 80 | 5 70 | 4 80 | 4 80 | 4 95 |
| *No. 28 | 4 90 | 6 00 | 4 90 | 4 90 | 4 25 |

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage, 25c. for 19 to 24 gages for galvanized corrugated sheets add 15c., all gages.

**LINSEED OIL**—These prices are per gallon:

| | New York Current | New York One Year Ago | Chicago Current | Chicago One Year Ago |
|---|---|---|---|---|
| Raw in barrel (5 bbl.) | $1 [illegible] | $1 48 | $0 75 | $1 67 |

**WHITE AND RED LEAD**—Base price per pound.

| | Red — Current | | Red — 1 Year Ago | | White — Current | White — 1 Yr Ago |
|---|---|---|---|---|---|---|
| | Dry | In Oil | Dry | In Oil | Dry and In Oil | Dry and In Oil |
| 100-lb. keg | 14 50 | 14 50 | 15 50 | 17 00 | 15 50 | 15 50 |
| 25 and 50-lb. kegs | 14 50 | 14 50 | 15 75 | 17 25 | 15 75 | 15 75 |
| 12½-lb. keg | 12 75 | 14 50 | 16 00 | 17 50 | 16 00 | 16 00 |
| 5-lb. cans | 15 00 | 16 50 | 18 00 | 20 00 | 18 00 | 18 50 |
| 1-lb. cans | 17 00 | 18 50 | 20 50 | 22 00 | 20 00 | 20 50 |

# LUMBER

**San Francisco**—Prices of rough Douglas fir No. 1 common in more than carload lots.

| | Lumber Prices in Yards at San Francisco — 6, 8 and 12 Ft. | 10 to 16 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft. |
|---|---|---|---|---|
| 3x3 and 4 | $24 50 | $25 00 | $26 00 | $28 00 |
| 3x6 and 8 | 25 50 | 26 00 | 27 00 | 29 00 |
| 4x4-6 and 8 | 26 00 | 27 00 | 28 00 | 29 50 |
| 3x10 and 12 | 26 00 | 27 00 | 28 00 | 30 00 |
| 3x14 | 26 50 | 27 50 | 28 50 | 30 50 |
| 4x10 and 12 | 26 00 | 27 00 | 28 00 | 30 00 |
| 4x14 | 27 00 | 28 00 | 29 00 | 31 00 |

| | 24 Ft. and Under | 25 to 32 Ft. | 33 to 40 Ft |
|---|---|---|---|
| 6x10 | $25 50 | $27 50 | $28 50 |
| 6x14 | 27 00 | 29 00 | 29 50 |
| 8x10 | 25 50 | 27 50 | 28 50 |
| 8x14 | 27 00 | 29 00 | 29 50 |

**New York, Chicago and St. Louis**

| | Southern Pine — New York* — 20 Ft. and Under | 20–24 Ft. | Chicago — 20 Ft. and Under | 22–24 Ft. |
|---|---|---|---|---|
| 3x 4 to 8x8 | $39 00 | $41 00 | $41 00 | $42 00 |
| 3x10 to 10x10 | 42 00 | 44 00 | 44 00 | 45 00 |
| 3x12 to 12x12 | 40 00 | 41 00 | 46 00 | 47 00 |
| 3x14 to 14x14 | 45 00 | 46 00 | 50 00 | 51 00 |
| 3x16 to 16x16 | 50 00 | 51 00 | 54 00 | 55 00 |
| 3x18 to 18x18 | 55 00 | 56 00 | 63 00 | 65 00 |
| 4x20 to 20x20 | 64 00 | 66 00 | 66 00 | 67 00 |

* Wholesale price (to dealers) of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

Price to contractors, on lighters or cars, New York, about $5 additional.

**St. Louis**: Yellow pine, 22@24 ft. long, 3 x 4 to 4 x 4, *$34.50*; 3 x 6 to 8 x 8, *$36*; 3 x 12 to 5 x 12 *$39*; 3 x 14 to 4 x 14, *$39*; 3 x 16 to 4 x 16, *$41*; 3 x 18 to 5 x 18, *$45*.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

**Other Cities**

| | 8 x 8-In. x 20 Ft. and Under — P | Fir | Hemlock | Spruce | 12 x 12-In. 20 Ft. and Under — P | Fir |
|---|---|---|---|---|---|---|
| Boston | $45 00 | $52 00 | $55 00 | $45 00 | $55 00 | $52 00 |
| Seattle | | *19.00* | | | | *19.00* |
| New Orleans | 26 00 | *23.50* | | | 31 09 | 27 00 |
| Baltimore | | *26.00* | | | *28.00* | |
| Cincinnati | **38 00** | 50 00 | | | **45 00** | 64 00 |
| Montreal | 70 00 | 85 00 | 68 00 | 78 00 | 78 00 | 100 00 |
| Los Angeles | | *45.00* | | | | *45.00* |
| Detroit | | Quotations f. o. b. mills only | | | | |
| Denver | | 31 75 | | | | 35 75 |
| Minneapolis | 42 00 | 36 00 | **33 00** | | 49 00 | *36.00* |
| Atlanta | 27 50 | | | | 39 00 | |
| Dallas | *31.00* | | | | *35.00* | |
| Kansas City | **40 00** | **47 00** | 47 00 | | **45 00** | **45 00** |
| Birmingham | 30 00 | | | | *35.00* | |

| | 1-In. Rough, 10 In. x 16 Ft. and Under — P | Fir | Hemlock | 2-In. T and Gr. 10 In. x 16 Ft. — P | Fir |
|---|---|---|---|---|---|
| Boston | $45 00 | $48 00 | $37 00 | $43 00 | $48 00 |
| Seattle | | *14.00* | | | *16.00* |
| New Orleans, at mill | 50 00 | 25 00 | | 30 00 | |
| Baltimore | | | | *35.00* | |
| Cincinnati | **62 50** | | | **33 50** | |
| Montreal | 120 00 | 60 00 | 60 00 | 80 00 | 80 00 |
| Los Angeles | | | | | *45.00* |
| Denver | | 27 75 | | | 27 75 |
| Minneapolis | 38 00 | 34 | | **37 00** | 36 |
| Atlanta | 15 00 | | | 18 00 | |
| Dallas | 32 00 | 30 00 | | 34 00 | |
| Kansas City | **37 00** | **31 00** | | 36 50 | **36 50** |
| Birmingham | **25 00**† | | | 23 00 | |

* Montreal: Up to 32 ft.; over which $3.00 per M. increase up to 30 ft.

Birmingham: †1x12x16, $2 extra per M. for dressing.

Extra for 2 x 4 to 2 x 6 in. S4S, $1 per M. 2 x 12 and 2 x 4 by 16 ft., $44. 3 x 12 x 16 ft., $48. 2 x 4 x 16, $42.

# FREIGHT RATES

On finished iron products in the Pittsburgh district mentioning plates, iron and steel bars, bar iron, bands, hoops, skelp, plates and sheets, wire nails, wire fencing, steel pipe, boiler tubes, riveted pipe, black and galvanized sheets, etc., the following freight rates are quoted per 100 lb. in carload lots of 100 lb.:

| | | | |
|---|---|---|---|
| Boston | $0 33 | Detroit | $0 33 |
| Buffalo | 20 | Kansas City | 81 |
| Chicago | 38 | New Orleans | 51 |
| Cincinnati | 29 | New York | 38 |
| Chicago | 38 | Pittsburgh (base) | 11 66½ |
| Cleveland | 24 | St. Louis | 47½ |
| Denver | 1 53 | | |

Sales: Add 1% tax. Minimum charge $1. Minimum carload 40,000 lb. Minimum carload on 60,000 lb. Prices are for steel products.

# CONTRACTORS' SUPPLIES

**STEEL SHEETPILING**—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago.

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $2 00 | $2 00 | $4 00@$5 00 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | New York and East of Missouri River |
|---|---|
| Hercules red strand, all constructions | 25% |
| Patent flattened strand, special and cast steel | 25% |
| Patent flattened strand, iron rope | 40% |
| Plow steel round strand rope | 40% |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| Iron strand and iron tiller | 10% |
| Galvanized iron rigging and guy rope | −7½% |

California, Oregon, Nevada and Washington: Galvanized iron rigging and guy ropes +12½%; bright plow 35% off.

Wyoming, New Mexico and Colorado: Plow steel, round strand, 35% off. galvanized iron rigging and guy rope +12½%.

Arizona, 30% plow steel, +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Utah: 30% plow steel, +17½% galvanized iron rigging and guy rope.

Western territory not included in above: Plow steel, 35%; galvanized iron rigging and guy rope +12½%.

**MANILA ROPE**—For rope smaller than ¼-in. the price is ½ to 2c. extra, while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0 18 | New Orleans | $0 16 |
| New York | 16 | Los Angeles | 14½ |
| Chicago | 18 | Seattle | 16 |
| Minneapolis | 17½ | St. Louis | 16½ |
| San Francisco | 15 | Montreal | 30 |
| Atlanta | 19 | Detroit | 17½ |
| Denver | 18 | Baltimore | 22 |
| Cincinnati | 17 | Kansas City | 16½ |
| Dallas | 29 | Birmingham | 20½ |

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | *0.3075* | $0 3325 |
| Boston | | 275 |
| Kansas City | | 225 |
| Seattle | *1875* | 2125 |
| Chicago | 2225 | 2525 |
| Minneapolis | 2299 | 2555 |
| St. Louis | 28 | 315 |
| Denver | 2375 | 2725 |
| Dallas | 29 | 375 |
| Los Angeles | 25 | 27 |
| Atlanta | 26 | 30 |
| Baltimore | 2550 | 29 |
| Cincinnati | 25 | 2750 |
| Montreal | 2150 | 2550 |
| Birmingham | 1925 | 2275 |
| New Orleans | 2725 | 3075 |

**PILES**—For plain pine piles, delivered New York, the price is as follows:

| | |
|---|---|
| Pine 12-in. butts, 6-in. tops, length 41-50 ft. | $9.00@11.00 |
| Pine 14-in. butts, 6-in. tops, length 51-60 ft. | *13.50@15.50* |
| Pine 14-in. butts, 6-in. tops, length 61-71 ft. | *19.00@21.00* |

| | Dallas | | St. Louis |
|---|---|---|---|
| 6-in. x 20-ft | $4 60 | 6-in. x 30-ft | $7 00 |
| | | 7-in. x 30-ft | 7 00 |
| 6-in. x 30-ft | 7 10 | 7-in. x 35-ft | 11 00 |
| | | 8-in. x 35-ft | 11 00 |
| 8-in. x 30-ft | 8 45 | 7-in. x 40-ft | 11 00 |
| | | 8-in. x 45-ft | 11 00 |
| 8-in. x 35-ft. | 10 38 | 8-in. x 50-ft | 16 00 |

**SCRAP**—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 railroad wrought | $10 50 | $11 50 | $9 00 |
| Steel plate | 9 50 | 10 00 | 10 00 |
| No. 1 machinery cast | 11 50 | 11 50 | 11 00 |
| Machine shop turnings | 3 00 | 4 00 | 3 00 |
| Cast borings | 3 75 | 5 50 | 3 00 |
| Railroad malleable cast | 8 50 | 10 00 | 8 00 |
| Rerolling rails | 11 00 | 13 00 | 12 00 |
| Relaying rail | | 30 00 | 27 00 |

**SHIP SPIKES**—Current prices per 100 lb.:

| In | San Francisco — Coast | San Francisco — Black | Seattle Black |
|---|---|---|---|
| | $9 10 | $8 40 | $8 50 |
| ½ | 8 65 | 6 65 | 8 25 |
| ⅝ | 8 50 | 6 50 | 8 40 |

Pittsburgh base, 8 to 10 in., $3.40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 87 — NEW YORK, SEPTEMBER 8, 1921 — Number 10

## This Week and Next

CONSIDERABLE space is given to water-works articles in this issue because of the convention of the New England Water Works Association at Bridgeport next week. The summary of chlorination experience and views drawn from 17 chemists and filter plant operators will be concluded next week. Not distantly related to the water-works articles, either geographically or by subject, is the abstract of the St. Lawrence Waterways report to which several pages of text and a large folding insert are devoted, while an article on hydraulic measurements by photography will appeal directly to many water-works men.

## Wood Water Pipe at Norfolk

THOUGHTLESS people might consider the Norfolk experience with a 24-in. machine-banded wood-stave pressure pipe line, described elsewhere in this issue, as a condemnation of that sort of conduit. Quite the contrary is the case. The lesson is that here is a material and type of construction, low in unit cost of carrying capacity, flexible in design and construction, capable of mishandling then and in operation, but adapted to repair when through mishandling things go wrong. Mr. Ledoux's article is notable because of this lesson and as a description of a unique job of restoring to use an engineering structure that might have been looked upon in utter despair. Testimony to Norfolk's faith in wood pipe is the fact that it has but recently let a contract for some ten miles additional of yet larger pipe, 30- and 36-in., also under pressure.

## How the Product Is Made

IN A RECENT bulletin the National Paving Brick Manufacturers' Association expresses the wish that every engineer and public official might find time to visit a paving-brick plant in its operating hours. It contends that the time would be well spent by the visitor and it is frank to say that the paving-brick manufacturer would profit from the time that he would contribute as guide and host. It would be a reflection upon the intelligence of engineers and contractors to argue the case in favor of careful inspection, and even study, of the manufacturing processes by which construction materials are produced. Nevertheless, the experience of manufacturers is that relatively few of their customers interest themselves in the operations by which the materials are made available. Buyers know what these processes are in a general way, but, lacking acquaintance with details, are unacquainted with the factors that go to make a good or a bad product. We do not mean that one must be thoroughly familiar with manufacturing processes to be able to specify a proper material, but we do believe the joint interest of user and producer would be served by more familiarity on the part of the user with the manufacturing processes. The corollary, of course, also holds—that the producer should know the conditions of use. Many efforts toward securing this mutual understanding have been made, the greatest being the continual efforts of the American Society for Testing Materials. These efforts would be much furthered if the thought expressed by the National Paving Brick Manufacturers' Association were more often acted upon—that engineers and contractors and public officials would visit brick plants and the establishments of other producers of materials as well.

## A Suggested St. Lawrence Plan

THERE are many variations possible in the physical details of canalizing the St. Lawrence for ocean-steamer traffic, at the same time utilizing for power the fall developed. One of these—with minor alternatives—is presented in the Wooten-Bowden report abstracted in this issue. It is not necessarily the scheme that will have to be followed if the project goes through, but it does give some line on the costs involved and the magnitude of the proposed engineering operations. As such it provides a datum from which consideration of the merits of the St. Lawrence plant can start with more accuracy that in the past, when there was not available an unbiased estimated of cost or a tentative physical plan. The International Joint Commission will in a short time submit the data in the other elements of the proposition, that is the commercial possibilities, the financial complications and the international obligations. With all the facts before the country the St. Lawrence development can then be argued out.

## Dr. Houston and B. Welchii

SIR ALEXANDER HOUSTON, director of water examinations, Metropolitan Water Board, London, England, has written an article for *Engineering News-Record*—to appear Sept. 22—which is a most valuable supplement to the discussion in our issues of June 2 and 9 of B. Welchii as a test of the sanitary quality of water and as a possible cause of gastro-enteric and diarrheal outbreaks. The article contains trenchant remarks on chlorination and on slow sand and mechanical filtration. The 66 contributors to the discussion of B. Welchii in our issues of June 2 and 9 made such frequent reference to the work and opinions of Dr. Houston that they and all others interested in water supply will welcome his review of this important question.

## When Are Construction Conditions Good?

FOR the first time this year the value of contracts let during any one month, as reported in *Engineering News-Record*, has exceeded the amount recorded during the corresponding month of 1920. During August the value was in excess of $106,000,000 as against $92,000,-

000 for August 1920. The year 1920 was considered a good construction year, so a comparison of the two years should be fair as indicating present construction conditions. It is apparent, however, that during 1920 a large amount of holdover highway work kept many busy. Such activity was not reflected in the contracts recorded as let last year. Again, industrial work last year was very active. This year it is not. On the other hand much private work is now being done under the general classification of miscellaneous building. About half the total contract value for the past month was in that class of work. And highway work in August was fifty per cent greater than August of last year. Why then, with these figures at hand, is the construction industry so depressed? Is it because the contracts are absorbed by the smaller contractors, from whom it is more difficult to secure business information? It is the common word among the large contracting organizations that conditions are bad. Why, with so much work being put under contract are they bad? Are contractors basing their judgment of "a good year" upon the remembrance of war contracts that ran into many millions? Someone is getting the contracts, doing the work, and profiting thereby. In view of the figures on contracts let contained herein, it is difficult to see why conditions are as bad as reported.

### Dangerous Cross-Connections

THE case for cross-connection between safe public water supplies and dangerously polluted private supplies is presented elsewhere in this issue in the Goethals corporation's report to a committee of Hartford manufacturers. The report, which for the most part discusses the problem in general terms, should be read in connection with the one of the same subject by C. M. Saville, manager and chief engineer of the Hartford water-works, printed in our issue of July 7, p. 12, wherein specific evidence against cross-connections based on Hartford conditions and experiences is given. The Hartford Water Commissioners have not only stood by their guns in refusing to rescind or modify their order—except in postponing the date it becomes effective—but they and their engineer appear also to have won over the manufacturers to an appreciation of the reasonableness of the order and a willingness to obey it. This is creditable to all concerned. Hartford's achievement promises to aid in the widespread campaign for the severance of all physical connections between public supplies made safe at great expense and dangerous private water supplies selected with no regard except cheapness. It will also give support to those water and health authorities who for the present feel all they can hope to attain is the material but imperfect protection afforded by substituting readily accessible, frequently inspected double check valves for old-fashioned, buried-no-one-knows-where single check valves.

### Letting Contracts Now

FALL LETTING of highway contracts has been urged upon state road-building organizations by the Secretary of Commerce. Avoidance of a further increase in unemployment, amelioration of present conditions, and a better spreading of the construction load are chief among Mr. Hoover's reasons for addressing his recent letter to the state governors. His arguments apply equally well to all classes of construction. In fact, they are more pertinent as applied to building work than to other types, for that can go on in cold weather. Fall letting for buildings means work this winter, when we will most need it, while fall letting for road, sewer, water and similar works is principally preparation for an earlier start in the spring. Objection to letting contracts now may be raised on the ground that the falling market indicates further decreases, and that those who invest now will lose. A job thoroughly planned and carefully executed without interruptions will be inexpensive in comparison with the job that is held up because of transportation congestion, scarcity or lack of materials, difficulty of getting labor, or failure of equipment to arrive in time. Winter construction is relatively certain of being free from these difficulties, while work let now for spring execution can get well ahead by carrying on demolition in winter, stockpiling materials and getting equipment on the job. The advantages give promise of counterbalancing what price reductions are likely to occur. Prices now, in fact, seem to be tending toward stabilization.

## Problems in Water Chlorination

WHILE questionnaires and symposiums cannot take the place of accurate scientific laboratory tests and field observations, the collection of such data as is available from different parts of the country will always serve as a starting point for further investigation. Moreover, it will prevent useless duplication.

Many apparently conflicting statements have been made with reference to experiences with liquid chlorine when used to eliminate bacteria from drinking water. Bringing data and opinion together, as is done elsewhere in this issue, enables one to explain the reasons why conflicts are found. Briefly, it is because of the different characteristics of dissolved and suspended foreign matter in drinking water. Most of the substances other than $H_2O$ react with chlorine, some of them forming disagreeable compounds. Few people ever get from drinking water the acid taste of real laboratory chlorine. Furthermore, the creosote-chlorine taste formerly experienced in Milwaukee is not to be compared with an algae-chlorine or colored-water-chlorine taste. Some waters are nearly neutral and a slight addition of the acid-producing chlorine gives the water acid characteristics. The great bulk of our waters, however, are far too alkaline to make the slight addition of chlorine a disturbing factor.

In preparing the questionnaire, we first had in mind asking about the effect of water with residual chlorine on the lining of the kidneys. We could not learn however, that even the doctors had made any studies and therefore abandoned the idea of burdening the questionnaire with a query to which practically every one would have had to confess at least comparative ignorance.

Some of the conclusions one reaches on reading the answers to the questionnaire are as follows: (1) Colic water troubles are due far more, probably, to other factors than chlorine, although cold slows up the chemical reaction and theoretically should make a smaller dose permissible if the taste limit had been nearly reached. (2) People do become accustomed to slight tastes and odors or else get tired of complaining. (3) No limit can be set on the amount of residual chlorine which will produce tastes. (4) A well water with 0.01 p.p.m.

may taste and a surface water with 0.8 p.p.m. may not. (5) With one or two exceptions corrosion has not been experienced. (6) The operators are about equally divided on the expediency of holding to the highest standard of filter efficiency rather than getting clarification only and bacterial control with chlorine. (7) Aiming at the Public Health Service standard is desirable but not necessary. (8) After certain limits—up to 600 to 1,000 units per c.c.—an algae-infested water requires more chlorine.

Finally one concludes that chlorination has come to stay as a most valuable health guard, and that the slight inconveniences and complications are far outweighted by the added safety factor placed in the hands of the operator.

## Water-Works Progress and Opportunity at Cambridge, Mass.

MASSACHUSETTS cities have been slow to adopt any method of water treatment except that incidental to storage or required for the removal of iron from ground water. This has been due in no small part to topographical and geological conditions favoring the introduction and maintenance of supplies of high natural quality. To this has been added early and persistent efforts by the State Board of Health and by municipalities to prevent dangerous water pollution and, where it could no longer be avoided in the case of existing supply, to go far afield, if need be, for new and relatively safe source. Where filtration has been adopted, it has heretofore been of the slow sand type, except in the case of iron removal, for which mechanical filters have been used. Chlorination has been little used in the state.

All these things make noteworthy the mechanical filtration and chlorination plant now being built for Cambridge, Mass., as described elsewhere in this issue. This plant is all the more notable because for years past Cambridge has had one of the lowest typhoid death rates in the country; but it should be added that freedom from typhoid did not protect Cambridge, early in 1920, from one of those mysterious outbreaks of intestinal troubles that have occurred of late in several cities having water supplies of good reputation. If this outbreak did not hasten the determination of the city to build a complete water-treatment plant, it must certainly have made the city fathers feel more sure than ever that the money for the plant will be well spent. And yet it will not be surprising if the vital statistics of Cambridge reflect little effect from the purification works after they are put in use. The typhoid rate there has long been so low as to give little hope from any further reduction on account of filtration.

In view of this, the water and health authorities of Cambridge might well give immediate and searching attention to studies of the water supply and of the vital statistics designed to show the beneficial effect of water treatment on causes of death and sickness other than typhoid. To urge this is not to question the wisdom of water treatment for Cambridge but rather to encourage the amassing of data that will show the exact nature and extent of the benefits flowing from a water supply as nearly ideal as engineers can make it, while at the same time throwing much needed light on some of the unsolved problems connected with intestinal outbreaks attributed, rightly or wrongly, to public water supplies. Cambridge's local progress gives it opportunity for world-wide service.

## Unemployment

THAT part of Gompers' address at Atlantic City last month in which he enlarges on unemployment is worthy of serious consideration. It points to the need for every agency that can influence costs and help to stabilize business to do all in its power. Not the least, however, of those who can influence the situation is Mr. Gompers and his influential assistants in the American Federation of Labor.

Mr. Gompers gives the total of unemployment as 5,700,000. It should be remembered, though, that the Department of Labor in giving out the statistics which Gompers quotes, pointed out that the comparison was with the peak of last year's employment, and that the demand for workers at the peak last year brought into employed ranks many women, girls, and boys who are not normally in the employed ranks. By what amount these factors would reduce the alleged "unemployed figures" the department does not say. Probably it would be a considerable percentage. Moreover, "normal" unemployment, statistics show, runs from 2,000,000 to 3,000,000, being lowest in the late summer.

Even so, however, there is good reason to be thinking about our unemployment. It is large, no matter what the off-sets. The immediate situation, too, is not so serious as that which we will find in the winter if unemployment on the present scale continues. It is to this that Gompers is looking forward. Now there is relatively little distress, but winter brings the need for watertight shoes, warm clothing, and coal.

We are all in hopes of a sharp pick-up between now and Christmas. There are many signs that it is on the way. It can be hastened if every one will do business on a narrower margin and by the workers giving full efficiency. In the construction industry, for example, if the workers can carry to owners, contractors, engineers, and architects the confidence that there will be 100 cents' worth of honest work for every $1 of wage payment, it will stimulate the constantly rising curve of construction work—even in fact of the approaching cold weather. The records kept by *Engineering News-Record* show a constant increase month by month in bids invited and contracts let this year. The August totals, in fact, exceed those of last year. High costs, however, still hold work back—and of these not the least is high labor *cost*. Note that we say labor *cost*, not *wage*. High *wages* are not incompatible with low costs.

What is true in the construction industry is true also in every line.

Of course, output per man is now very much better than it was last year. Some say it is near the pre-war normal. Where the chief room still lies for improvement is in the abrogation of many of the restrictive union rules. Right there Mr. Gompers and his associates are in a position to have a tremendous influence.

There is practically no hope of changing these rules by advice or by force from the outside.

Therefore, while the outlook causes concern and while there are many factors that can influence the situation, Mr. Gompers is in a position—better than any other man—to help stimulate business and thus reduce unemployment.

# Problems in the Chlorination of Water—I.

## Seventeen Water-Works Operators Give Experience on the Effect of Temperature on Tastes and Odors Corrosion of Metals and Efficiency Factors

*Chlorination of public water supplies having come to stay, it is necessary to go to the bottom of all of the problems which the process brings to the operator. Does chlorine cause more tastes in summer or winter? In malarial countries the use of quinine, one of the bitterest and least palatable of drugs, becomes a habit for which a craving develops. Do people get so accustomed to chlorine tastes as not to notice the "medicinal" flavor? It is too much to expect that they will ever crave it as do the quinine addicts. Perhaps they get tired of complaining and we assume that they like it. Anyway, to the ordinary tongue what is the limiting dose which does not produce a noticeable taste? How about the numerous rumors, a few substantiated, too, of metal corrosion? Then there is the old question of the extent to which chlorination should take the place of filtration. Should plant operators strive less to produce a low bacterial count by filtration, relying on chlorine for that, and try to get 100 per cent clarification as economically as possible? The operator cannot brush the question aside lightly as being fostered on one side by the consulting engineers who want to design and build filters and on the other by sellers of chlorine apparatus. The consumer is the first consideration of the operator. He must continually balance the public health against the form and economy of treatment. He is on the firing line and gets a reaction quickly if this product does not keep pace with the continually increasing standards which the widespread health education of the masses demands.*

*In view of all these considerations* ENGINEERING NEWS-RECORD *decided to ask operators of typical plants to tell of their experience along these lines—tastes, metal attacks and efficiency factors. As was to be expected, agreement was not obtained on any one of the eleven questions asked. However, sufficient light was shown to settle certain points as much as they can ever be settled when taking into account (1) the varied character of water over the country and (2) the unstable and variable characteristics of the chlorine combinations made with the water-borne materials.*

*Nineteen answers were received but from two no information bearing on the subject was obtained. Springfield, Mass., says E. E. Lockridge, chief engineer of water-works, has been able to secure from its slow sand filtration plant results fully equal to those given by the chlorine experts. Charles P. Hoover, chemist of the filtration plant at Columbus, Ohio, depends on lime causticity for sterilization, using chlorine as a precautionary treatment only and cutting it out when contained organic matter is high and chlorine produces a taste.*—EDITOR.

### Temperature and Tastes and Odors

TASTES and odors cannot be measured in the laboratory. They are almost intangible, yet decidedly affect the esteem in which the consumer regards a water. It was felt therefore, that a widespread experience as to tastes in summer and winter would add to the known laboratory facts relative to the effect of low temperatures in slowing up chemical reactions. Knowing that the public verdict on any subject is large psychological and influenced by propaganda, prevailing opinion and style, a question was asked to bring out the persistency or not of complaints. Definitely then, the opinion as to maximum quantities permissible was sought. The three questions and answers which follow indicate decidedly divided opinion on the public's verdict and no agreement on the limiting amounts that may be used. Quality factors apparently are far more decisive than varying amounts of chlorine dosage.

1. *What troubles have you experienced in the chlorination of [illegible] Have you had more trouble in cold weather than in warm weather after a given amount of chlorine has been applied?*

2. *Does the public become accustomed to the tastes and odors in chlorinated water so that complaints are less frequent after a supply has been treated for a long period?*

3. *What is the maximum amount of free chlorine per-[illegible]*

*J. S. Gettrust, Superintendent of Filtration, Akron, Ohio.*—1. [illegible] that the public does not get accustomed to them if they are intermittent. 3. Varies with different waters. Akron water frequently contains 0.15 p.p.m. without taste or odor.

*J. W. Ellms, Consulting Engineer and in charge of the Cleveland rapid filters.*—1. Chlorination is more easily brought about in cold water than in warm water. This is in line with the well-known fact that all gases are more readily dissolved in cold water than in warm. Smaller doses have more bactericidal effect in cold weather than in warm. More free chlorine appears to be present in very cold water treated with this disinfecting agent than in warm water. This would seem to indicate that a longer time is necessary to complete the reactions taking place which fact is, of course, in line with the effect temperature has upon the velocity of reactions. Experiments made some years ago by the writer showed that bacterial multiplication was prevented so long as free chlorine was present. The bactericidal effect of chlorine has been explained as a poisoning of the cell by adsorbed gas. What complex reactions may follow are, of course, problematical. However the chlorine, or the hypochlorous acid which may be formed from it, eventually disappears as such. Whether these reactions, because of the energy liberated, are sufficient to account for the killing of some or all of the bacteria, or whether it is a case of poisoning, it is impossible to state with our present knowledge.

2. Consumers may become accustomed to slight tastes due to the use of chlorine, but it is doubtful if they ever do or will tolerate very marked tastes lasting for even a few days. Moreover, one must carefully distinguish between the real primary causes for obnoxious tastes and odors. If the chlorine itself, because of the quantity used is the cause, the remedy lies in part in the hands of the water-works officials. If the water is infested with micro organisms, either living or dead, or with dead organic matter, suspended or dissolved, possible remedies may also be found in filtration. Where the cause is due to trade-waste pollution, especially the kind of wastes derived from by

product coke ovens and gas plants, the remedy lies in preventing such material from entering the water supply. The writer's investigations in this latter field have convinced him that where such wastes are the source of the trouble, subsequent chlorination must inevitably produce foul tastes and odors, and that filtration is no remedy. The problem in this case is not one of water purification, but of the proper disposal of trade wastes.

3. The disappearance of free chlorine is in most cases so rapid in a distribution system that the writer doubts if "chlorine tastes" are usually directly caused by this reagent. Probably from 0.4 to 0.6 p.p.m. of chlorine, when first applied, might be detected by taste by the layman, but the actual quantity of excess of chlorine remaining from such an application will vary with the temperature and kind of water treated. Certain kinds of organic matter may combine with the chlorine and be the real cause for the taste, even though no free chlorine be present.

*A. E. Walden, Superintendent and Chief Engineer, and S. T. Powell, Chemist, Baltimore County Water and Electric Co., Md.*—1. Considerable trouble has been experienced from tastes and odors after chlorination during the colder months of the year. The tastes and odors have invariably been more pronounced when there has been a drop in the temperature of the water. We have been able to apply three or four times as much chlorine during the summer months as in the winter.

2. The public does not become accustomed to tastes and odors in chlorinated water. Complaints become less frequent unless a very unusual amount of the chemical has been used.

3. No definite amount of chlorine in a free state can be designated as a permissible limit for all water supplies, but it is our opinion that it is inadvisable to permit more than 0.25 p.p.m. of free chlorine to exist in the water for more than half an hour.

*J. W. Armstrong, Filtration Engineer, Montebello Filters, Baltimore, Md*—1. Chlorine is applied to the filtered water at rates varying from 0.22 to 0.6 p.p.m. In summer the water will absorb twice the amount that it will in winter. This is probably due partly to the effect of the cold water and partly to the fact that a larger amount of organic matter prevails in the water during the summer.

2. When we first started the plant a slight chlorine taste in the water would bring numerous complaints, but during the past winter very few complaints were received.

3. Water containing from 0.1 to 0.15 p.p.m. of residual chlorine does not necessarily taste but it is likely to, and we believe that residual chlorine in filtered water should be kept below 0.1 p.p.m. Water leaving the plant fairly high in residual chlorine will, after traversing four miles of pipe, show a considerably reduced amount, and after about eight miles of travel there is very rarely any residual chlorine left.

*S. Van Loan, Deputy Chief, Bureau of Water, Philadelphia, Pa.*—1 and 2. No trouble. 3. Impracticable to fix a standard, as amount varies with character of the water and distance to delivery point.

*Dr. Frank E. Hale, Director of Laboratories, Department of Water Supply, Gas and Electricity, New York City.*—1. Complaints from taste with regard to New York City's supplies have not been connected with temperature, but rather with fluctuations in dosage. The greater portion of our supplies passes through reservoirs of sufficient storage capacity to eliminate any large excess of chlorine, and furthermore, the dosage is so low, averaging usually from 0.1 to 0.2 p. p. m., that there is very little excess in the supply at any time. Orthotoluidine tests indicate less than 0.05 residual free chlorine. From experiments with chloramine and bleach (see *Journal* American Water Works Association, November, 1919, p. 804), temperature has no noticeable connection with the amount of chlorine dosage required for given results; i.e., under the same conditions as to turbidity, color, organic content, microscopic organisms, amount of B. Coli or contamination present, the same dosage of chlorine will produce the same efficiency, winter or summer. The dosage applied has varied from winter to summer at different plants and in different years at the same plant. At the Dunwoodie plant during 1916-17 the dosage was approximately the same winter and summer, but during 1919-20 the dosage was larger in the winter and fall months than in the summer months. On the other hand, dosage at the Phoenicia plant has been greater in the summer than in the winter, and in the Bronx pipe line about the same the year around. At the Dunwoodie plant the gas is introduced to the water through diffusers. In cold weather chlorhydrate forms and clogs the diffusers so that they have to be removed and allowed to stand in a warm place until the chlor-hydrate evaporates.

2. It is a question whether consumers have become accustomed to taste and odor, or whether they have become tired of complaining. In large measure the amount of complaint depends upon whether the supply is from surface sources or from ground sources, people who have been accustomed to well supplies noticing particularly any change. Such complaints have been occasioned not only by chlorination, but by a change from well water to surface water, and *vice-versa*. Even after becoming accustomed to the change, people complain if, by accident, an over-dose is applied, or the chlorinated water goes directly to the consumer without passing through a storage reservoir.

3. The maximum amount of free residual chlorine permissible would depend largely upon whether it was from surface or ground sources. It also depends largely upon various organic constituents in the water supply, such as essential oils of microscopic organisms and tarry matters taken up from pipe coatings. I have received complaints from well water which had been treated with only 0.1 p.p.m. chlorine and have personally been able to notice a slight odor of chlorine when the orthotoluidine test indicated a residual free chlorine of only 0.01 p.p.m. On the other hand, I have introduced bleach to a surface water to the extent of 0.8 p.p.m. available chlorine without being able to detect the odor immediately after the mixture was made.

*The J. N. Chester Engineers, Consulting Engineers, Pittsburgh, Pa., sent the list of questions to several plants which they operate. The consensus of opinion culled from the information thus obtained together with personal observations is reported by J. F. Laboon.*—1. It is more difficult to control the dose in winter than in summer and most of the taste troubles we have found have been due to overdosing during the cold months of the year. It is necessary to reduce the dose during the winter months to prevent excessive taste, although our bacterial results have been satisfactory at these times.

2. Consumers are ever ready to complain when a chlorine taste develops and we cannot say that they ever become accustomed to it, although we have observed that they do not notice so readily an overdose as in previous years.

3. We try not to apply a greater amount of chlorine than would produce a slight excess as indicated by the orthotoluidine test. This is one of the rules we set up in our plants as a guide for absolute sufficiency of dose.

*H. E. Jordan, Superintendent Filtration, Indianapolis Water Co.*—1. If there is a seasonal difference in difficulties as to the use of chlorine, the difficulties are greater in winter than in summer. Our tendency is, however, to attempt to use more chlorine in the winter than in the summer, so that we probably treat closer to the taste-producing limit at that time.

2. I do not believe that the Indianapolis water supply has a taste of chlorine; neither do I believe that any water supply, which to make satisfactory bacterial reduction must be treated with excessive amounts of chlorine, should be used without modifications of the production process to eliminate the load upon that (the chlorine) portion of the treating plant.

3. There is no reason to chlorinate a public water supply to such an extent as to have a continuous excess of free chlorine in the treated water.

*R. S. Buzzell, Chief Chemist, Filtration Plant, Flint, Mich.*—1. Cold water is a favorable factor in eliminating tastes when organic color or "hay tea" is present to an amount likely to give rise to a bad taste in water of summer temperature. If the chlorine application is constant in both cases, it does not increase the disagreeable taste in water

of high temperature. Our complaints occur at times of the natural rise of color and not from chlorine.

2. A filtered water of low color and naturally free of tastes, moderately hard, given a proper and reasonable chlorine application, should be agreeable to the taste. We have rarely had complaints arising from chlorine treatment, but I do not believe one can get used to a water having a disagreeable or "medicine" taste, usually due to an overdose of chlorine.

3. The permissible free chlorine is certainly a local problem. Some waters can carry a greater amount than others, and the taste will still be agreeable.

*H. P. Bohmann, Superintendent Water-Works and Water Purification, submitted answers prepared by R. L. Piper, Chemist, Water Department.*—1. Lower temperatures retard chemical action so that smaller amounts of chlorine combine with the organic matter and bacteria. This leads to the use of smaller doses so as to avoid a large excess of free chlorine. 2. No. The public is more sensitive after several occasions of taste. Complaints are more numerous as the people sometimes imagine tastes when there are none. 3. 0.08 p.p.m.

*August V. Graf, Chief Chemist, Filter Plant, St. Louis, Mo.*—1. Trouble from tastes occur at times of spring and fall turnovers if more than 1 lb. per m.g. is used, but chlorine is rarely applied in an amount less than 2 lb. No free chlorine is present when complaints of taste are received. No trouble is experienced during the winter with 0.03 p.p.m. of free chlorine in treated water. 2. No. 3. 0.5 p.p.m.

*Lewis I. Birdsall, Superintendent of Filtration, Minneapolis, Minn.*—1. No trouble. 2. Do not know. 3. Would suggest 0.1 p.p.m.

*Dr. Ray R. LaCroix, Chief Chemist, Board of Water Commissioners, Denver, Col.*—1. We have no trouble with different temperatures because we reduce the amount of chlorine going into the water as soon as the temperature drops coincident with which drop the bacteria decrease. 2. Yes. The public does become accustomed to the tastes and odors in chlorinated water. However, we endeavor to keep within a certain limit which does not become noticeable.

*C. G. Gillespie, Resident Engineer, Filtration Division, Sacramento, Cal.*—1. Have noticed invariably more persistent and far-reaching chlorine tastes in cold than in warm weather, except in waters subject to algae and organic pollution. These latter factors have even a more controlling influence in imparting a sustained taste.

2. There is no question but that one becomes accustomed to chlorine tastes if they are not too pronounced. I have observed the taste in the home supply most after returning from an extended absence.

3. At Sacramento during the winter 0.07 p.p.m. residual chlorine at the station is needed for disinfection, but tests for free chlorine are negative uptown and yet tastes are noticed.

*George H. Wilhelm, General Manager, East Bay Water Co., Oakland, Cal., submitted answers prepared by P. I. Daniels.*—1. We have had no difficulty in this respect, as the temperature in this district probably does not vary sufficiently to cause any trouble. We introduce a slightly larger dose of chlorine in the winter on account of the increased turbidity of the water. 2. We do not dose the water in excessive amounts, so cannot say. 3. It does not seem reasonable that there should be any amount of chlorine in the free state left in the water. If the water has been thoroughly filtered I can see no reason for free chlorine.

*George C. Bunker, Physiologist to the Panama Canal in Charge of Water Purification on Canal Zone.*—2. No. The most which may be expected is passive submission during emergencies such as an epidemic or pending the installation of filters. 3. Varies. On the Canal Zone 0.02 p.p.m. of residual chlorine will not cause complaint.

*Elmer D. Merrill, Director, Bureau of Science, reporting to A. Gideon, Manager, Metropolitan Water District, Manila, P. I.*—1. The temperature variation in the local water supply is very slight and once the correct amount of chlorine to be added is definitely fixed, no trouble has been experienced in the process of chlorination.

2. Chlorine treatment, if properly administered and strictly controlled, would leave only small traces of chlorine in the treated water. Our experience in the Philippines has shown that the taste and odor imparted by chlorine is so slight when it reaches the consumer as to give no cause for complaint. Mr. Gideon says: "We had a few complaints when I started the calcium hypochlorite treatment in 1910 but none since that time. I suppose the people got accustomed to the very slight chlorine odor. We use a solution of 1 to 1,600,000 of free chlorine to water by weight, and on several occasions when we tried to increase the ratio, complaints of tastes and odors were received.

3. In the case of the water supply of the city of Manila, no measurements have been made of the exact quantity of free chlorine present in treated water. However, the amount of 0.625 p.p.m. of chlorine is about the maximum that could safely be used without imparting a disagreeable taste and odor to the water.

## Attacks of Chlorinated Water on Metals

With a few exceptions chlorine in bactericidal quantities has not been found to attack metals. Apparently Mr. Walden has a water so nearly neutral that the small amount of chlorine makes it acid and in consequence he has corrosion troubles. Mr. Laboon reported difficulty at Jefferson, Mo., with meters, when hypochlorite was used, and Mr. Gillespie indicates difficulty with valve bonnets where chlorine is applied under suction. (See *Engineering News-Record*, July 15, 1920, p. 127). Most of the answers were brief and are included in the following table. All of those answering "yes" to Question 6, excepting Walden and Powell, apparently referred to more concentrated solutions than are commonly employed in water disinfec

OPINIONS AS TO ATTACKS OF CHLORINATED WATER ON METALS

| Operator | Q 4. Is Chlorinated Water Acid to Test Indicator | Q 5. Increased Corrosion Seen in Pipes | Q 6. Other Metals Attacked | Q 7. Bronze Attacked | Q 8. Boilers Pitted |
|---|---|---|---|---|---|
| [illegible] | [illegible] | No | [illegible] | No | No |
| [illegible] | Unnoticed | No | [illegible] | None reported | [illegible] |
| [illegible] | [illegible] Blue | Yes | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | Thymol Blue | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | Phthalein [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | No | No |
| Holt | [illegible] | [illegible] | [illegible] | No complaints | No complaints |
| [illegible] | [illegible] | [illegible] | [illegible] | Slt. | No complaints |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | No |
| Buzzell | [illegible] | No | No | [illegible] | No |
| [illegible] | [illegible] | [illegible] | [illegible] | No | No |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | No | No |
| Pirtle | [illegible] | [illegible] | [illegible] | No | No complaints |
| [illegible] | [illegible] | [illegible] | [illegible] | Yes | No complaints |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] and bonnets | [illegible] |
| Willcox | [illegible] | No | [illegible] | No | No |
| Bunker | No. Phenol red | No | No | No | No |
| Merrill | [illegible] | [illegible] | [illegible] | [illegible] | No complaints |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

tion. The question was intended to refer to the extremely weak solution of waters with residual chlorine remaining after treatment. The five questions and the few extended comments follow:

4. *a. Does the hydrogen-ion concentration fall on the acid side of the scale in chlorinated water? b. Specify indicator. c. Does this happen if no free chlorine is present in the supply?*

5. *Has the increased corrosion in water pipes, both hot and cold services, been noted after chlorination of the water supply?*

6. *Does the chlorine attack metals other than iron and steel and if so, what?*

7. *What effect has been reported on bronze parts such as valve springs, seats, impellers, boiler attachments, etc.?*

8. *Has there been any report on damage to turbine blades and nozzles in power plants? Or pitting of boilers in steam plants? Or damage to range boilers in residences?*

*Mr. Gettrust*—5. Corrosion from $CO_2$ present in waters coagulated with alum might erroneously cause chlorine to be suspected.

*Mr. Ellms*—4. Because of the small amount of chlorine usually applied an increase in hydrogen-ion concentration seems doubtful. When chlorine is applied to water, two reactions probably occur:

$$a.\quad Cl_2 + H_2O \leftrightarrows HCl + HOCl$$

$$b.\quad 2\,HOCl \leftrightarrows 2\,HCl + O_2$$

The first equation by no means completes itself immediately, and may account for the residual "free chlorine" usually found, although the hypochlorous acid ($HOCl$) would react similarly.

It is certain that the dissociation of the $HCl$ would furnish an increase in the $H$ ions present. If this reacts, as it probably does, almost immediately with the alkaline carbonates usually present, there would be formed calcium and magnesium chlorides and carbonic acid.

$$CaCO_3 + 2\,HCl \qquad CaCl_2 + H_2CO_3$$

The carbonic acid dissociation probably takes principally the form of $H+$ and $HCO_3$ ions. The acid is little dissociated, yet is sufficiently so to indicate its acid character. Experiments by the writer with filtered Lake Erie water using quantities of chlorine ranging from 0.1 to 10.0 p.p.m. produced the following $P_H$ values 18 hours after being treated:

| Chlorine Applied, P.P.M. | Excess Chlorine 18 Hours Later, P.P.M. | PH |
|---|---|---|
| 0 | 0 | 7 80 |
| 0 1 | Tr. | 7 75 |
| 0 3 | 0 02 | 7 70 |
| 0 5 | 0 02 | 7 70 |
| 1 0 | 0 30 | 7 60 |
| 5 0 | 2 00 | 7 40 |
| 10 0 | 7 00 | 7 20 |

N.B.—Temperature rose from 49 deg. F. to 72 deg. F. in 18 hours.

The color changes were found to be very gradual, and for quantities of chlorine within the limits usually applied, it is evident that the $P_H$ value is hardly affected more than 0.1. If the entire quantity of chlorine represented by 1 p.p.m. were converted into hydrochloric acid, which in turn reacted with the carbonates to produce free carbonic acid, there would be produced only about 0.6 p.p.m. of this acid.

Applying a recently suggested formula ("Relationship of Hydrogen Ion Concentration of Natural Waters to Carbon Dioxide Content." By R. E. Greenfield and G. C. Baker, *Journal Industrial & Engineering Chemistry*, Oct., 1920):

$$(H^+) \quad \frac{4\,CO_2 \cdot 10^7}{(HCO_3)} + 1 \times 10^{-4} \text{ where } CO_2 = \text{free}$$

carbonic acid and $HCO_3$ = alkalinity in terms of $CaCO_3$.

To determine the $P_H$ value of natural waters, the writer finds that Lake Erie water, with about 1 p.p.m. of free $CO_2$ and 90 p.p.m. of alkalinity, has a $P_H$ value of 7.84, which is practically the same as the value (7.8) determined colorimetrically. If it is now assumed that to this water 1.0 p.p.m. of chlorine is applied and that by its complete decomposition 0.6 p.p.m. of additional free $CO_2$ is produced in the water, the calculated reduction in the $P_H$ value would be approximately 0.1. This is not as much of a reduction as was actually found colorimetrically ($P_H$ from 7.8 to 7.6), when applying 1.0 p.p.m. of chlorine. However, in this experiment 30 per cent of the chlorine yet remained after 18 hours, and it is not improbable that in consequence the water was actually a little more "acid"; that is, had a slightly higher hydrogen-ion concentration than that calculated. It will be noted that in none of the experiments made with Lake Erie water was the water rendered acid; i. e., a $P_H$ value of less than 7.0 was not reached. In less alkaline waters this might, however, occur.

*Mr. Bohmann*—4. Yes, provided the natural alkalinity of the water is less than the amount of acid formed when the chlorine is added. Chlorine added to water always forms hydrochloric acid and liberates oxygen, whether there is any free chlorine present or not.

*Messrs. Walden and Powell*—4. We have noted invariably that after chlorination the hydrogen-ion concentration falls on the acid side of the scale; the indicator used is brom-thymol-blue. The $P_H$ value has been noted to be as low as 6. Extended experiments carried out to determine this point were made and it was found that the water before chlorination and after filtration has a $P_H$ value of 7.2. After chlorine treatment the $P_H$ fell to 6. The $P_H$ values were determined at the end of three successive days. It appeared that the chlorinated water gradually rose until at the end of the third day the water was again alkaline, showing a value of 7.2, the same as before the water was chlorinated.

6. In the plants of this company there is an indication that chlorine attacks not only iron and steel, but also bronze and admiralty metals.

7 and 8. It has been noted that impellers in turbines have shown very definite corrosion. Slight pitting has occurred in the boilers of one plant, apparently more pronounced after the dose of chlorine was increased.

*Mr. Armstrong*—4. The hydrogen-ion concentration has been as low as 6.1 for filtered and for chlorinated water, using brom-thymol-blue as indicator. With the tests we have made, there seems to be no appreciable difference in the hydrogen ions in the filtered water before and after the application of chlorine.

*Dr. Hale*—4. No free acid exists, in my opinion, in the ordinary water supply that has been chlorinated, but the chlorine combines with the alkalinity to form hypochlorite. So-called residual free chlorine is the available oxygen of this hypochlorite. The above is indicated by a reduction in alkalinity accompanying the introduction of liquid chlorine.

5. The amount of chlorine introduced into a supply, ordinarily, is too small to have any effect on corrosion, and if the above opinion regarding the formation of hypochlorite is correct, the only effect upon corrosion would be the addition of an infinitesimal amount of oxygen to the supply.

6. Chlorine is known chemically to attack, in the presence of moisture, practically all metals except silver and possibly lead, but insoluble deposits formed by partial action prevent further corrosion.

7. We are not aware of any complaints of action on bronze parts, such as valve springs, etc., particularly since such opportunity is rare in New York City's experience. We have read of such complaints, however.

8. Complaints have been received of range boilers, but these were in connection with the Catskill supply and are in no way connected with chlorination, in our opinion, since our average dosage last year was 0.07 p.p.m.

*Mr. Laboon*—4. In one of our plants where the water is treated with lime, generally there is present alkalinity as determined with phenolphthalein, thus indicating the presence of hydroxyl ions, and therefore making the presence of hydrogen ions impossible. This indicates that the hydrogen-ion concentration falls on the non-acid side of the scale. Waters which are acid to phenolphthalein, in other words containing carbon dioxide and other organic acids, would indicate the hydrogen-ion concentration falling on the acid side with chlorination. This would happen, we believe, even if no free chlorine were present.

5. The consensus of opinion of our informers and our own experience dictates that water pipes, both hot and

cold services, are corroded very little, if at all, due to chlorination.

6. Iron and steel seem to be the only metals which are very appreciably affected by chlorinated water, although it is our belief that the other metals are also affected, but to a lesser degree, and the result of the corrosion is not noticeable in a short length of time. The plant at Jefferson City, Mo., experienced considerable difficulty while using hypochlorite of lime due to the corrosion of the brass parts, such as gear trains in water meters. The difficulty has been overcome by the substitution of the electrolytic cell generating chlorine for the hypochlorite.

*Mr. Jordan*—4. The hydrogen-ion concentration in a chlorinated water should pass toward the acid side in an amount equal to the unbalancing effect of the amount of chlorine added. If the water is sufficiently alkaline, as is the case in the Middle West, the hydrogen-ion concentration will not reach the neutral point, much less the acid.

*Mr. Bunker*—In the chlorinated waters from three purification plants on the Canal Zone the hydrogen-ion concentrations fall on the alkaline side of the scale with phenol red as an indicator. The following table illustrates this point:

| Plant | Hydrogen-Ion Concentration: Filtered Water | Hydrogen-Ion Concentration: Chlorinated Water | Residual Chlorine |
|---|---|---|---|
| Mt. Hope | 7.2 | 7.2 | 0.08 |
| Agua Clara | 7.9 | 7.6 | 0.06 |
| Miraflores | 7.1 | 7.0 | 0.24 |

The following table gives the $P_H$ concentrations of the filtered water prior to chlorination at the Miraflores plant and of the same water after chlorination as drawn from taps on the distribution system.

| | Filtered Water | Hydrogen-Ion Concentration: Distributed Water | | | Residual Chlorine: Distributed Water | | |
|---|---|---|---|---|---|---|---|
| Date | Hydrogen-Ion Concentration | Tap No. 1 | Tap No. 2 | Tap No. 3 | Tap No. 1 | Tap No. 2 | Tap No. 3 |
| Feb. 7 | 7.1 | | 7.2+ | 7.2+ | | 0.02 | 0.0 |
| Feb. 8 | 7.1 | | 7.2+ | 7.2+ | | 0.0 | 0.0 |
| Feb. 9 | 7.1 | 7.1- | | 7.1- | 0.0 | | 0.0 |
| Feb. 10 | 7.1 | 7.1- | 7.2 | 7.1 | 0.01 | 0.03 | 0.0 |
| Feb. 11 | 7.1 | 7.1 | 7.1 | 7.2 | 0.01 | 0.03 | 0.0 |
| Feb. 12 | 7.1 | 7.1- | | 7.1 | 0.0 | | 0.0 |

An average of 0.378 p.p.m. of chlorine was applied to the filtered water during the period covered by the above table.

7. No action has been observed on the bronze impellers of nine centrifugal pumps through which chlorinated water passes with residual chlorine continually present in amounts ranging from 0.02 to 0.15 p.p.m.

[*Section II on "Efficiency Factors" will appear in the issue of Sept. 8*]

## New Hampshire Water Cross-Connection Control

Secondary sources of water supply in New Hampshire are controlled by the State Board of Health under legislation enacted in 1915 and amended in minor features in 1919. The law gives the board full control of all emergency intakes and also of all cross-connections between secondary and city supplies. When it is necessary to resort to an emergency supply not already approved by the board, notice to that effect must be sent to the board immediately. The board requires double check valves of the Factory Mutual type, "where practicable," we are informed by Charles D. Howard, chief chemist of the board, on all cross-connections between industrial and public water-supplies. "Since 1915," Dr. Howard states, "a considerable number of these installations have been effected and the work is still going on." Where such cross-connections exist the board requires that all water used by the employees, whether for drinking or ablution, shall be supplied from the public system, through connections made on the street side of the double check valve. The law requires at least semi-annual inspections of valves on cross-connections.

# Repairing Wood Water Conduit at Norfolk, Virginia

### Ten Miles of 24-in. Machine-Banded Pumping Main Leaking So Badly as to Appear Hopeless Successfully Repaired

By J. W. Ledoux
Consulting Engineer, Philadelphia, Pa.

REPAIR of a 24-in. machine-banded, mortise-and-tenon joint wood pipe line delivering water under pressure for use in Norfolk, Va., became necessary in 1918 to cut down heavy leakage. The leakage was due somewhat to defective joint and alignment work during construction but principally to a flattening of the pipe by the earth load while the pipe was under low pressure, and an opening of longitudinal joints midway in the cross-section of the pipe when the conduit was subjected to heavy pressure. The repairs on the highest pressure portion were effected by putting special sleeves consisting of steel bands and rubber strips over the circumferential joints and by rebanding with steel rods and lugs. The local conditions, method of repair, and leakage tests before, during and after the repairs are detailed in this article.

In 1912 the Norfolk County Water Co., which had been supplying the suburbs of Norfolk, Va., from a system of driven-wells located six miles east of Norfolk, found its supply becoming insufficient for the growing demands, so secured water rights on streams draining some 45 square miles in Princess Anne County, 12 miles southeast of Norfolk, and began the construction of an impounding reservoir on the nearest one of the streams, known as North Landing River. The first development consisted of an earth dam impounding 441 m.g., the drainage area being 12.15 square miles and the water surface of the reservoir covering an area of 440 acres. A pumping station was built and two oil-engine belt-driven centrifugal pumps, each having a capacity of 3 m.g.d., were erected therein. The plan was to pump the water from the impounding reservoir ten miles to a 1-m.g. settling basin located at the driven well plant.

The experience of the water company with cast-iron pipe used for its pumping main from the well supply to its distributing system, as well as that of the city, whose supply was taken from impounding reservoirs on drainage areas similar to the North Landing reservoir, showed that in a very few years the carrying capacity of the pipe was reduced very materially, due to the combined effects of tuberculation and a hard clay-like internal coating; therefore a careful study was made to determine the best type of pipe for this ten miles of pumping main. An investigation indicated that a 16-in. cast-iron pipe would cost, laid, about the same as a 24-in. wood pipe of the cheapest type, and have only about a third the carrying capacity. The writer had previously installed 7,000 ft. of this class of wood pipe in Western Pennsylvania for a working pressure of 150 lb. per square inch and obtained fairly satisfactory results, so felt confident that the pipe could be made tight for the proposed pressure, which would never exceed 65 lb. per square inch at the pumping end of the line. So with some misgivings the water company decided to put in the 24-in. wood pipe under specification that the lower half would be designed for a working pressure of 80 lb. and the upper half 43 lb. per square

inch; that it would be laid under the supervision of the wood pipe manufacturers and be satisfactory as to leakage. The construction was finished some time in 1913.

The pipe was made of 3-in. Norway pine staves, the walls having a nominal thickness of 2 in., machine banded with 1½-in. wrought iron, No. 14 B.W.G., spaced about ¼ in. apart, depending upon the pressure. The joints were mortise and tenon, made in the usual manner by simply driving the pipe in place by means of a "battering ram" handled by men.

The elevation of the pumps was about 10 ft. above tide; the elevation of the settling basin at the outlet end of the line 28 ft., so the pumping pressure when pumping at the rate of 3 m.g.d. was less than 20 lb. per square inch. A 10 x 50-ft. standpipe was located at the pumping station.

Under these conditions the plant was operated until the summer of 1918, when the city of Norfolk, finding its own supply becoming inadequate due to the greatly increased demands of its enormously augmented population and the war activities of the Army and Navy Base, and knowing that it possessed a small drainage area and large storage capacity while the Norfolk County Water Co. possessed a comparatively large drainage area and small storage, entered into negotiations resulting in a contract to lease for three years the Norfolk County Water Co.'s plant, unify both systems and thus secure an additional supply of at least 4 m.g.d from North Landing reservoir. This contract provided for the installation of an electrical transmission line, duplicate pumps, motor-driven, having a combined capacity of 8 m.g.d., and it was reasoned that this amount of water could be pumped through the line as long as any water was available from the North Landing reservoir. It was further provided that the water would be discharged into the nearest city lake at a distance of about 40,700 ft. from the pumping station, and that the 24-in. wood pipe must carry 8 m.g.d. as determined by a service test made in a manner satisfactory to the city engineer.

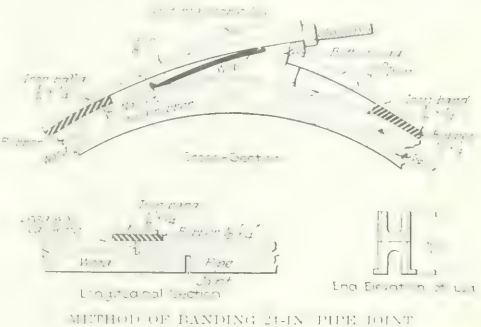
### Leakage Under Pressure

At this time, July, 1918, the new pumps were supposed to have been contracted for by the Army Base which had charge of all the improvements and the unification of the two systems, and it was necessary to have the pumps before an adequate test could be made.

It was assumed that when 8 m.g.d. were pumped, the pumping pressure would increase to 53 lb. and in all probability develop a considerable amount of leakage which, if it did not take up, would require repairs by the water company.

To get an idea of the extent and distribution of any leaks that might exist under such pressure as was available, a test was made with the old pumps and standpipe by shutting successively each valve on the line, located about a mile apart, and the flow was measured by a Venturi type of meter. The results were astounding. In the first 24,000 ft. under a pressure of 21 lb. per square inch, the leakage amounted to 2.4 m.g.d. and an inspection of the line showed the leakage to be almost continuous for the entire distance. It was then decided to repair to the first valve, some 6,500 ft., which showed a leakage of 0.7 m.g.d. When the pipe was uncovered it was found that practically every joint leaked and nearly every pipe leaked along the staves, halfway between the top and bottom.

So it was decided to reinforce the entire length with rods between the circumferential joints and with bands over the joints. The rods were ⅝ in. in diameter, secured by double malleable iron lugs. Several methods were tried before finding a satisfactory joint reinforcement. In the first method the outer part of the old joint, between the pipe-length ends, was caulked with lead wool. Then a ⅜ x 6-in. iron band, bolted at the ends so as to form a sleeve with a diameter 1 in. larger than that of the outside of the pipe, was centered over the joint and the space between the sleeve and the pipe filled with leadite poured through a pipe jointer. Although apparently successful at first, in a few days the leadite gave way through erosion. Neat cement was then used and found to be effective as regards tightness but was too costly because of the necessity for digging large bellholes to enable the cement pouring work to be done properly. After much further experimentation a circumferential joint was devised (see sketch) that was the most effective and economical of all those tried. The joint was scraped off all around the pipe, and, at the top, for a distance of 12 in., it was caulked with lead wool. A strip of rubber 75 in. long, 1½ in. wide



METHOD OF BANDING 24-IN. PIPE JOINT

and ¼ in. thick was stretched around the pipe, centered directly over the joint, and tacked on the pipe at each end of the strip, leaving a space 6 in. wide between the ends. Upon this was placed a wrought-iron hoop, ⅜ in. thick, and 1½ in. wide, made taut by a bolt end and lug. This band was made out of ⅝-in. round iron by means of a steam hammer, leaving one end for a buttonhead and the other end for a thread 5 in. long. As the thread was screwed up the hoop was hammered and the leakage effectively stopped for any desired pressure.

Near the end of each day, before the trench was back-filled, a pressure test was applied to the line and any leaky joint that developed was made tight by screwing up on the bolt end of the hoop and hammering. The joints were about 8 ft. apart, and two men could repair about 25 joints a day after the digging was done.

For the first 6,500 ft. the pipe between the joint bands was continuously reinforced by the ⅝-in. rods already mentioned. The next mile required only occasional bands where stave leaks occurred, but practically every joint for a distance of 23,000 ft. had to be repaired.

The electric pumps were not obtained until April, 1919, or after two miles of pipe had been repaired, and then only one pump could be operated on account of the inadequacy of the electric transmission line. The capacity of one pump was about 5 m.g.d.

In April a test was made which showed the leakage

for the first 11,000 ft. to be 1.7 m.g.d. under 29 lb. pressure and 4.6 m.g.d. under 30 lb. pressure. Up to the first valve, a distance of 6,500 ft., the leakage was 0.43 m.g.d. under 42 lb. pressure and 1.1 under 64 lb. pressure. At this time the leakage on the entire 10 miles, while pumping at the rate of 4.67 m.g.d., was 0.47 m.g.d. While the pressure at the pumps was 30 lb. the average pressure on the second section was about 26 lb. This leakage was determined by deducting from the rate of pumpage the discharge over a weir at the outlet of the pipe, 50,000 ft. from the pumps.

By July, 1919, the first three sections, or about 17,400 ft., had been repaired and both pumps were in operation, so that for the first time it was possible to pump into the line nearly the full contract quantity of water at the required pressures. A test showed the following results:

| | Pump Pressure, Lb. | Total Leakage, Gal. |
|---|---|---|
| [illegible] | 65 | [illegible] |
| [illegible] | 55 | [illegible] |
| Up to the third valve closed | 45 | 3,000,000 |
| Up to the fourth valve closed | 35 | 1,950,000 |

After the test an application of sawdust was made and then a second test showed the leakage to be:

| | Pump Pressure, Lb. | Total Leakage, Gal. |
|---|---|---|
| To the first valve | 65 | [illegible] |
| To the second valve | 55 | 970,000 |
| To the third valve | 45 | [illegible] |
| To the fourth valve | 35 | 1,500,000 |

Work was then continued and frequent tests made to locate and repair the portions of the line showing leakage, until Dec. 20, when a test was made subjecting each section successively to the pressure necessary to pump 8 m.g.d. to the nearest city lake, as per contract. The results were as follows:

| | Pressure, Lb. | Leakage, Gal. |
|---|---|---|
| First section | 5[illegible] | 40,000 |
| Second section | 4[illegible] | 35,000 |
| Third section | 40 | 46,000 |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| Sixth and seventh sections | 13 | 35,000 |
| Total leakage, gal. | | 273,000 |
| Total distance, ft. | | 40,700 |

The leakage was measured by means of a 2-in. Empire meter placed on a by-pass around a gate valve located close to the pumping station. One of the pumps was operated at full capacity, allowing sufficient water to go through the line to maintain the required pressure, the balance of the water being discharged back into the suction well. The plan was first to pump with the 7th valve closed and the entire line subjected to 13 lb. pressure for an hour, measuring the flow through the 2-in. meter; then the 7th valve was opened and the 5th valve closed and the entire line up to the 5th valve subjected to 21½ lb. pressure for half an hour and to 13 lb. pressure for half an hour, deducting this last flow from the first to determine the leakage from the 5th to the 7th valve. In this manner pressure and leakage determinations for the whole length were made for two pressures in each case.

Up to this time and latterly the formula of flow was found to be $Q = 4{,}640{,}000\sqrt{h}$, in which $Q$ = gallons per 24 hours, and $h$ the loss due to friction in feet per 1,000, the coefficient corresponding to about 103 in Chezy's formula, although in the early tests it was found to be only 97.

The water company then asked for an official test and acceptance of the line, so on Feb. 21, 1920, the first official test was made, the following engineers being represented: Walter H. Taylor, 3rd, formerly city engineer and then director of public works of Norfolk; Dabney H. Maury, consulting engineer; N. Z. Ball, representing the city; J. W. Ledoux, consulting engineer, and C. C. Behney, representing the water company.

The first operation was to calibrate the Simplex meter at the pumping station. Then a pitot tube traverse and velocity test was made at a tap close to the pumping station. Then a traverse and velocity test was made at a tap on the 24-in. pipe at a point on the line 40,300 ft. from the pumping station. At that point the pipe was found to be elliptical in form, the internal major or horizontal diameter being 25½ in. and the minor or vertical diameter 22¼ in. The following were the main results:

| | |
|---|---|
| Length of line pumped through | 49,900 ft. |
| Length of line to nearest city lake | 40,700 ft. |
| Length of line to Pitot tube | 43,300 ft. |
| Pressure at pumping station during test | 55.7 lb. |
| Passage as measured by Simplex meter | 7,680,000 gal. |
| Pumping as measured by Pitot tube near pumping station | 7,680,000 gal. |
| Flow at tap 40,300 ft. from pumping station | 7,470,000 gal. |
| Apparent leakage | 210,000 gal. |
| Equivalent delivery through line into nearest city lake—distance 40,700 ft. | 9,175,000 gal. |
| Deduced formula of pipe flow | $Q = 5{,}070{,}000\sqrt{h}$ |

Necessary pressure at pumping station to deliver 8,000,000 gal. into nearest city lake, 49 lb.

## Comments and Conclusions

During all this work there was abundant opportunity to inspect the condition of the pipe and the iron banding, and no evidence of deterioration could be seen, so that as far as the iron and wood are concerned, the future life of the pipe is indefinite. This is probably due to the favorable character of the soil in which the pipe is laid.

While original defective alignment and joint work were no doubt responsible for a great deal of the leakage the most important lesson taught is that wood pipe should be continuously subjected to the pressure under which it is to operate. This particular pipe for the first five years after it was laid was subjected to a maximum pressure at the pumping station of about 18 lb. per square inch and at the upper portion of the line to about 5 lb. The earth filling over the pipe, averaging about 2 ft. in depth, exerted a sufficient pressure to gradually press the pipe into an elliptical form, which it retained until when the high pressure was applied the effect was to force the pipe back into a cylindrical form, which could be seen by a crack in the earth all along the center of the pipe line, or at least for the first 20,000 ft. By continuing this pressure the earth filling assumed its new permanent position, which it would retain unless the pipe were permitted to work under a low pressure again for a considerable length of time, say several weeks, depending upon whether the soil were fairly dry or saturated.

This condition of flattening of the pipe was probably responsible for most of the trouble above outlined. On the upper portion of the line the difference in internal pressure was never great enough to cause the pipe to resume its circular form after it had once been pressed down into the elliptical shape.

If the pumping machinery had been installed promptly, as was originally anticipated, the cost of repairs would in all probability have been reduced by 50 per cent and if the pipe had been originally laid under a very light fill it would not have been pressed out of shape, for wood being an organic substance will gradually take a permanent set even when subjected to external pressure far below the elastic limit.

The experience herein related does not discredit wood pipe; neither does it condemn the original form of joint, although I much prefer the form used in the repair on account of its adjustability.

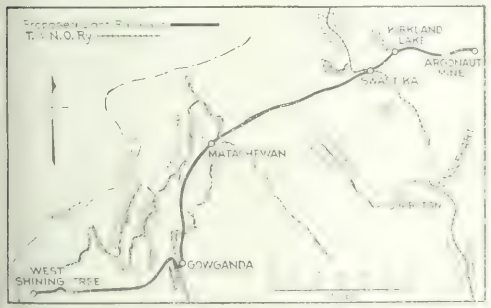
The reason why the coefficient of flow has increased so favorably, or by about 16 per cent, is partly that the increased peripheral velocity has cut away the adhering scum and partly that the hydraulic mean radius of the pipe has increased due to the final change from elliptical to circular form.

Taking the results of the tests of pressure to which the various portions of the line have recently been subjected without increasing the leakage, and using the formula of flow which is now applicable, it is certain that the pipe line now has a safe capacity of 9.6 m.g.d. when delivering into the nearest city lake, which is 20 per cent above the contract requirements.

## Light Railways for Canada

TEMPORARY pioneer railways of 3-ft. gage are planned for Temiskaming County in northern Ontario, to develop agricultural and mineral resources and to serve mines now handicapped by lack of railway accommodation. Isolated mining properties are said to pay $20 to $30 per ton for hauling in machinery and supplies by teams over rough trails. It is proposed that when traffic has reached a certain limit these lines would be converted to standard-gage branches at little additional cost, the original track and equipment being then used for development at some other location.

Two lines are now projected, starting from Swastika on the Temiskaming & Northern Ontario Ry., about 400 miles north of Toronto. As shown by the accompanying




PIONEER RAILWAYS FOR [illegible]

map, one is to run west and southwest to Lowganda and West Shining Tree, about 80 miles; the other is to run east about 20 miles to the Argonaut gold mine. A portion of the longer line was surveyed in 1913 by the T. & N. O. Ry., but this project was abandoned on account of the war. The country is rugged and broken but not very hilly, with an elevation of about 1,000 ft. above sea level and keeping within the limits of the divide known as the height of land (elevation 1,200 ft.). It is heavily timbered in some parts and the open portions include both farming and barren lands. There are innumerable streams and lakes, with possibilities of water-power development.

It is stated that the two railways would serve an area of some 3,000 square miles, in which are located a number of gold and silver producing mines and about 11,000 mining claims for gold, silver, barium, asbestos, feldspar, copper and iron. The timber resources include both lumber and pulp wood. Few roads or trails traverse the district.

Grades of 3 per cent and 12-deg. curves would be the limit in location. Track construction is to consist of 56-lb. rails on jack pine ties 5 x 6 in. and 6½ ft. long, laid with sixteen ties to a 30-ft. rail and ballasted lightly with gravel. Passing sidings 200 ft. long are to be provided at five-mile intervals and there will be about ten small frame stations. Grading will average 12,000 cu.yd. per mile, only about 4 per cent of which is rock, as the location is governed largely by the requirement for low first cost. A considerable amount of trestling will be required.

Steam locomotives of about 15 tons weight and using oil fuel are proposed, the equipment for 100 miles of line including six locomotives, twelve passenger cars and 100 freight cars. Freight-car loads will be limited at first to 10 tons, though it is expected they may be increased to 20 tons when the roadbed has become compacted. The cost is estimated at $15,500 per mile, of which $2,500 represents engine and car equipment. Construction work will be done probably by general contract or by station-men, except that the company will do the tracklaying and ballasting.

This project of the Northern Light Railway Co., of Toronto, awaits approval by the railway department of the provincial government of Ontario, but it is hoped that work can be commenced in the autumn. Col. R. P. Rogers is manager and chief engineer.

## Wood Stave Pipe Stands Blast and Fire

TWO tests of machine-bound wood stave pipe, one accidental and one planned, took place recently at Seattle, Wash. In one the pipe was bent by a blast. The other was a fire-resistance test.

In the first case to be noted a dynamite blast unexpectedly sprung two 16-ft. lengths of 6-in. water main under 115 lb. pressure into a reverse curve, with a maximum ordinate of 8 in. The resulting leaks were stopped with wedges and the line continued in service for six days. Since then the line has been relocated. The main had been in use 13 years.

Shortly before this incident a fire-resistance test of 6-in. creosoted wood stave pipe, under 125 lb. pressure, was made by the Continental Pipe Manufacturing Co. in its Seattle yard. The staves of this pipe had been creosoted with 8 lb. pressure and vacuum treatment. The pipe was spirally wound with No. 6 galvanized-steel wire, 1 in. c. to c. The 8-ft. pipe lengths tested were plugged at each end with wood connected by a steel rod extending through the pipe. A corporation cock was used as an air vent. After the pipe had been under city pressure for 16 hours the fire test was begun. The following account of the test has been supplied by the company named above:

The test section was completely covered with fine kindling saturated with kerosene oil. The fire was then kindled and immediately became intensely hot, causing the galvanized steel wire winding to elongate. This elongation permitted the staves to separate. The consequent leakage immediately reduced the intensity of the fire and eventually extinguished it. The pipe section continued to leak considerably through the seams. The leakage, however, diminished as the wire winding cooled. Two hours after the fire had been started most of the leakage had stopped; and two hours later leakage had entirely ceased.

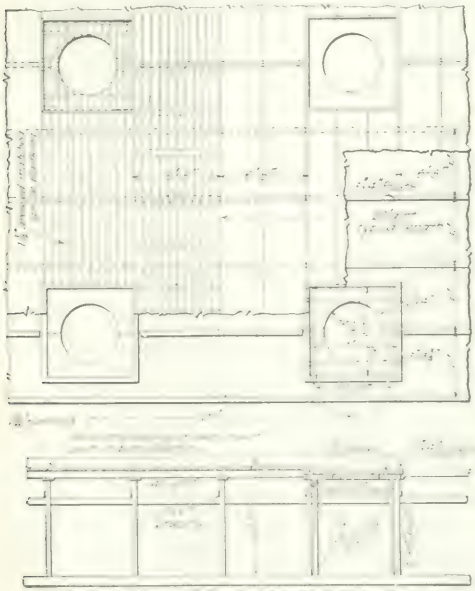
# Using 1¾-in. Plank for Flat Slab Floor Forms

By J. E. Gurvin
Superintendent, Aberthaw Construction Co., Boston, Mass.

CAREFUL records of erection costs have indicated that a considerable saving may be effected in forming flat slabs by the use of panels of 1¾-in. matched plank instead of the ¾-in. panels ordinarily used. The scheme has recently been tried out by the Aberthaw Construction Co. in the construction of a storehouse for the Monadnock Paper Co. at Bennington, N. H.

The features of the system are the elimination of the joists and the batting of panels on the girts. Plinths or drop panels are supported by form posts, suitably braced. Sizes of panels were limited so that none were too heavy for convenient handling.

It can be seen that successful erection is made possible only by accurate spacing and alignment of posts and girts. Spacing was maintained by cutting ledgers for horizontal bracing to such lengths that each ledger covered three posts extending out to out, and having marked on it the location of the intermediate post. All braces of the same length were given distinguishing marks to prevent misplacement. The bottoms of the posts in alternate rows were lined and spaced by a straight line of ledgers nailed to the green

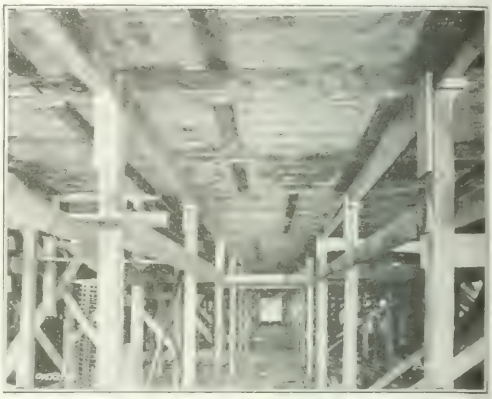


concrete floor at the edge of the row and having marked on it the location of each post. Alternate posts in the rows so marked, or in other words only the posts coming at the ends of the horizontal braces, were first erected; then the intermediate posts were filled in at the marks on the braces. During the above described operations, plinths were being erected and by the time girts were nailed in place, laying of the panels could proceed.

Approximately 15 per cent more material is required than with the ¾-in. panels, but this is offset by increased salvage value of the 1¾-in. stock. Panels were stripped with practically no breakage, and at the end of the job it was decided that their condition would warrant their being used on another job of the same type. Each panel was used from three to five times.

Records were kept on labor costs of the four principal items, namely, posts, plinths, girts and panels. These records indicate that the cost of the under structure and plinths of the new type will be slightly less than the cost of under structure of the old type if joists are included with the latter.

On the operation of laying the panels, however, a saving of nearly 50 per cent over the old system was realized. It must not be supposed, however, that this was entirely due to the new type of panels. Weather conditions were favorable and a plentiful labor supply rendered a picked organization possible. The story height was low and the layout an ideal one for getting good costs.



HEAVY PLANK ARE BASE OF FLAT-SLAB FORMS

A few other advantages were noted. Patching of panels due to breakage was practically eliminated and ceilings were somewhat more smooth and even. It has been noted that with the old style of centering where plinths are supported by special joints, loading suddenly applied during the pouring of the concrete would sometimes cause pronounced settlement of the plinths through flexture of the supporting joists. By the method of supporting plinths with the new type, this condition cannot obtain.

Finally, if we deduct from the actual saving a liberal allowance for the favorable conditions existing on this job, it is surely being conservative to say that with the new type of centering, a saving of from 20 per cent to 25 per cent should be effected.

## Gravel Test Road for Heavy Traffic

A 30-ft. gravel road 2½ miles long is to be constructed by the Wisconsin Highway Commission in conjunction with the Dane County highway officials to determine the sufficiency of well maintained gravel surfacing under heavy traffic. The test road is located just outside of Madison, Wis., and is a section of main trunk highway having a very heavy traffic. In its quarterly report the State Highway Department says: "If a success, gravel will be used in the future in many places where we now consider concrete paving necessary."

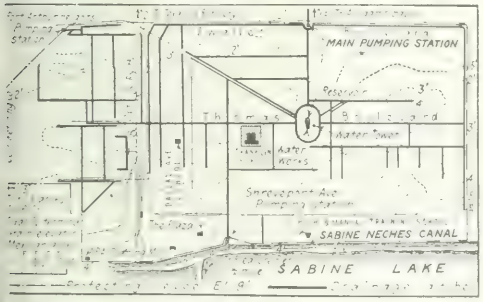
# The Cost of Anti-Malaria Work in Port Arthur, Texas

By R. G. Upton
City Sanitary Engineer

THE Engineering Department of the city of Port Arthur, Texas, has promoted anti-malaria and mosquito eradication work for several years past by drainage, street improvement, and other efforts, spending large sums of money annually. These improvements are of great value to the city other than as mosquito prevention measures, but they will be considered here from the viewpoint of anti-malaria work only.

The entire city is now well drained and the streets improved. The main drainage ditches are below mean gulf level, so that all water and about 90 per cent of the sewage is pumped up to gulf level, which makes both equipment and maintenance an ever present cost. The city is also inclosed by a storm levee to protect it from storm water from surrounding country. The city now covers 3,500 acres and has about 65 in. of rainfall annually, but has practically no runoff.

To understand the anti-malaria work that has been done here, one must contrast past conditions with the




PORT ARTHUR DRAINAGE AREA

present as well as compare the present with the ideal. The present townsite was formerly little better than a marsh with a slight slope from Lake Sabine backward Alligator Bayou. Houses were built first near Sabine Lake on the higher points of land. The area now comprising the city was frequently overflowed by salt water from storms and by fresh water from rains. Both fresh and salt water mosquitoes were then a serious impediment to the progress of the city. Since that time the mosquito menace has been decreasing.

The history of drainage work done here goes back to 1897 when the Port Arthur Townsite Co. installed a pump at the end of 19th St. to throw the water over the railroad grade. No data on the cost of the equipment or operation are available. The next improvement was the drainage canal on Shreveport Ave., which was provided with flood gates to keep out back water and with pumps to lift the water to gulf level. This work was completed in 1903 and the successful operation made habitation possible as far back as Seventh and Eighth Streets in the downtown district. Rapid growth of the city led to ditching and to the addition of pumps, which system was completed in 1913 but was found inadequate after the storm of 1915. This storm flooded the entire city with from 2 to 5 ft. of salt water. The present system was begun after this storm.

The present drainage system consists of three pumping stations at the ends of the main ditches, to lift the water to gulf levels; four miles of storm sewers, 23 miles of main drainage ditches, 105.2 miles of gutters and laterals on improved streets, and a protecting levee ten miles long surrounding the city. This levee has an elevation of 9 ft. above mean gulf level, which is 2 ft. higher than the highest known storm-water invasion from the gulf. First cost and annual upkeep are not small items of expense but the value received in protection to the city is great. For anti-mosquito work it is indispensable because it keeps out all storm water and enables the drainage system to operate so that the entire city is comparatively free from standing water a few hours after the heaviest rains, where formerly were only swamps and marshes. People who are not familiar with the local conditions should bear in mind that rain in this section of the country comes in floods, sometimes as much as 6 in. in 24 hours. The ditches, pumping stations, and levee were installed by a bond issue of $180,000.

Other items chargeable to anti-malaria work come under street improvements. Where formerly we had ruts and water holes in the streets we now have asphalt and shell. We are charging one-third of the asphalt street improvements and one-half of the shell street improvements to drainage or anti-malaria work. This division of cost is not entirely arbitrary for we have calculated that grading, leveling, and ditching cost about that portion of the total amounts. Below is given a summary of improvement costs that are properly anti-malaria work, since 1915. Cost prior to this is unavailable.

COST OF INSTALLATION CHARGEABLE TO ANTI-MALARIA WORK SINCE 1915

| | |
|---|---|
| Drainage bonds of 1915 | $180,000 |
| Asphalt street bonds, $164,000 (one-third charged) | 54,666 |
| Shell street bonds, $292,000 (one-half charged) | 146,000 |
| Total | $380,666 |

The cost of maintenance for one year is given below. The street and bridge fund is chargeable largely to anti-malaria work, which consists in repair on ditches and culverts, extensions, filling of holes, cutting of grass and cleaning and sprinkling. We have estimated that at least three-fourths of this fund goes to anti-mosquito work.

MAINTENANCE COST FOR ONE YEAR

| | |
|---|---|
| Pumping and lighting (budget) | $12,000 |
| Streets and bridges (Budget, $40,000; three-fourths charged to anti-malaria work) | 30,000 |
| Storm levee repairs | 500 |
| Total | $42,500 |

Other anti-malaria work not included in the above is carried on by private citizens, such as screening of cisterns and filling in lots. Filling costs from $25 to $200 per lot for a large part of the city. In addition to the work of the Engineering Department there are Health Department ordinances which require cutting of grass and screening of cisterns, and which forbid standing water on any premises.

The Engineering Department has had the support of the entire citizenship in the anti-malaria work in the past, and future progress is to be expected. Due credit should be given to drainage and improvement work done by Jefferson County and also to the Gulf Refining Co. and the Texas Co. for improvements made by them adjoining the city of Port Arthur.

# Government Engineers Report on St. Lawrence Waterway

## Engineering Features of Navigation and Power Development of River from Lake Ontario to Montreal, as Reported to International Joint Commission by Col. W. P. Wooten and W. A. Bowden

By Harrison G. Roby
Consulting Engineer, Washington, D. C.

*In the fall of 1919 the Canadian government accepted the invitation of the United States government to undertake a joint investigation of the improvement of the St. Lawrence River for deep-draft vessels, in the interest of both countries, and for the most beneficial use of the waters. To the International Joint Commission were referred the questions as to the economic advantages to be derived from the improvement, as to the traffic that is likely to be carried upon the proposed route, as to the apportionment of capital cost, and of cost of operation and maintenance of the improvements, and as to the best method of improvement, including the draft of water and the development of power. The report of the commission will be submitted to the two countries this fall.*

*To facilitate the work of the commission each government appointed an engineer for the purpose of acquiring data and of preparing complete outline plans for and estimate of cost of the improvement. W. A. Bowden, Chief Engineer, Department of Railways and Canals, was named by the Dominion of Canada, and Col. W. P. Wooten, Corps of Engineers, U. S. Army, was designated by the United States government. The joint report of the engineers was submitted to the commission on July 1 of this year. The present abstract of the report gives its salient features.*

THE total length of the St. Lawrence between Montreal and Lake Ontario is about 182 miles, and the difference in elevation is 224 ft. The work of improving the river is made feasible because of three important advantageous conditions. The first of these is that the obstructions to navigation are concentrated in comparatively short stretches, with longer stretches between the drops which require little or no improvement. The second condition favorable to the construction of the proposed works is the location of rock ledge within reasonable depths at all sites of necessary structures, and at the same time below the bottom grades of the proposed canals for a large part of their total length. The third advantage is the large amount of water-power made available by the proposed works, due to the large and remarkably even flow of the river. The sale of this by-product will go a long way toward carrying the entire cost of the improvement.

For the purpose of discussing the treatment to be accorded the St. Lawrence it is divided into five divisions, as follows: (1) Montreal Harbor to deep water in Lake St. Louis; (2) Deep water in Lake St. Louis to end of breakwater at Lake St. Francis terminus of proposed ship canal between Lake St. Louis and St. Francis; (3) End of breakwater to lower end of St. Regis Island; (4) Lower end St. Regis Island to Chimney Point; (5) Chimney Point to Lake Ontario. Of these divisions the first three lie wholly within Canadian territory. The international boundary line follows the river throughout the fourth and fifth divisions.

The decisions reached as to the improvement to be made in each division to obtain the necessary depth of navigation and to obtain the greatest beneficial use of these waters are summarized in the following conclusions:

### Summary of Conclusions and Recommendations

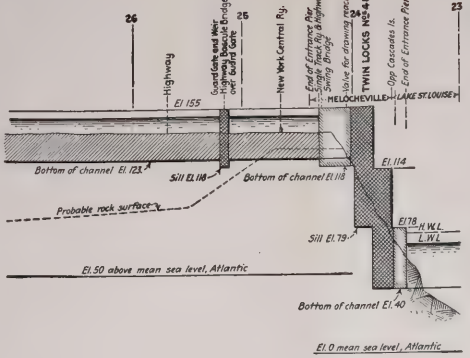
The physical conditions are favorable for improvements for navigation which will be permanent, and will have very low upkeep costs. For the project as recommended in the report, the total cost of improvement from Montreal to Lake Ontario is $252,728,000. This is an estimate based on present day prices, (which are about 80 per cent above pre-war prices) for a 25-ft. depth with such provisions that a 30-ft. depth may be secured later without interfering with the use of the waterway. It also includes the cost, to the switchboard, of developing 1,464,000 hp. The total annual cost of operation, maintenance and depreciation of these works is $2,562,000. Of this sum $1,457,000 is properly chargeable to the operation, maintenance and depreciation of power plants. The estimated cost of increasing the navigable depth throughout the entire stretch to 30 ft. at a later date is $17,986,180. (See detailed figures on opposite page.)

The more intangible assets to be derived from this improvement, such as the development of industries in both countries, the advantages of deep-water navigation from the ocean to the Great Lakes, the saving of coal, and the improvement in railroad freight conditions, while of great importance to the two countries, are not considered in this report, as the engineers do not understand that their instructions cover an investigation of these matters.

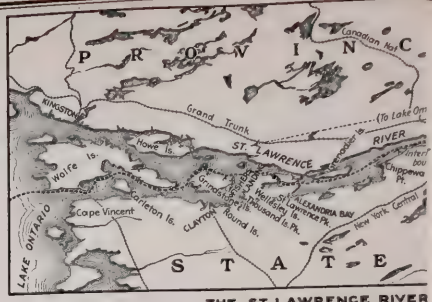
### Power Possibilities

Improvement of the entire reach from Montrea. to Lake Ontario for navigation alone is feasible, but the loss of power that can be generated as a byproduct in some reaches is not warranted. The development of nearly all the potential power in the river amounting to approximately 4,100,000 hp. can be made as co-ordinate parts of schemes for the improvement of navigation.

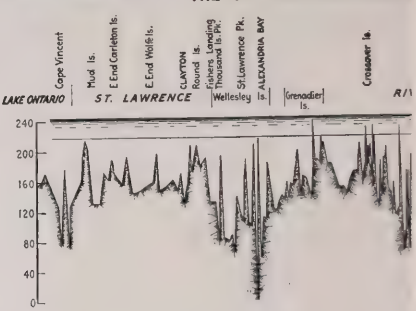
The simultaneous development of such a vast quantity of power is not a sound economic procedure, as a market to take this output is not now in existence, and cannot be expected to spring into being at once. The sound method of procedure is to improve for navigation alone those reaches where side canals and locks can most economically be used, and where the development of the power at some future time is not interfered with by the proposed improvement and, in that part of the river where the construction of locks and dams offers the

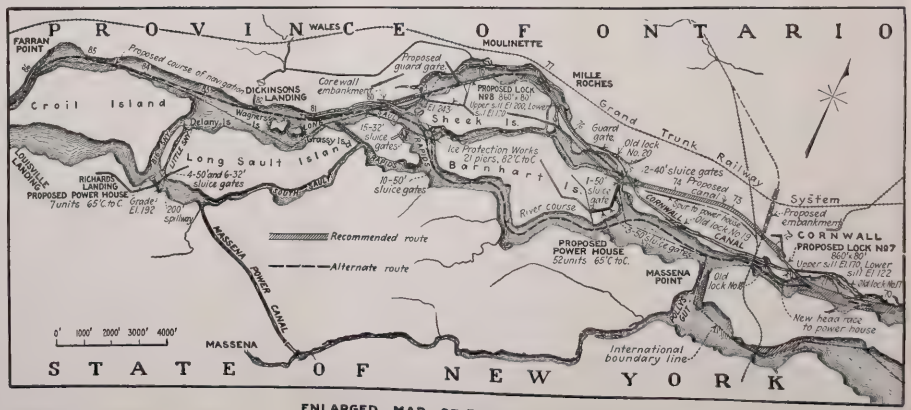



TYPICAL SECTION
AT LOCKS 4 & 5




THE ST. LAWRENCE RIVER

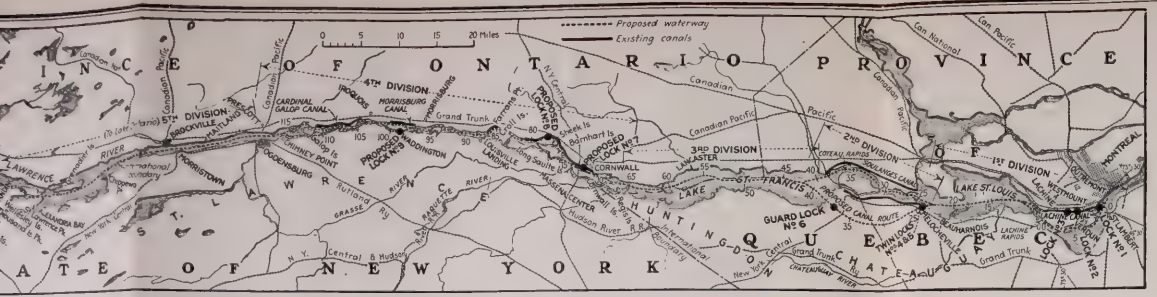


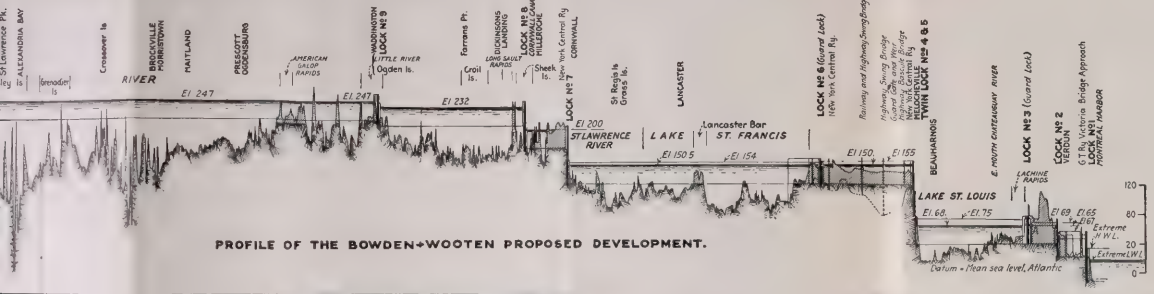

ENLARGED MAP OF FOURTH DIVISION

## Maps, Profile and Cr

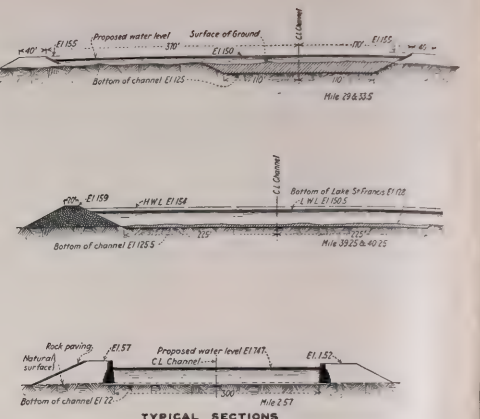
As Recommended in Report to International Joint Commission by Col. W



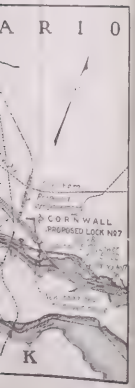

ST. LAWRENCE RIVER FROM LAKE ONTARIO TO MONTREAL SHOWING THE NAVIGATION AND POWER DEVELOPMENTS.

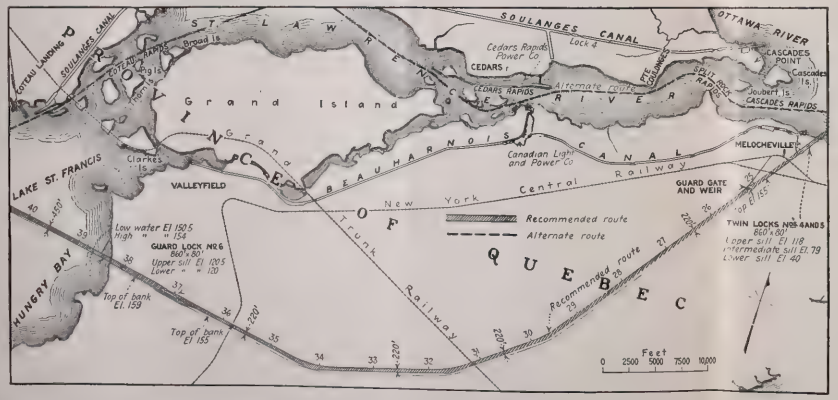



PROFILE OF THE BOWDEN-WOOTEN PROPOSED DEVELOPMENT.

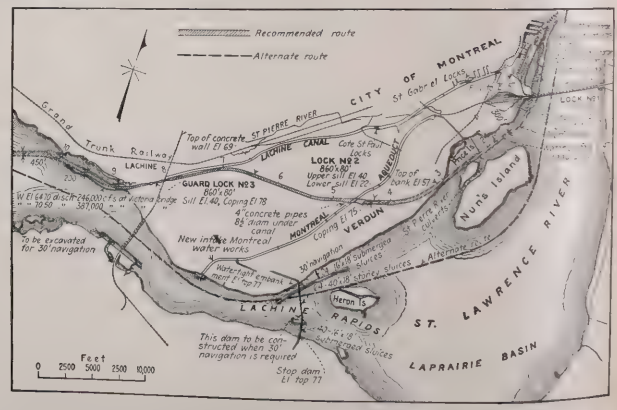



TYPICAL SECTIONS




ENLARGED MAP OF SECOND DIVISION




ENLARGED MAP OF FIRST DIVISION

## Profile and Cross Sections of Waterway and Power Development of St. Lawrence River

t Commission by Col. W. P. Wooten, Corps of Engineers, U. S. A., representing the United States, and W. A. Bowden, Chief Engineer of Department of Railways and Canals, representing Canada

most feasible means of improving navigation, to provide for the development of the incidental power obtainable as a result of the heads created by the dams.

If the improvements are carried on simultaneously it will be possible to complete them in eight years from the time the work is begun, if funds are made available as fast as needed.

The details of the power and navigation project are summarized in the accompanying table and the location and profiles shown on the drawings on the accompanying insert sheet.

All locks are given the same inside measurements as those now being built at Welland, which are 860 ft. c. to c. of quoins of gates, and 80 ft. between lock walls. The bottom width adopted for canal prisms is 220 ft. for 25-ft. depth and 200 ft. for 30-ft. depth. One bank is placed far enough away from the center line to allow

extent on the amelioration of ice conditions by power development in Division 2, which development should be made before that in Division 1, is begun. When the development of this power is required it can be made by the expenditure of $83,797,000, in addition to that required to complete the improvement for 30-ft. navigation.

The lowest lock (No. 1) is located about 2,000 ft. downstream from Victoria Bridge on the north side of the river. The lift at this lock at mean flow will be from El. 21 to El. 47. After passing the north approach to the bridge the canal will continue for a distance of 4,000 ft. above the foot of Nun's Island as an elevated pond created by a retaining wall on the river side and the Verdun level on the land side. Near the Verdun shore the pond is contracted by carrying a retaining wall from the level to within 300 ft. of the opposite wall.

TABLE SHOWING DETAILS AND COSTS OF PROPOSED ST. LAWRENCE WATERWAY

| Division | Length: Canal | Length: River | Change in Level: Ft. | Change in Level: Mi. | No. of Locks | Hp. Dev. | Estimated Cost, 25 Ft. | Estimated Maintenance | Estimated 30 Ft. Depth | Possible Hp. |
|---|---|---|---|---|---|---|---|---|---|---|
| Montreal-Lake St. Louis... | 13 0 | 12 0 | 24 | 42 | 2 (guard) | | $55,783,000 | $350,000 | $12,944,000 | 860,000 |
| Lake St. Louis-Lake St. Francis | 13 5 | 2 5 | 18 | 83 | 2 (1 guard) | | 36,590,000 | 400,000 | 3,110,000 | 1,560,000 |
| Lower St. Francis-St. Regis Island | 0 | 23 0 | 28 | 5 | 0 | | 1,158,000 | 30,000 | 662,000 | |
| St. Regis Island-Chimney Point | 7 5 | 4 5 | 48 | 42 | 3 | 1,464,000 | 159,097,200 | 1,762,000 | 1,270,180 | 180,000 |
| Chimney Point to Lake Ontario... | 0 | 69 0 | 69 | 1 | 0 | | 100,000 | 20,000 | | |
| Total ... | 34 0 | 148 0 | 182 | 224 | 7 2 (guard) | 1,464,000 | $252,728,200 | $2,562,000 | $17,986,180 | 2,600,000 |

he widening of the canal to 400 ft. in the future, if lesirable. Channels in the lakes are given a width of 50 ft. In river sections, where a reduction in velocity s also necessary, the project channel width is greater, arying from 600 to 1,000 ft. A description of the evelopment, by divisions, follows:

### First Division

This stretch comprises the rapids just above Montreal larbor, La Prairie Basin, the Lachine Rapids, and the hoal at the lower end of Lake St. Louis. It is not avigated except by special passenger boats, ordinary raffic following the Lachine Canal. The difference in evel between Lake St. Louis and Montreal at mean tage is 45 ft.

Several methods of improving this division have been ıvestigated. The one that is recommended for adoption onsists of a side canal on the Ville Emard route, with wo main locks and a guard lock, as shown in the drawıgs. It provides for 25-ft. depth of navigation at the utset. The canal sections would have a bottom width f varying from 220 ft. in through cuts to 450 ft. in ıbmarine channels. The locks are built for the ultimate epth of 30 ft. over sills, so that there will be no intererence with navigation while the work necessary to ecure the additional depth is being prosecuted.

Provision for the future widening of this waterway is ıade from Victoria Bridge to west of the town of erdun. The cost of this improvement is estimated to e $55,783,000. The annual cost of operation, mainenance, and depreciation will be $350,000. Whenever 30-t. depth for navigation is warranted, the additional ork required in the First Division to obtain this will e the construction of a concrete dam, with control gates cross the river at the Lachine Rapids, and the raising f the side walls of the canal sections at an estimated ost of $12,944,000.

The ice conditions in this division of the river make ıe development of power more uncertain and more xpensive than at other sites higher up, and the head ıat would be available is dependent to a considerable

Culverts under the canal will provide for the discharge of the river St. Pierre and for the drainage of the town of Verdun.

The second lock is located west of the town of Verdun. The lift will be from El. 47 to El. 65, which is a little less than the elevation of Lake St. Louis at low stage. After passing the lock, the route swings through an angle to the left, and proceeds parallel to and south of the present Lachine Canal, to the guard lock, which is located directly above the Canadian Pacific Ry. line which crosses the river. This lock is designed to take the difference in level between the reach below it, El. 65, and Lake St. Louis, which varies from about 65.5 to 74.0. After passing the guard lock, the canal passes south of the guard lock of the present Lachine Canal, enters the pool created by the breakwater of the Lachine Canal, and remains behind the breakwater to its end. In Lake St. Louis a large amount of solid rock dredging is required to obtain the proposed section at low water.

Another route which has been thoroughly investigated makes the cross-over from the river bank to the present Lachine Canal at some distance to the east of the recommended location. It leaves the river before reaching the foot of Nun's Island, and meets the Lachine Canal near the present Cote St. Paul Lock. This route is somewhat more expensive than the one outlined above both for 25-ft. depth and for 30-ft. depth. It also severs some parts of lower Montreal from the main body of the city, and in all respects is less feasible.

To make the river navigable by means of a dam near Victoria Bridge high enough to submerge the Lachine Rapids, or by means of two dams, one near Victoria Bridge and one at Heron Island, and a canal running along the north shore of the river from the head of the Lachine Rapids to Montreal Harbor, having two locks, one at Montreal Harbor and one about 4,000 ft. below the dam across the river, would provide a practicable method of improvement of this division. The power that is made available by the dam, however, is intermittent, because of the reduction in head in the winter caused by the rise in tailwater level due to the severe

ice jams that form in the river below Montreal. As a source of power, other sites further upstream are much more economical; and for the improvement of navigation alone, the recommended scheme is over seven million dollars cheaper.

### Second Division

This division, about sixteen miles long, connects Lakes St. Louis and St. Francis, and includes the Cascades, Split Rock, Cedars, and Coteau Rapids, having a total fall of 83 ft. at mean flow. There are several water-power plants now operating on this stretch of the river, which together generate about 180,000 hp.

The project that is recommended for the improvement of this division consists of a side canal, with locks on the south side of the river. The route leaves the shore of Lake St. Louis near the village of Melocheville, at an angle of 45 deg. and continues on this course until it is nearly four miles from the river. It then swings back, passing the town of Valley Field at a distance of two miles, and enters Lake St. Francis at Hungry Bay.

Near the lower entrance to the canal a double flight of twin locks is located, which raises the water level at once to a little less than that of Lake St. Francis at low stage. A guard lock is located near the upper end of the canal, about 6,000 ft. from the shore line of the lake. At high water this lock will have a lift of about 3 ft.

The estimated cost of the works for a depth of 25 ft., a least prism width at bottom of 220 ft. and with banks and bridges placed for a future widening to 400 ft. and locks and other structures designed for a depth of 30 ft. is $36,590,000. The annual cost of operation, maintenance, and depreciation will be $400,000. The estimated cost of deepening the canal in future so as to afford a depth of 30 ft. is $3,110,000. The development of the power in this stretch of the river can be made in future without interfering with the use of these navigation works. The amount of power that could be developed in this manner would be about 1,560,000 hp. and the cost is estimated at $151,688,000.

If the development of nearly 1,500,000 hp. were not contemplated in the fourth division, a combination navigation and power project would be advisable in this second division. This project would involve the construction of a dam across the river near the village of Cedars, to carry the level of Lake St. Francis, the excavation of navigation and power canals along the north shore of the river from the proposed dam to the Ottawa arm of Lake St. Louis, and the building of locks and of a power plant. The lower lock, having a lift of about 40 ft. would be located at the shore of Lake St. Louis, and another lock with the same lift would be built about a mile up the canal. To overcome the drop in the rapid water at the head of the Coteau Rapids, a guard lock, with a small lift, would be located a little below Broad Island. Above the guard lock a pool would be formed by dams connecting Grand, Thorn, Pig and Clark Islands.

The estimated cost of this alternate waterway for a depth of 25 ft., a least prism width of 220 ft. and with locks and other structures designed for 30 ft. is $49,709,000. The annual cost of operation, maintenance, and depreciation will be $400,000. The cost to deepen it to 30 ft. at a later date is $5,481,000, and the amount of power that could be developed by the construction of a power canal from the pool above the dam at Point Au Biron to a power house just north of Cascades Point, would be about 1,560,000 hp., and its cost is estimated at $124,468,000.

If the alternate method were adopted, the cost of the future development of power in this stretch would be $27,220,000 less than if the first method were adopted. Present injurious ice conditions in the river below would be mitigated by the adoption of this project. But these benefits would be secured by an increase in first cost of the navigation improvements of $13,119,000, and by an additional increase of $2,371,000 when 30 ft. navigation is required. The eventual saving would therefore be $11,730,000, but if the development of power were delayed more than 11 years, interest being taken at 6 per cent, the advantage in cost would lie with the first project. It is believed that the power recommended for development in the Fourth Division will meet all market requirements for more than 11 years. For this reason the project for an improvement by canal from Melocheville to Hungry Bay is recommended in preference to the alternate project.

### Third Division

This reach is about 28 miles long, and comprises practically all of Lake St. Francis. It is proposed to dredge a channel 450 ft. wide and 25 ft. deep at low water wherever the same is not already obtained. The extent of the necessary work is not great.

The improvement of this Third Division, Lake St. Francis to the head of St. Regis Island, is the simplest of any on the project, as it consists practically entirely of dredging. The estimated cost of the recommended improvement is $1,158,000. The annual maintenance cost will be $30,000. An additional 5-ft. depth (same bottom width of channel) can be secured through this division at any future time, without interfering with navigation, and an estimated cost of $662,000.

### Fourth Division

This division, from the upper end of St. Regis Island at the head of Lake St. Francis to Chimney Point, below Ogdensburg is 48 miles long. There are four rapids with swift water at other places which give to the division a total drop of about 92 ft. In the recommended project the first power development is located in this division taking advantage of the drop in the Long Sault rapids.

The recommended improvement makes excellent provision for navigation, gives safety to life and property below the improvements by providing two dams, either one of which is alone able to hold back the water in Lake Ontario, and develops a large percentage of the water power, with provision for the ultimate development of practically all the potential power in this stretch of the river.

The main features of this project are a series of dams at Long Sault Rapids and vicinity that will raise the water level to approximately El. 231, and a second dam at Ogden Island that will raise the level to that of Lake Ontario, less the necessary drop in the river. A short canal with two locks is combined with the lower dam, raising the water in the water way from the level of Lake St. Francis El. 152, to the pool level, El. 231; and another lock is provided at the upper or Ogden Island dam. A large power plant is located at the foot of Barnhart Isand, and a small power plant near the head of Long Sault Island. All structures in the vicinity of Long Sault Rapids are so designed that they may be

ater raised to obtain at the power plants the greatest ead that can be economically maintained.

From Lake St. Francis to the west end of Cornwall avigation will be imposed by extensive dredging, both o obtain the necessary sectional area for the boats using ie waterway, and to reduce the velocities.

At the west end of Cornwall the course of navigation aves the river and enters a canal. About 1,000 ft. rom the shore is located the first lock, which raises the ater level about 48 ft. to El. 200. The canal connect- g the lower and the upper locks is about six miles in ngth. No rock is encountered in carrying excavation grade and at the upper end the canal enters the lake the Cornwall Canal which was created some years go by the construction of dams at the head and foot of heek Island.

The upper lock is located on the north shore of Sheek land, and will have a lift of about 31 ft. A dam will n from the lock, across the lake mentioned above, and ut on mainland above the village of Moulinette. A ir of guard gates will be installed about a mile above e upper lock, with dams running from them to high id on Sheek Island and on the Canadian mainland.

### Dams in Fourth Division

The series of dams and other structures at the Long ult Rapids extends from high ground on the Canadian le, across the intervening channels and islands, to high ound on the American side.

The most important of these are; a concrete dam ross the Long Sault, about 3,900 ft. long, with spill- y and control gates; a concrete dam and power house ross the South Sault channel at a point between the id of the Massena Canal and the upper end of Long ult Island; a concrete dam across the proposed diver- n through Long Sault Island; and the Barnhart and power plant. This plant located at the eastern l of the island, will contain 52 units, spaced 65 ft. ter to center. Trash chutes will be placed at both ls, and at the angle in the center of the plant, and total length of the structure will be about 3,800 ft. nnecting the concrete structures earth dams will be vided having a top width of 40 ft. at El. 243 and e slopes of 3 to 1. These earth dams will have con- te core walls extending to rock wherever the ground face is below El. 220, and to an impervious founda- n where the ground surface is between El. 220 and . Above El. 232 the earth embankments will not be vided with core-walls.

At Ogden Island, a concrete dam will be built across north channel, consisting of a submerged gate sec- n, 600 ft. of spillway, and a stoney sluice gate section. e lock which provides the lift from El. 231 to the el of Lake Ontario (minus the drop necessary to duce the river flow) is located just south of the nd. A concrete dam containing stoney sluice gates ends from the lock to the south shore of the river. e approach channels both above and below the lock require considerable improvement.

Above the last lock, the waterway follows the course the river, except that the alignment is improved by t through Leishman's Point, at Rockaway Point and Arrowhawk Point. The section of the river from lock to Galop Rapids is increased so as to give a velocity of 3.5 ft. per sec. at mean flow. Through the Galops Rapid the course of navigation will pass south of Lotus, Lalone and Galop Islands. By first improving north channel and removing the Gut Dam between Adams and Galop Islands, it will be possible to cofferdam the south channel and to do the excavation in the dry.

The land flooded in the fourth division will amount to about 15,300 acres, of which 4,400 is on the Canadian side, 7,200 on islands, and 3,700 on the American side. The towns of Iroquois and Morrisburg will be protected by dikes, and the drainage of these towns will be taken care of by means of collecting basins and pumps.

The records of the St. Lawrence River since 1860 show a remarkably even flow. The level of Lake Ontario has varied from an extreme minimum of 243.21 in November, 1895, to an extreme maximum of 248.95 in May, 1860. The discharges corresponding to these elevations are respectively 191,000 sec.-ft. and 320,000 sec.-ft. In winter the flow drops below that ordinarily corresponding to the stage of the lake, due to ice effect. The lowest flow recorded is about 185,000 sec.-ft. A system of regulation of the flow of the river has been work out which makes it possible to increase the low flows without causing the lake to fluctuate beyond the limits set in the last sixty years.

Except for a very few periods of unusually long continued deficiency in supply, a flow of 210,000 sec.-ft. can be maintained. Of this amount 190,000 sec.-ft. will pass through the power plant at Barnhart Island, where a minimum head of 74 ft. is secured by the recommended project. The remaining 20,000 sec.-ft. will pass through the power plant at the upper end of Long Sault Island, under a head of 29 ft. Assuming an overall efficiency of 88 per cent, the power that will be generated at the Long Sault dam will be, as stated before, 1,464,000 hp. Each unit will pass 4,580 sec.-ft. under full gate opening and will deliver about 34,180 hp. to the bus bars.

### Cost of Power Development

The project recommended provides a depth of 30 ft. in all lock structures and a depth of 25 ft. in channels except where a greater depth is required to discharge without unduly great velocities the water from Lake Ontario under the new conditions created by the works proposed. The estimated cost of this project, including the installation of hydraulic and electrical machinery for the development of the power, is $159,097,200. The power output will be about 1,464,000 hp. The annual cost of operation, maintenance and depreciation will be $1,762,000 of which $1,457,000 is properly chargeable to the development of power. The estimated cost for securing 30-ft. depth for navigation in the future is $1,270,180 additional.

A survey and estimate has been made of a side canal with locks leaving the river on the Canadian side below the city of Cornwall and entering it again opposite Chimney Point. It would be 45 miles long, with four locks. For 25-ft. depth in canal prism and 30-ft. depth in lock structures the estimated cost is $77,500,000. An additional cost of $10,100,000 would be incurred to deepen the canal reaches to 30 ft. This is considerably more than the estimated cost of an improvement of this division, however, by means of dams in the river, creating pools, and locks past the dams. For 25-ft. depth, the cost of improvement by this method would be $63,500,000. The construction of dams and locks without provision for the development of the water power that would otherwise be thrown away through the control gates would be for navigation alone an economic waste that should not receive serious consideration.

The execution of the project as recommended will

make it possible at a later date to raise the structures at Barnhart Island and to dredge the tailrace so as fully to utilize whatever head the operation of the works may show to be economically practicable. Furthermore, the construction of the Ogden Island dam affords a control over the level of Lake Ontario and the flow in the St. Lawrence River. This control can be exercised so as to raise the mean level of Lake Ontario without causing it to fluctuate beyond the limits which it has reached in previous years. But the studies which have been made of this problem fail to show that any very great increase in the natural low water flows can be made for the benefit of either power or navigation in Montreal Harbor and the ship channel below.

### Fifth Division

This division is about 65 miles long, and the fall at mean flow is about 1 ft. The channel is generally deep and wide, except through the Thousand Islands where the minimum width is about 500 ft. The improvement of this division will require the removal of certain shoals, and the widening and straightening of the present channel. The estimated cost of the work is $100,000 and the annual cost of operation and maintenance is $20,000.

## Ground Water Control on Drainage Project in Florida

### Taintor Gates in Canals Hold Water at Different Levels in Different Soils and Pass Floods —Sand Foundations

By F. Teichman
Consulting Engineer, Wollaston, Mass.

CONTROL of the ground water level or water table in a drainage district by gates in the main canals, with the gate structures built on sand, is a special feature of the Lake Worth drainage district, which is the largest in Florida, having 130,000 acres in an area about eight miles wide and paralleling the coast for 24 miles.

Lake Worth and some smaller lakes along the Florida East Coast Canal are separated from the ocean by a narrow strip of land but are so connected with it that the water is brackish and at sea level, varying slightly with the tide. About two miles west is a chain of small lakes just inside the east boundary of the district, beyond which there is muck soil for about two miles and then six miles of sandy soil. The surface of the chain of lakes is at El. 10, which is the desirable ground water level for the muck soil, the sandy soil being at higher elevation and requiring a ground water level of about El. 16. This muck soil is well decomposed fibrous vegetable matter without silt, holding moisture readily, easy of cultivation and good for truck farming. The sandy soil requires generous fertilizing and is good for trees of the citrus variety. Heavy rains in Palm Beach county occur from March to June and August to December, the rains being largely local or covering relatively small area for each storm. During June, 1919, for instance, the rainfall was 25 in. and during three days of March, 1921, it was 7 in. The canal system and its structures are figured for a run-off of 1 in. per 24 hours, giving extra capacity to the smaller canals that may have to carry the excessive local rains.

Main canals about two miles apart extend north and south, with laterals at right angles to these at ½-mile intervals. At the southern boundary is the Hillsboro Canal and two miles below the northern boundary is the West Palm Beach Canal, both being state canals from Lake Okeechobee and draining the Everglades. The district has connected its chain of lakes with Lake Worth by the Boynton Canal. In both this canal and the West Palm Beach Canal is a concrete outlet structure having square conduits with gates, the maximum head being 12 ft. This outlet on the district's canal has a discharge capacity of over 2,000 sec.-ft. A lock for boats is provided in the structure on the state's canal.

The area of the district is divided into eight units, all intersected by the main canals, which serve to spread the water of heavy local rains and thus relieve local flood conditions. In each unit is a control structure for holding the water at El. 16 for the sandy soil. Below this the water is at El. 10, the flow being through the

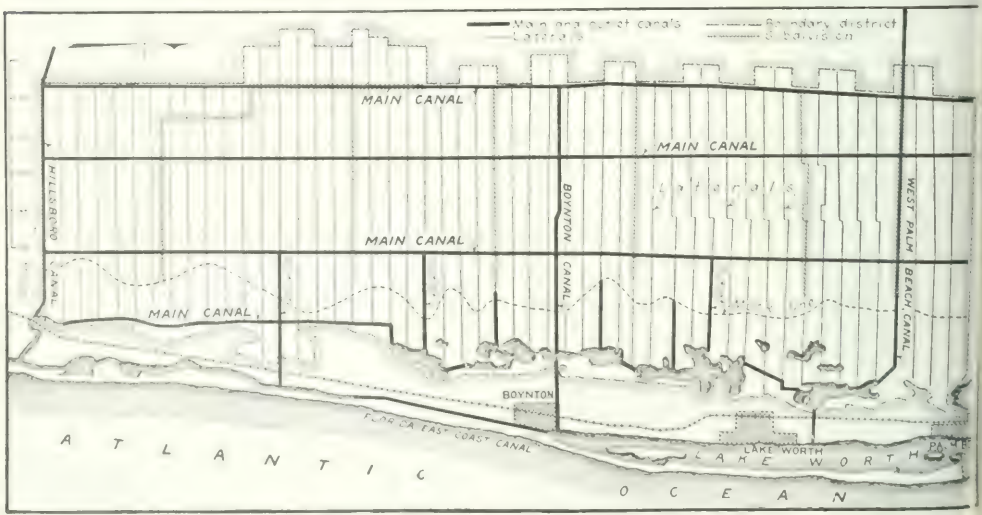



FIG. 1. CANAL SYSTEM OF LAKE WORTH DRAINAGE DISTRICT, FLORIDA

chain of lakes and thence through the Boynton Canal and its control works into Lake Worth. It is aimed to retain these levels during the dry seasons. When a wet season approaches, the water is held at lower levels which are more suited to crop requirements, when there is rain and which also help to keep down the peak line of floods. Thus before the March rainfall this year the gates of the Boynton control works had been opened more than a day on account of the weather predictions, so that the 7 in. of rain raised the water only 2 or 3 in. above its initial level. With an emergency flood storage capacity of 12 to 18 in. in the canal system and the chain of lakes it is expected that any excessive rains can be taken care of without overflow.

The control structure in the Boynton Canal is placed in a canal of 80 ft. bottom width, and has twelve square conduits fitted with Taintor gates, giving a head of 12 ft. and a discharge capacity of 2,400 sec.-ft. under 10-ft. head. On the upper drainage canals, the control structures have similar gates to support a head of 6 to 7 ft. during storage periods, the discharge capacity being equal to the flood flow capacities of the several canals, which ranges from 400 to 800 sec.-ft. The difference between upstream and downstream levels averages about 2 ft.

A Taintor gate is placed at the downstream end of each conduit, with stop planks above and below, as shown in Fig. 2. By removing the upstream stop planks a portion of the flood water may be passed over the closed gates in order to afford temporary relief until the gate operator arrives. Wood is used for the gates on account of the air on the Florida coast having a corrosive effect on steel. Each gate has a cast-iron rack and pinion, the pinion shaft having a square end for a portable ratchet lever.

All the structures are placed directly on the sand, having a porous foundation problem similar to that discussed so frequently in connection with irrigation works in India and Egypt. The destructive agencies to be resisted by structures placed on sand are: (1) Uplift on insufficiently loaded parts of the structure; (2) sliding downstream of the structure under the effect of the head; (3) yielding of the sand if too heavily loaded and not confined; (4) piping at the tail end; (5) undermining of the structure by the agitation of the stream at the tail end.

As to piping, the Indian rule is to make the creep under the structure of such length that the intensity of the creeping current is reduced to a value that at the tail, where the current returns through the canal bottom to the tail water, it will not move the particles of the soil. In "Practical Design of Irrigation Works," by W. G. Bligh, safe values for length of creep to head are given as 12:1 to 18:1. An inquiry directed to Mr. Bligh, giving the curve and the characteristics of the sand of the Lake Worth District, brought the reply that he approved of the adopted gradient 15:1, but that the theory of clinging creep, although originally emanating from Indian engineers (and represented in his books) is not now followed in India.

In this connection, it may be stated that the district structures were provided with gage tubes giving the uplift pressures in front and behind all sheet piling for about every 20 ft. of length of structure. The following results were observed: (1) For sheet piling at lower end of structure of about 10- to 12-ft. length the assumption of clinging creep gives results that nearly tally with observations; (2) For a driven curtain wall of 3 to 4 ft. at tail end of structure the loss of head is about twice that figured for clinging creep; (3) between upper and lower curtain the gradient is a straight line, as must be expected.

The theory and its application of neutralizing head by creep is by no means new in this country. Examples are found in structures of the U. S. Reclamation Service and probably elsewhere. The Reclamation structures have the advantage that they are located in silt carrying streams, so that after installation the condition of their safety improves by the formation of an upstream apron that increases its imperviousness by deposit from the seasonal silt-carrying flood waters. Although the streams and canals of Florida carry no silt it is not unlikely that a slow sealing of the interstices of the soil takes place by decaying vegetable matter.

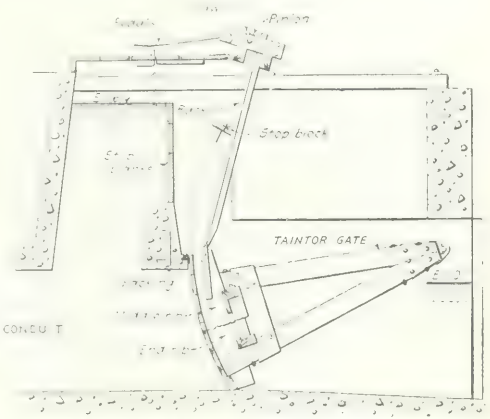



FIG. 2. TAINTOR GATES REGULATING GROUND-WATER LEVEL

The Indian structures as described by W. G. Bligh and by P. M. Parker in his book "Control of Water" are works of greater magnitude. The weight of the structure to counteract uplift is attained by heavy concrete or masonry work in the river or canal bed, where, however, only about one half is effective, the other half being balanced by flotation. Such treatment is undoubtedly correct where large quantities of water have to be passed and where material and labor are cheap. For the Florida work the maximum discharge requirement is little more than 2,000 sec.-ft., rock has to be hauled for long distances and cost of labor is high. So the structures are built in reinforced concrete, with a combination of several conduits having a standard width of 5 ft. and of such height as conditions may require, the structures being filled over and loaded by the soil. This method of controlling the drainage, flood water and ground water level of the Lake Worth Drainage District will eliminate the two undesirable conditions of too much water and too little water.

The organization work and the laying out of the canal system was done under Orrin Randolph, former chief engineer. Construction work is in progress under F. C. Wagen, chief engineer, with Wills & Sons & McCarthy as contractors for the canal work and the structures. The writer has been the consulting engineer for the District and designed the work.

# Pave 70-Ft. Boulevard with Sheet Asphalt

## Mechanical Plant Features Reconstruction of 4¼ Miles of Ocean Parkway in Brooklyn —To Cost $750,000

THE largest continuous area of street paving ever placed under contract in the Borough of Brooklyn, New York City—representing a length of 4¼ miles and a surface of 164,000 sq.yd. of 3-in. sheet asphalt on a 6-in. concrete base—is being completed on Ocean Parkway between Park Circle, near Prospect Park, and Ave. W. The cost, based on the bid price, will be about $750,000. The route is the well known 70-ft. wide boulevard leading from Brooklyn to Coney Island and carries a heavy motor vehicle traffic, particularly on Saturday and Sunday during the summer when great crowds journey to the seaside resort. The paving work includes a concrete curb and gutter, and has been divided into three contracts of 2, 1¼ and 1-mile lengths. The chief point of interest is the unusually extensive use of mechanical plant on the 2-mile section known as Contract 1.

Ocean Parkway was constructed in the days when automobile traffic was negligible and the original surfacing of gravel and broken stone was subsequently treated with applications of ¾ gal. of asphaltic oil per square yard and covered with a thin layer of stone chips, forming a mat which reduced the dust nuisance. There was, however, no foundation course, with the result that as traffic increased the surface became extremely uneven.

In the reconstruction work the first operation consisted in removing the existing bituminous mat and the stone and gravel underneath, involving a maximum cut of about 1 ft. to prepare the subgrade for receiving the 6-in. concrete foundation. The table shows the principal quantities involved on the three contracts. Contract 1 was awarded to the Borough Asphalt Co. at a total cost of $363,653.75, amounting to a price per square yard of asphalt paving (including concrete curb and gutter) of $4.58; Contract 2 was awarded to the Cranford Co., of Brooklyn, at a total cost of $214,484.10, equivalent to $4.29 per square yard; Contract 3 was awarded to the Brooklyn Alcatraz Asphalt Co. at $165,804, equivalent to $4.81 per square yard. For the 163,950 sq.yd. of asphalt surfacing included in the three contracts the bid price averages $4.54 per square yard.

IN REMOVING OLD SURFACE THREE GRADING SHOVELS AND THIRTY-FIVE MOTOR TRUCKS WERE USED

TRACTOR GRADER LOADING TRUCK ALONGSIDE

TWO PAVING GANGS LAYING CONCRETE TO FOLLOW CLOSELY BEHIND GRADING ON 70-FT. BOULEVARD

FINISHING OCEAN PARKWAY RECONSTRUCTION WITH A 1-IN. BINDER AND A 2-IN. SURFACING OF ASPHALT

On Contract 1 a time limit of 75 working days was pecified, but the contractor has been able to work at a ate 100 per cent faster than the contract requirements rrough the use of extensive mechanical equipment. he surface was broken up with plows hauled by steam ollers and the material removed in one of two ways: irst, by an elevating tractor grader which made a ıt 5-ft. 5-in. wide and had a rated capacity of 800 ı.yd. per 8-hr. day, and, second, by three steam grad- ıg shovels each with ½-cu.yd. dippers. Both types of ıachine loaded directly into motor trucks, of which a ;et of 35 5-ton machines was employed on the regulat- ıg and grading work alone. With this equipment an ;erage day's work for the contractor in regulating ıd grading amounted to about 1,015 cu.yd. of material :moved. The subgrade was rolled with two 10-ton ıllers.

The scheme of construction involves close sequence :tween the grading, concreting and asphalt laying ;erations. To keep pace with the grading work and :cause of the great width of the boulevard, two pav- g mixers, each of 2/3-yd. capacity per batch, are nployed, as shown in one of the photographs. Ten ton motor trucks are employed exclusively in hauling ncrete materials. The sand and broken stone are :posited in piles on the finished subgrade ahead of the ixers. Working an 8-hr. day each mixer has turned ıt, on the average, 1,470 sq.yd. of 6-in. concrete. The ıily advance along the 70-ft. wide thoroughfare is, erefore, 378 ft. The concrete is mixed in proportions 1:3:6. The concreting force serving the two mixers nsists of one foreman and 56 laborers. The mixers :e of the boom and bottom-dump bucket type and, le by side, easily command the 70-ft. width to be ved.

Asphalt surfacing operations follow along far enough hind the concreting to allow the foundation to set. ıe surfacing consists of 1 in. of binder and 2 in. of :aring surface. Nine 5-ton trucks are employed on uling asphaltic materials to the job. The asphalt is ought to grade and rolled in the usual way; one 10-ton d one 5-ton roller are used.

On Contracts 2 and 3 less plant and more hand-labor :thods are in evidence. The Cranford Co., however, nploys one steam grading shovel, two 10-ton subgrade llers six 5-ton motor trucks on grading work, two cu.yd. paving mixers, and ten 5-ton automobile trucks r hauling concrete materials.

On the third contract the Alcatraz Co. has one 10-ton bgrade roller, three 5-ton automobile trucks for haul- ing subgrade material, one concrete paving mixer ⅔ cu.yd. capacity, and six 5-ton trucks for hauling concrete materials.

CONSTRUCTION QUANTITIES, OCEAN PARKWAY PAVING CONTRACTS, BROOKLYN, N. Y.

| Item | Contract 1 | Contract 2 | Contract 3 | Total |
|---|---|---|---|---|
| Grading, cu.yd. | 28,000 | 7,570 | 6,900 | 42,470 |
| Conc. foundation, cu.yd. | 13,245 | 8,335 | 5,750 | 27,330 |
| Sheet asphalt, sq.yd. | 79,450 | 50,000 | 34,500 | 163,950 |
| Conc. curb and gutter, lin.ft. | 1,625 | 12,900 | 8,700 | 23,225 |

The work of paving Ocean Parkway is being done under the direction of the Department of Parks of the Borough of Brooklyn, of which John N. Harman is commissioner and E. J. Mullane, engineer in charge.

## Water-Works Cross-Connections at Hartford, Conn.

### George W. Goethals Corporation Reports in Favor of Improved Type of Double Check Valves Under Certain Conditions

AN ORDER by the Water Board of Hartford, Conn., requiring the elimination of all cross-connections between the city water-works system and private supplies from independent sources led a number of large manufacturers of that city to engage George W. Goethals & Co. to report on the subject. Specific questions at issue were the adequacy of "improved check valves" to prevent a menace to health from secondary polluted supplies; whether the fire hazard due to the elimination of cross-connections would more than offset the health hazard due to their retention, and what action the manufacturers had best take in case the Water Board refused to rescind its order. The Goethals company reported that within stated limits, and with frequent inspections, reliance could safely be placed on an improved type of double check valve, with less menace to health than would be caused by the increased fire hazard due to the elimination of all cross-connections. The substance of the report, including a substitute plan for the manufacturers to propose in case the order is not rescinded and an alternative plan of action in the Water Board will not accept even the substitute follows:

We have examined the water connections of the following plants: Underwood Typewriter Co., Hartford Rubber Works, Pratt-Whitney Co., Billings & Spencer Co., Hartford Machine Screw Co., Johns Pratt Co., and New Departture Mfg. Co.

The piping layouts of these plants are so arranged that water for drinking, cooking purposes, hand basins, and, in instances, a percentage of sanitary closets, is drawn from the city main through separate metered connections, and are entirely separate and distinct from all other layouts within the plant limits. Water for sprinkler heads, hydrants and standpipes and certain percentages of sanitary closets is drawn from the city mains through 8-in. connections in which are installed the double check valves. The number of such connections vary from one to a maximum of five in the case of one plant. This system is generally independent of the individual industrial service supply from Park River. In certain plants cross-connections between the city and industrial water are in use protected by double hand valves and drains, so that under emergency conditions it is possible to get city water for the industrial work. In other cases the same result is obtained by actually placing short sections of pipe between the city and interior industrial supply piping.

The sprinkler and hydrant systems are in all cases connected with emergency fire pumps drawing water from the Park River or, as in one case, from an adjacent pond, as a secondary source of supply.

### Public Health Paramount

It will not be disputed that safeguarding the public health is of paramount importance in the design, installation and operation of a modern water supply system, and that an adequate and dependable water supply always available for fire protection is in importance second only to the question of public health. Furthermore, a complete breakdown in the supply system of a city for more than a few hours reverses the relative importance of the above, and if there were a secondary polluted supply available, no city would hesitate to force such water through its mains. The relative importance of the question varies with conditions. As a practical matter, it would be wiser to attempt to maintain supplies of water which would meet all conditions of fire and water closet demands without interruption, than to attempt to maintain 100 per cent pure water, because the first is practically possible and the second is not. The present system of pipe distribution, the manner in which underground pipes are repaired and maintained, the unknown branches always found connected to city mains taking water from polluted sources, the installation of water closet flushometers direct connected to city mains, and other sources of possible contamination, prohibit the maintenance of theoretically pure water at all times.

As a matter of general policy the primary water supply of the city should not be connected physically to a secondary polluted supply, except and only to provide for fire protection in the event of temporary failure of the primary supply. Where such secondary supplies are available, cities have recognized the advantages and have permitted the connection of same to the primary supply, but only under the most rigid control, inspection and maintenance, and only for sprinkler and hydrant service.

To allow such connections in special cases and in limited numbers, the so-called double F. M. [Factory Mutual] check valve installation came into use about 1910 or 1911. This equipment has to date been recognized as a reasonably certain safeguard to public water systems by the officials of many cities and has been accepted as a sufficient and satisfactory safeguard by the Commissioner of Health of the State of New York. The Board of Health of New Jersey has recommended this arrangement in specific instances.

No one will deny that under certain conditions, occurring most infrequently in properly maintained installations, swing check valves leak; notwithstanding this, we do not believe authenticated instances can be cited in New England or elsewhere since 1912, which have resulted in contamination of the primary supply and where the presence of B Coli, if found, could not be traced to sources *other than check valves of this type properly installed and inspected.*

It will be understood that the proper installation of swinging checks of standard F. M. or improved type calls for practically static water condition in the pipes on the plant side of the valves, except under actual fire operations. For various mechanical reasons this increases the reliability of the valve.

We believe the F. M. valve is open to further improvement in design, and in our opinion the all-bronze type built by C. D. Rice, chairman of your committee [Committee of Manufacturers, Hartford, Conn.], is a step in this direction.

A criticism directed against the F. M. check valve installations is that they leak or are most liable to leak appreciably under pressures higher than the city pressure. Such can be the case only on the assumption of obstruction holding the seal up or the seal being partly torn away. This condition in a water line, static at all times other than in case of fire emergency, is an exceptionally remote possibility and indicates improper supervision. No one today condemns modern rapid mechanical filters on the basis that, if you do not properly operate and maintain them you will unquestionably get polluted water into your clear water well and thereby menace the public health.

If the above criticism is the principal one, it is perfectly feasible to install a special type valve at the fire pump that effects a physical separation during pumping operations between the secondary and primary supplies. This valve under no possible condition can leak to the primary side up to 150 lb. per square inch, and, hand or power operated can under no circumstances be so manipulated as to connect the fire pump direct to the city mains. This valve, in the event of poor adjustment, will leak to the atmosphere and present evidence of its adjustment at all times on its exterior. With this installation the F. M. check or improved design check should be installed back near the city take off to provide against the condition of city pressure dropping to a point where the dead head of water in the sprinkler heads would slowly settle back into the city mains unless checked. This system makes most improbable pressures in excess of city pressure reaching the check valves.

If the city of Hartford would eliminate all physical cross connections now existing between polluted secondary supplies and the city mains, and require the comparatively few double check control installations to be replaced with all-bronze body special design checks similar to Mr. Rice's design, with or without certain additions that might be suggested; and if the city would compel such installations to be on independent sprinkler head and hydrant lines with no cross-connections of any character; and, lastly, would continue the present system of weekly or bi-weekly inspection; then the danger to the public health would, in our opinion, be entirely negligible.

Such a policy would permit the continued availability of an inexhaustible secondary supply for fire protection, which far outweighs, in our opinion, a limited tank supply placed below ground, required if the valves are eliminated.

### Conclusions

Our conclusions therefore are as follows:

1. The public health of the city of Hartford can be completely safeguarded with the continued use of a check valve system of improved design on the following basis.

a. Eliminate all city connections to secondary polluted supply wherever located, except existing connections to sprinkler heads, hydrants and fire pumps.

b. Eliminate all existing cross-connections running from sprinkler head or hydrant feeders to interior service and taken off on the plant side of check valves.

c. Install improved type of double swinging checks in self draining concrete vaults protected from frost and freely accessible for all purposes.

d. Maintain not less than bi-weekly inspection tests.

2. It may reasonably be stated that the increased fire hazard resulting from the elimination of a check valve system installed as defined immediately above would more than outweigh the remote danger to public health through the proper operation of such valve system.

3. There is no recognizable danger to the safety of the public health in the carrying of polluted water in extensions to city mains ending in hydrants and sprinker heads if no cross-connections are allowed and if check valves are installed as above.

4. In the event the city declines to rescind the present rder or to modify it so as to allow the above recommenda- ions to be followed, we propose the installation suggested special valve at fire pump] and additional fire pumps suf- cient to provide full plant protection and all necessary ydrant supply for a general plant fire, independent of ity supply.

5. In the event the city declines this alternative, install mallest ground or elevated tank for sprinkler heads that ill pass underwriters, and connect existing fire pump in- ependently to exterior hydrant lines and standpipes, add- ig to the pumping equipment where necessary to give the ill capacity of hydrants to the maximum number required.

The order of the Hartford Water Board that all cross- onnections must be severed by Sept. 1, 1921, in accord- nce with a report and recommendations by Caleb Mills aville, manager and chief engineer Hartford Water epartment, was printed in *Engineering News-Record*, uly 7, 1921, together with the larger part of Mr. aville's report on the Subject. (See news this issue.)

## Underground Water Supply for an Akron Rubber Plant

By Frederick L. Roache
Cleveland, Ohio

TO THE rubber industries a large supply of water is as necessary as rubber and the water must be ld. The demands of the four large rubber companies Akron, Ohio, combined with the sudden increase in pulation, increased the water consumption beyond the pacity of the city supply, and compelled some of the bber companies to develop water supplies of their n. A supply with a summer-and-winter temperature 49 deg. F. was secured and has been delivered to e works at a unit cost of about one-third of the city tes.

The rubber company with which I was connected was ated on a branch of one of the small rivers between ke Erie and the Ohio River. A study of the rain- ll and run-off of this small river was made. A -ft. concrete weir was built above the plant and a ieze automatic stage-register was installed. The ainage area was about 43.4 sq.mi. The normal nual rainfall was 37 in. and the drainage area about per cent cultivated. I estimated that the evapora- n was 10 per cent, the run-off 20 per cent, amount sorbed by vegetation and used for domestic purposes, per cent, leaving about 40 per cent as underground rage. Both the rainfall and the river flow were ry erratic, with winter and summer periods of mini- m flow. The minimum river flow in July was less an 1.23 m.g.d. and the total precipitation for the nth was 1.98 inches.

After preliminary tests, made by driving 2½-in. pipe wn to and 15 to 20 ft. into rock, securing samples, d plotting ground water profiles in the valley of 3 mi. area above the weir, six wells, with 20-in. reens, were sunk to rock, which was found at depths 102 to 149 ft. Pumping tests of the first well war- nted sinking more wells, and like tests of the second ll showed a yield of 1,649 gal. per minute. When five the six wells had been sunk it was estimated that an erage total of 3,500 gal. a minute could be obtained. 24-in. (vitrified clay and cast-iron) pipe line, 6,000 long, with a fall of 17 ft. to the plant, was built. was assumed that this would be large enough to ry 1,000 gal. per minute additional, from a sixth well, by gravity, and that if necessary the pipe line could be put under a small pressure without lessening the yield of the wells. To meet the increasing demand for water, each of the five pumps was run at full capacity, giving a yield of 4,500 gal. a minute, and the sixth well was sunk. The total output under normal conditions, using six wells, was 5,000 gal. a minute.

The pumping plant consists of five 15- and one 20-in. American deep well pumps, operated by four 25-, one 20- and one 40-hp. motors, the latter driving the 20-in. pump. A novel and efficient connection between pump and motor (both shafts vertical) was made by the use of a pliable leather belt, which eliminated jar and excessive load in starting and allowed a small error in alignment.

The combined suction and supporting pipe and the discharge pipes have diameters of 10 in., except that for the 20-in. pump the diameters are 12 in. The water is discharged into baffled weir boxes, each equipped with a 24-in. rectangular weir. The weir boxes discharge into open manholes connected with the main supply line. The weir box was connected to still water wells in the pump houses, where Frieze automatic water-stage registers record the entire flow over a weir.

The pump houses are of wood, 14 x 16 ft. in plan, with pitch roof, and a concrete floor and pump base. For removing the pumps and cleaning the wells each pump house is provided with a trolley crane running on a 15-in. I-beam placed just beneath the ridge pole and supported by an A-frame independent of the roof purlins.

Electric current was carried from the plant power house—2,200-volt, a.c., three-phase, 60 cycles—and reduced in voltage at each well house to 440 volts. This current was metered at each well.

The pump houses were successfully warmed during a severe winter by two electric heaters in each. The 1½-in. pipe line from the weir box to the still well in the pump house was warmed by a frost box in which were installed four 110-volt light bulbs in series. Carbon filament bulbs were used because they gave more heat than bulbs of later type.

An accurate account of the maintenance costs was kept. Combining these with 10 per cent for depreciation and repairs, and 6 per cent for interest on the whole investment (excluding land values, as the land was used for other purposes), the cost ranged from 13 to 17c. per 1,000 cu.ft., varying with the amount supplied, or about one-third the city rates. Besides the saving in cost, water with the desired low temperature throughout the year was obtained. Bacterial tests of the water from each well showed a total count of from 8 to 12 per c.c., except that one well showed 40 bacteria.

### Concrete Barges in Austria

The construction of concrete ships and barges in the United States has practically ceased, but apparently the industry is continuing in Europe, for a note has just been received from V. C. Lazarus, of the Syndicate for Ferro-Concrete Ships, of Vienna, stating that on July 3, a large reinforced-concrete barge was launched at Krems, Austria, for use on the Danube River. This is a 700-ton dead weight and has the same hull design as the steel barges normally used on the Danube. Information regarding the dimensions of the barge is not available.

# Special Structural Design for Newspaper Building

## Lower Chord of Steel Roof Trusses Will Form Future Floor Reinforcement—Unit Loads Varied On Floors

TEMPORARY steel roof trusses, independent press foundations and floor design for light and heavy loads in different parts of the building are structural features of the new reinforced-concrete building for the *South Bend Tribune* at South Bend Ind., which has been designed for the combination of office and industrial requirements of a newspaper publishing business. An unusual feature of the roof construction is that the present trusses will be removed when additional stories are built, the bottom chords remaining in the floor (now the roof) and intermediate columns being placed under them.

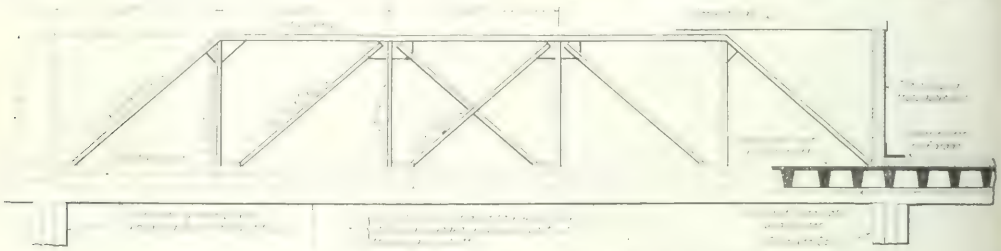
This building is three stories high but designed for three additional stories. Storage for 1,000 tons of press paper is provided in the basement, which has also a boiler room, 100-ton coal bunker, fire-proof vault and locker room with toilets and shower baths. On the first floor are the business offices in front and the press and mailing room at the rear, separated by a hall in which the newsboys get their papers. Behind the press room is a 14-ft. driveway, under the second floor, extending from the alley to the street and having doors at each end. An electric overhead hoist lifts the 750- to 1,200-lb. rolls of paper from trucks in the driveway and lowers them into the basement, where they are handled by a small electric truck with a stacking attachment. On the second floor are the editorial offices, composing room (54 x 64 ft.) and stereotyping room (33 x 54 ft.). An assembly room 60 x 60 ft., with dining room and kitchen at the rear, occupy the main part of the third floor, these facilities being mainly for the use of the employees. Brown, rough-faced brick is used for the exterior walls, with steel and gray granite and terra cotta trimmings.

Interior columns are omitted in the assembly room, in order to give an unobstructed space, the roof slab being supported over this part of the floor by steel trusses of 54½-in. span, whose lower chords are embedded in concrete girders. Above the roof slab (or future fourth floor) the trusses are inclosed in a tile superstructure with concrete roof. When the additional stories are to be built, the upper part of each truss will be removed by cutting the web members at the top of the concrete floor slab, new concrete columns being then placed under and upon the girders to continue the columns from the lower floors, as shown by the dotted lines. The bottom chord will remain as reinforcement in the concrete girders.

Floor construction is mainly of the ribbed slab type, with the ribs concealed by a ceiling of metal lath and plaster. Sheet steel inverted troughs 20 in. wide are used to form the 5-in. ribs, spaced 25 in. c. to c., the depth of the rib being 12 in. with a 2-in. slap on top. An exception to this construction is the stereotyping room, where a 5-in. slab and girder design is used on account of the weight of the furnaces or melting pots. This part of the floor is designed for a live-load of 500 lb. per square foot, and the composing room (with heavy typesetting machines) for 300 lb.; elsewhere the load is 150 lb.; except that for the offices it is only 100 lb. The floor panels are mainly 18 x 22 ft. c. to c. of columns.

Foundation conditions are simple, the site being on a deep bed of sand and gravel, so that the footings are just beneath the basement floor, the load limit of the footings upon the material being 6,000 lb. per square foot.

A special foundation, for the 60-ton press, independent of the building foundations, consists of a pair of massive concrete girders, connected by transverse beams and supported on short columns. The floor under the press is level with the first floor slab, but isolated from it by a space 8 to 30 in. wide, covered by steel plates, so that vibration due to the machinery will not be transmitted through the building.



STEEL ROOF TRUSSES TO BE REMOVED WHEN STORY IS ADDED

To remove the hot gases and fumes from the stereotyping room the melting pots have hoods connected by metal pipes to flues built on the inside of the rear wall. In addition, a ventilating shaft 3 ft. square extends from the middle of the ceiling to the roof, where it is capped with an exhaust head. When the additional stories are built this shaft will be carried up to the new roof. For general ventilation of the first and second floors there is a fan in the basement, delivering fresh air through galvanized iron risers cased with hollow tile. A fireman's pole placed near the press and extending from the second floor to the basement, is an unusual appliance installed to enable men to drop rapidly from floor to floor without taking time to go round by the stairs. A pneumatic tube system serves the several departments. Sprinkling equipment for fire protection is connected to an outdoor nozzle for the attachment of fire hose.

In the design of this building the architects, Austin & Shambleau, South Bend, Ind., were guided by floor layout plans prepared by F. A. Miller, editor and vice-president of the *Tribune*. The H. G. Christman Co., also of South Bend, had the contract, with R. G. Taft as superintendent of construction.

## Test Bearing Strength of Bolts Through Concrete Beam

By S. C. Majumdar
Structural Engineer, H. W. Lane Co., Detroit, Mich.

During a recent investigation of the strength of a number of monorail supports in an industrial plant it was necessary to assign definite values to bolts which had been cast into concrete beams. These bolts extended horizontally through 15 in. of concrete and supported clip angles at one or both of their extremities. The load being applied at the clips, bending was introduced in the bolts preventing a uniform bearing in the concrete. In addition there was a slight eccentricity in the application of the load to the clip angles. The exact amount of eccentricity which was transmitted to the bolts depended somewhat upon the stiffness of the connection between the monorail beam and the clip, the assumption being that the clip would act as a cantilever

FAILURE OF TWO 1-IN. BOLTS UNDER TEST AT ... OF 21,500 LB.

and tend at least partly to produce a vertical load rather than a rotation about the far bolt. In view of these complications it was decided to make an actual test.

Two 1-in. bolts placed 5½ in. above the bottom of the beam were used, the concrete having been poured about 3 months. An attempt was made to approximate as nearly as possible the exact conditions, both as to stiffness and eccentricity. To the standard clip angle shown at the top, in the accompanying view, was bolted a hanger consisting of two angles 4 x 3 x ... in. or about 2 ft. long, on the bottom of which was hung, by means of steel cables, a loading platform. This platform was made up of two 12 x 12 in. timbers 12 ft. long, covered with 3-in. plank, and was guyed in each direction to prevent swinging during the process of loading. A level was also applied to the vertical hanger to insure concentric loading on the platform. As pig iron was piled on the platform and the cables straightened out and adjusted themselves to the load, shims were placed under and kept to within a couple of inches of the main timbers to prevent too great a drop when the failure occurred. This precaution was taken to prevent sudden impact on the reinforcing bars in the concrete beam with a possibility of destroying their bond.

Failure occurred at 21,500 lb. and took place several minutes after the last pig was applied. Although the concrete was worth considerably less in bearing under the bolts than in shear the ultimate failure was evidently one of shear. The beam had been previously painted and it was impossible to detect any cracks that may have developed prior to failure. If any such cracks were present they were too small to break the surface of the paint.

Had it been possible to design the above connections, using vertical bolts in direct tension instead of bearing, the same bolts would have developed an ultimate strength of at least three times as great as they did.

## Man-Hours and Material Cost Data for Cast-Iron Pipe Laid

By Leo G. Hall
Onekama, Mich.

The accompanying table showing the number of man-hours and the amount of material per 100 ft. length of 4- to 36-in. cast-iron pipe laid on a number of jobs is similar in form to the valuable series of tables for various classes of building operations contributed to *Engineering News-Record*, May 26, p. 888, by Frank E. Barnes.

My table is based upon (1) direct observation of work on water mains for the General Chemical Co., Marcus Hook, Pa.; for the Camp Hill Embarkation

DATA FOR ESTIMATING COST OF CAST-IRON PIPE IN PLACE

| Size of Pipe, In. | Man-Hours Laying 100 Ft. of Pipe | | Trench Depths for Laying, Ft. | | Materials per 100 Ft. of Pipe, Lb. | | |
|---|---|---|---|---|---|---|---|
| | Class C Pipe | Special Pipe | Class C Pipe | Special Pipe | Class C Pipe | Special Pipe | Oakum |
| 4 | 24 | 40 | 5 | 4 | 2,200 | 50 | 1 9 |
| 6 | 27 | 44 | 8 | 7 | 3,600 | 70 | 2 8 |
| 8 | 30 | 47 | 11 | 9 | 5,200 | 95 | 3 8 |
| 10 | 34 | 54 | 16 | 11 | 7,100 | 125 | 4 6 |
| 12 | 38 | 61 | 22 | 12 | 9,300 | 160 | 5 3 |
| 16 | 48 | 75 | 32 | 25 | 14,400 | 210 | 8 0 |
| 20 | 64 | 106 | 48 | 38 | 20,400 | 265 | 11 0 |
| 24 | 80 | 130 | 75 | 50 | 27,600 | 325 | 13 5 |
| 30 | 98 | 157 | 90 | 62 | 39,900 | 430 | 19 0 |
| 36 | 120 | 190 | 110 | 76 | 54,600 | 650 | 26 0 |

Cantonment and Warehouses, Newport News, Va.; the Willys Corporation, Elizabeth, N. J.; and (2) upon indirect data from a number of industrial and railroad yard construction jobs with which I had no field connection. The pipe used was of the Class C type.

Figures marked with an asterisk were arrived at by interpolation. The considerable divergencies in some of the original figures could usually be traced to special circumstances, and allowances were made accordingly in striking an average. The figures show about what may be expected of an average well organized gang on a large job, with no special difficulties to overcome.

The widest divergencies appear under trenching. The figures given are intended to represent average performance in trenching between the depths of 2½ and 6 ft. only, where little pumping and no sheeting is required. At depths exceeding 6 ft., the cost increases much faster than the depth. Trenching here includes bellholes and backfill. Quantities of lead and yarn are sufficient to take care of a small amount of wastage which always occurs on a construction job.

As to fittings, experience shows that it is best to allow the cost of 10 ft. of straight pipe for each ell, tee or wye and 20 ft. of straight pipe for each double wye, cross or special fitting. Such expenses as hauling, superintendence, etc., are not susceptible of being tabulated in compact form and are therefore omitted.

# Use of Photography in Hydraulic Measurements in India

## Photographic Tests Made on Large Jets Check Remarkably Close with Actual Gagings by Current Meter

By S. C. Majumdar.
Executive Engineer, Public Works Department, Madras, India.

In *Engineering News-Record*, July 8, 1920, p. 62, Pierce J. McAuliffe describes experiments made by him to measure the velocity of discharge through hydraulic dredge pipes. Practically similar methods were adopted by the writer in January, 1919, to determine the coefficient of discharge through sluices working under high head. The result then obtained has now been verified by actual gagings.

The sluice experimented upon is one of the eight scouring sluices in the Krishnarajasagara dam which is being constructed by the Mysore State across the Cauvery, one of the largest rivers in southern India. The dam is to be raised ultimately to a height of 124 ft. from the river bed, but at the time the experiment was made water could be stored only to a depth of 63 ft. The sill of the sluice is 12 ft. above the river bed and the tunnel in the rear of the 6 x 12-ft. shutter 77 ft. long and 6 ft. wide. Even when the shutter is raised fully the water surface in the rear is below the springing level of the tunnel archway, the section of the waterway being a perfect rectangle 6 ft. wide at the sill. The bottom and sides of the tunnel are paved with first class ashlar masonry and there is no splaying at the ends. The water issues out of the tunnel in a fine jet and falls freely into the air. There is neither bottom nor side contractions but the main body of the jet is covered by very fine sprays at the top. For some distance after it leaves the tunnel and where it is not covered by sprays the sides of the jet are found to be in vertical planes interspersed with well defined rays formed presumably by the horizontal joints of the masonry at the mouth of the tunnel. These parabolic rays are visible even with the naked eye along the whole depth of the jet.

### Determining Coefficient of Discharge

The problem of finding the value of the coefficient of discharge through these sluices has been engaging the attention of the Governments of Madras and Mysore during the last three years. The only site available for gagings was about two miles below the dam, where the river flows in three branches, the total width being about 3,300 ft. The velocity is necessarily low and and results obtained in 1918 and early in 1919 had to be rejected being most erratic. It was only at the beginning of the present year that all the difficulties could be satisfactorily overcome and the gagings made then with Fteley current meters were found to be fairly reliable.

When the gagings were in progress in 1918 the writer, who was in charge of these operations, proposed an alternative method to find out the value of the coefficient of discharge. The theory underlying the method is well known, viz., that when water falls freely into the air with an initial velocity, as is the case in the present instance when the discharge leaves the tunnel, it follows the path of a parabola and if the co-ordinates of this parabola are known the velocity of the issuing jet can be determined by eliminating $t$ from the equations, $vt = x$; $\frac{1}{2}gt^2 = y$, where $v$ = velocity in feet per second, $t$ = time in seconds, $x$ = horizontal co-ordinate in feet and $y$ = vertical co-ordinate in feet.

But the problem was to measure these co-ordinates. Direct measurements were impossible, for, apart from personal risk to the observer, results even roughly approximating the truth could not be obtained owing to the presence of fine sprays on the top of the jet. It therefore occurred to the writer to take a photograph of the profile of the jet and it was believed that the sprays would appear in the photograph in a lighter shade and as such it would be possible to distinguish them from the main body of the flow. It was also expected that a good photograph would show the parabolic rays on the side of the jet and it would be possible to determine the velocity not only at the top and bottom but also at intermediate points of the jet.

As expected the sprays in the photograph (taken Jan. 18, 1919) could be clearly distinguished for some distance and the path traced by the top layer of the jet could be clearly located. In addition, one of the rays leaving the tunnel at a depth of 3.2 ft. from the surface could be clearly distinguished and its path could be traced till it met the water surface of the river. The

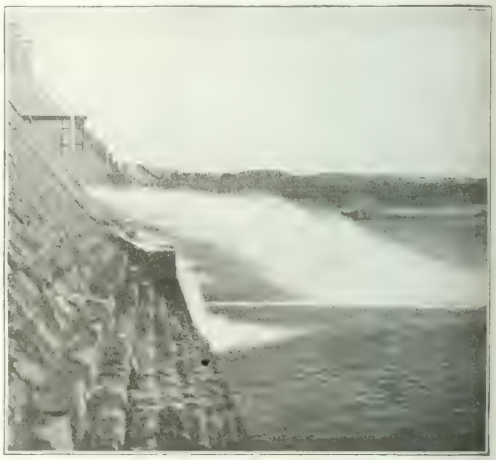


FIG. 1. SCALE AND JET FROM SLUICE

path traced by the bottom layer of the jet could not be distinguished quite so clearly, as the insufficiency of light caused this portion of the photograph to be somewhat hazy. This was not serious, for most of the discharge is confined within the paths which could be clearly traced and as such an error in the measurement of velocity at the bottom can only affect the estimation of the total discharge to a small degree. To avoid this difficulty an alternative method is suggested, viz., to assume that the velocity changes uniformly with the depth and to deduce the velocity at the bottom from the known velocity at the surface and at 3.2 ft. depth of the jet respectively. The results were worked out by both methods.

In order that the sprays may be clearly distinguished from the main body of the jet no lines have been drawn in the photograph. But the three parabolic paths have

been reproduced in the drawing, with the help of the co-ordinates actually measured from the photograph. Just above the jet a scale arranged in the shape of inverted *T* will be noticed. This was fixed in the plane of the front profile of the jet which was photographed and all the measurements have been made with this scale, viz., the abscisses measured with the horizontal scale and the ordinates with the vertical scale.

Two sets of co-ordinates have been measured for each of the parabolas, at points marked $A_1$, $B_1$ and $C_1$ and those marked $A_2$, $B_2$ and $C_2$. The velocities as obtained by either set agree closely; the slight difference may be due either to the error in measurement or to imperfect draftsmanship. The latter cause is more probable in the case of the points $A_2$, $B_2$ and $C_2$, (1) because at the point $A_2$ the sprays are very prominent and cannot be distinguished quite so clearly as at $A_1$, and (2) because the points $B_1$ and $C_1$ where the parabolas meet the river surface can be more clearly located than those lying higher up on the curve. For this reason the writer is of the opinion that the velocity worked out from the co-ordinates of the points $A_1$, $B_1$ and $C_1$ should be more reliable. In any case the discrepancy in the values of the coefficients as given by either set of co-ordinates is very slight and, as will be noted below, is within the range of values obtained as a result of actual gagings most carefully conducted.

*Calculations*—When the photograph was taken the shutter was raised 3.4 ft. above the sill, giving an effective head of 48.03 ft.

The co-ordinates of the points measured directly from the photograph with the scale shown in the picture and the velocity calculated therefrom are as follows:

| | | | | |
|---|---|---|---|---|
| At $A_1$ | $x$ | = 22.8 | ft. | = $vt$ |
| | $y$ | = 3.7 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 47.40 | f.p.s. | |
| At $A_2$ | $x$ | = 29.5 | ft. | = $vt$. |
| | $y$ | = 6.4 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 46.64 | f.p.s. | |
| At $B_1$ | $x$ | = 19.8 | ft. | = $vt$. |
| | $y$ | = 9.8 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 25.30 | f.p.s. | |
| At $B_2$ | $x$ | = 11.2 | ft. | = $vt$. |
| | $y$ | = 3.2 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 25.04 | f.p.s. | |
| At $C_1$ | $x$ | = 13.6 | ft. | = $vt$. |
| | $y$ | = 9.3 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 17.84 | f.p.s. | |
| At $C_2$ | $x$ | = 6.8 | ft. | = $vt$. |
| | $y$ | = 2.7 | ft. | = $\frac{1}{2}gt^2$ |
| | $v$ | = 16.56 | f.p.s. | |

The depth of the jet measured on the sill at the extreme end of the tunnel is as follows: $AC = 3.7$ ft., $AB = 3.2$ ft., $BC = 0.5$ ft.

The area of waterway between $A$ and $B$ is therefore 19.2 sq.ft. and that between $B$ and $C$ 3 sq.ft.

The total discharge as given by the velocities worked out from the co-ordinates of the points $A_1$, $B_1$ and $C_1$ amounts to

$$\frac{47.40 + 25.30}{2} \times 19.2 +$$

$$\frac{25.30 + 17.84}{2} \times 3 = 762.6 \text{ cu. ft.}$$

Equating this to the usual sluice formula $CA\sqrt{2gh} = 762.6$, where $h$ the effective head = 48.03 ft. and $A = 20.4$ sq.ft., the value of $C$, the coefficient of discharge, is found to be 0.674.

Similarly the value of the coefficient as worked out from the co-ordinates of the points $A_2$, $B_2$ and $C_2$ is found to be 0.664. By adopting the alternative method referred to above the value of the coefficient as given by the co-ordinates of the points $A_1$ and $B_1$ is found to be 0.680 and that given by the co-ordinates of the points $A_2$ and $B_2$ is found to be 0.67.

Gagings were conducted about a year after the photograph was taken. The water level in the reservoir was practically the same and there was no material difference in the effective head of discharge. The range of heights of shutter openings during the gaging period varied from 1.4 to 3.7 ft. and the coefficients from 0.641 to 0.700. But on a careful examination of the results it was found that the variation in the height of shutter opening had no effect on the value of the coefficient found except when the shutter was opened fully or at any rate the effect was so slight that it was covered by the unavoidable error in gagings. It has therefore been proposed to accept the mean value of the coefficient, 0.673, as being more reliable than that given by any of the individual gagings. The values of the coefficients as worked out from the co-ordinates measured from the photographs agree with this value remarkably closely, being 0.674 when calculated from the co-ordinates of

FIG. 2—PATH OF RAYS DECIDED UPON

points $A_1$, $B_1$ and $C_1$, 0.680, by the alternate method on the same points; 0.664 by $A_2$, $B_2$ and $C_2$, and 0.670 by the alternate method on the latter points.

On the day when the photograph was taken the weather was fairly calm and in addition the issuing jet was protected from the wind by the high dam. But that there was frictional resistance offered by the air is evidenced by the formation of sprays on the surface of the jet. Theoretically, this should cause some error in the application of the equations of the parabola which do not take into account this additional force. But that this error is insignificant is demonstrated by the close agreement of the result with that obtained from actual gaging.

In conclusion it may be stated that the accuracy of the method depends to a great extent on the skill of the photographer. In the present case the services of a local photographer only could be procured. The photograph is not quite so good as could be desired as only one intermediate ray can be clearly distinguished and the lower portion of the photograph is somewhat hazy. The photograph could have been improved upon by providing a dark background and lighting the lower portion of the jet artificially. The accuracy of the measurements of co-ordinates depends on the size of the photograph and a more satisfactory result can be obtained by using a camera of larger size. It has also occurred to the writer that measurements can possibly be more accurately made by projecting the view on a screen, but the method has not yet been tried.

# Mechanical Filtration Plant Being Built in Cambridge

## Water Purification at Massachusetts City Includes Coagulation, Sedimentation, Aëration and Chlorination

By George A. Johnson.
Consulting Engineer, New York City

THE mechanical filtration plant of 14 m.g.d. capacity now under construction for the city of Cambridge, Mass., is the first of its kind to be built in Massachusetts, and is more than twice the size of the one at Bangor, Me., the largest plant of this type heretofore built in New England. The Cambridge plant includes a covered sedimentation basin, filters, aerating and chlorinating devices for the filtered water, a covered clear water basin, a wash-water receiving basin, from which water is sent back to the settling reservoir, and low-lift pumps to deliver stored water from Fresh Pond to the filters, when the gravity flow to the pond fails to meet the demand. The structures are mainly of reinforced-concrete flat-slab and beam-and-slab type, with brick walls above the first story and concrete roofs.

The population of Cambridge was about 110,000 in 1920, and some 92,000 two decades earlier. In the same period the water consumption increased from 79 to 100 gal. per capita.

### Reservoir System

Cambridge has a surface water supply, impounded in large reservoirs and subjected to a further period of long storage in a receiving reservoir. From the latter, the water is pumped to the city, in which there is an equalizing reservoir. The total storage capacity in the two impounding and the one receiving reservoirs is 3,092 m.g. Of this, 2,338 m.g. is provided by the Hobbs Brook reservoir, 354 m.g. by the Stony Brook reservoir and 400 m.g. by the Fresh Pond receiving reservoir. The water stored in the Hobbs Brook reservoir flows down the natural channel to the Stony Brook reservoir. From this reservoir to Fresh Pond the water flows through 7.53 miles of closed conduit. The population on the 23.57 miles of drainage area tributary to the two storage reservoirs is about 2,800 or 119 per square mile. Fresh Pond has a drainage area of about a mile on which there are some 8,000 people, but a bank protects the pond from surface drainage.

The reservoir system as a whole provides a long storage period, which affords considerable reduction of color and bacteria, but algae in Fresh Pond sometimes cause much trouble. Ample regulations for the sanitary protection of the water supply have been made. The swampy areas that give rise to color have been reduced and this work will go on. Measures to lessen algae growths will also be prosecuted. Fresh Pond water, as delivered to the pumps, has an average turbidity of about 10 p.p.m.; a color averaging about 25 with a maximum of some 40; and an average hardness of 30 p.p.m. of which about half is temporary. Notwithstanding these relatively favorable conditions, provision of a complete water treatment plant has been thought wise and designs for it have been made by the writer, who has been consulting engineer to the water board since 1915. Contracts for the plant were let June 28.

The filter plant site has an area of 1.6 acres, near Fresh Pond. The filters will be supplied so far as possible from a weir chamber at the lower end of the conduit now feeding Fresh Pond. Any deficiency will be made up by a low-lift pump connection with present suction pipe from Fresh Pond. The structures are mainly of reinforced concrete of flat-slab and beam-and-slab type. The superstructure above the first story is brick and the roof is of concrete.

*Sedimentation Basin.*—The sedimentation basin is a covered reservoir 96 x 137 ft. in plan and 16 ft. in effective depth. It covers approximately 0.3 acre of ground, and has an effective capacity of 1.5 m.g., or 2.5 hours' flow when the filters are operating at full capacity. The basin is divided into two equal parts arranged so that either can be taken out of service at will for cleaning, or otherwise to suit operating conditions. A distributing weir and a downward baffle are provided at the inlet end, and a surface take-off or skimming weir at the outlet end. Distributing pipes for returned filter wash water are located on the bottom of the basin just beyond the baffle at the inlet end. A sludge pump, overflow and gate chambers complete the equipment of the sedimentation basin which is separated from the clear water basin by a 20-ft. bank to guard against any contamination of the filtered water through slight leakage from this source.

*Filters.*—There are ten filter units laid out in one row with pipe gallery and operating platform along one side. A concrete flume, which receives coagulated and settled water from the sedimentation basin through a 48-in. pipe, traverses the length of the pipe gallery and supplies all of the filters. The filter tanks are monolithically constructed, each 20 x 24 ft., by 9 ft. deep, with a filtering area of 480 sq.ft. and a filtering capacity of 1.4 m.g. per 24 hours when filtering at the rate of approximately 2 gal. per square foot per minute, or 125 m.g. per acre per 24 hours.

The filtering materials will be about 27 in. of special filter sand overlying 9 in. of graded gravel. The filter equipment is in general conformity with customary practice, except that the pipe sizes are made somewhat larger. The Wheeler filter bottom is to be used.

*Filter Bottom.*—The filter floor, of the type known as the Wheeler bottom, consists of closely arranged rows of pyramidal depressions, each 5.5 in. deep and 8.8-in. base, with a ¾-in. brass tube 1.5 in. long set at the apex, for the connection and discharge of the filtered water or the admission of wash water from the channels or filtered water collectors below. In each pyramidal depression are placed five 3-in. solid cement spheres, one at the center and apex of the ¾-in. opening, and four in an upper layer.

*Wash Water Receiving Basin.*—Partly to guard against overloading the adjacent city sewer at inopportune times as well as to conserve the limited water supply the dirty wash water flowing from the filters will be discharged through a 20-in. line into a 37½-ft. covered circular concrete tank 10 ft. deep. As soon as filter washing commences the wash water return pump is started, taking suction from a sump in the receiving tank and returning the wash water through a 12-in. pipe to the inlet to the sedimentation basin. A 12-in. overflow from this tank leads to the city sewer.

*Clear Water Basin.*—The 4-m.g. covered clear water basin is 147 x 274 ft. in plan and has a maximum depth of 13 ft. of water when the aerator is in operation. It holds three hours' supply to the main pumping station,

and is designed to meet the requirements of the Fresh Pond pumps, which operate at the rate of 20 m.g.d. for 16 hours, and stores enough filtered water to make up the deficiency of the filters during the regular 16-hour pumping period. One side of the clear water basin extends under the filters. A filtered water conduit runs under the pipe gallery and is arranged so that the clear water basin can be by-passed, if necessary.

*Aerator.*—The aerator consists of sloping concrete slabs in which are fastened short baffles arranged herring-bone fashion. These baffles retard and overturn the water flowing over them so that it receives a very thorough exposure to the air. Free carbonic acid and offensive odors are released from the water and dispersed into the air in this manner.

*Chlorination.*—A separate room is provided in the head house for the apparatus and operation incident to the chlorination of the filtered water. The chlorine will usually be applied to the filtered water after it has passed over the riffle aerator, but provision is also made for its application at the outlet of the filtered water conduit whenever the clear water basin is not in use.

*Pumping Equipment.*—There are provided one 4 m.g.d., two 6, and one 10 m.g.d. horizontal centrifugal pumps to supply raw water from Fresh Pond to the sedimentation basin when the gravity supply from the 63-in. conduit is insufficient. These can be operated in different combinations so as to deliver very nearly whatever quantity of water may be required. In addition, two horizontal centrifugal pumps, each of a capacity of 1,100 gal. per minute, deliver filtered water into a wash water storage tank for use in cleaning filters. Two vertical centrifugal pumps, each of a capacity of 1,700 gal. per minute, return the used wash water to the sedimentation basin.

Chemical mixing machinery is operated by electric motors. All pumps are driven by alternating-current motors, direct-connected, on a 550-volt, 3-phase, 60-cycle current.

*Wash Water Tank.*—A tank 29 ft. in diameter and 84 ft. high affords sufficient water to wash two filters in succession. It is arranged, however, in connection with pumps so that it automatically begins to receive water as soon as a wash begins.

*Superstructure.*—The superstructure is a two-story building 223 ft. long by 71 ft. deep with a central tower enclosing the wash water tank. The first story is concrete, the second story is faced with tapestry brick and synthetic stone trim, and the roof is concrete covered with a waterproof membrane. The interior is finished in a manner appropriate to its various uses. The superstructure houses the filters, administration offices, laboratory, chemical storage room, wash water tank, pumps and all other machinery and all other devices for the operation of the plant.

*Special Treatment.*—During the periods of high water in the streams from which the supply is taken it may at times be necessary to add a small amount of soda ash to the raw water as it flows through the 42-in. supply line at a point about 100 feet from the sedimentation basin. This added soda ash will make up any existing deficiency in alkalinity, and insure complete decomposition of the coagulant—sulphate of alumina.

*Estimated First Cost.*—In numerous respects this filtration plant differs from others elsewhere, and these facts have tended to increase its first cost. The natural attractiveness of the surroundings at the filter site demand something a little more than usually ornate in the way of architectural features. The abnormally large clear water basin made necessary in order to provide storage against a 50 per cent overdraft during the 16 hours the Fresh Pond Pumping Station is in regular service, furnishes a large item of additional cost over that to be met ordinarily. The aerator is another item, and the waste wash water receiving tank with piping connections and pumping equipment another. The contract price for the entire installation was $723,900, or $51,700 per million gallons rated capacity.

Edward W. Quinn is mayor of Cambridge and Timothy W. Good is superintendent of water-works and James J. Scully is president of the Water Board.

The general contract is being carried out by Coleman Bros., of Charlestown, Mass. The filter equipment is being installed by the Roberts Filter Manufacturing Co., Darby, Philadelphia, Pa. The designing and supervising engineers are the George A. Johnson Co., of New York City, for whom Fred S. Childs is the resident engineer.

## British Concerned Over Foreign Competition

In England there appears to be the same situation regarding foreign competition in home-used engineering structures and equipment as was noted in *Engineering News-Record*, Aug. 11, 1921, p. 221, in the Staten Island pier cranes. The London correspondent of this journal writes:

Whether or not British firms and public bodies should accept tenders from abroad, even though they are considerably below the figures quoted by English manufacturers, is a question which is arousing much heated discussion among engineers. The latest example is the acceptance by the London County Council of a tender submitted by Brown and Boveri of Switzerland, for an 8,000 kw. turbo-generator set. The tender accepted is about £8,000 or 16 per cent lower than any British quotation. The British Engineers' Association has taken up the matter in vain with the Council and pointed out that Britain loses £25,000 by the work going abroad, £15,000 to £18,000 in direct wages to engineering trades, and probably another £10,000 in wages spent on raw materials. Thus, the British worker has lost the work, the foreign manufacturer gets a fine advertisement, and if he chooses to use German material he can make a big profit; the only benefit accruing to the British manufacturer will be the prospects of a higher rate of contribution to the unemployment funds.

The British Engineers' Association maintains that the London County Council makes it purchases with public funds for the purpose of rendering public services, and if the purchases be made in Britain the money expended remains there. In the case of an order for a turbo generator, at least 80 per cent of the purchase price would be distributed among the British workers in the form of wages and salaries. Owing to increased wage rates, reduced working hours, restricted output and other causes beyond the power of the employer to compensate by his own ability and enterprise, the costs of production in England have reached a point at which the country's power to compete in the export markets of the world is gravely impaired. Unless the engineering industry can have a fair chance of securing a very large share of the home market as a stabilizer, production on an economical scale of the required variety of products, will be seriously restricted, now enterprise will be discouraged and a high rate of mortality may be expected among the smaller works started since the war began, whereby unemployment would be increased, and large capital investments sterilized.

# LETTERS TO THE EDITOR

*If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.*

## Poor Design Cause of All Structural Failures

Sir:—In your issue of Aug. 13, p. 171, [illegible] the collapse of a reinforced-concrete ceiling in the Marlborough-Blenheim Hotel at Atlantic City. This article and your editorial point to the rusting of steel as the cause of this failure, and you make the statement that this is the first example of the failure of a reinforced-concrete structure after the same was put in service.

I should like to point that in *Engineering News*, April 23, 1908 there is an account of a reinforced-concrete girder bridge that collapsed in the night with no load upon it, *two years after it was built*. In *Engineering News* [illegible] 27, 1906, there is an account of a similar bridge that collapsed under a traction engine after it was in service for some time. Both of these bridges had short shear members.

There have been other failures and partial failures that did not happen during construction. I know of three large buildings that had to be "unloaded" years after they were built. None of these cases are published. Doubtless other engineers could add to the list. Corrosion had nothing whatever to do with these three failures. It was original weakness in design.

I have frequently advanced the proposition that practically all structural collapses are due to poor design, including about all of the many reinforced-concrete failures during construction or later. This ceiling is no exception. The unit stress on the little wires was 100,000 lb. per square inch. Why look for corrosion or for any other reason whatever for the collapse? The marvel is that it did not collapse many years ago, and the explanation is that the long-suffering concrete was taking the tension. Concrete in a beam or slab of normal reinforcement will be subject to five or six times as much tension as the steel so long as it is not cracked. In this particular design the concrete tension would be probably ten or twenty times that of the steel.

Pittsburgh, Pa., Aug. 27. EDWARD GODFREY.

## Timber Truss Roofs of Navy Hangars

Sir—I was much interested in the article on the curved-chord timber roof truss on page 246 of the Aug. 11 issue. This type of truss is not new. I have no doubt that Mr. Summerbell will be able to secure a patent, knowing the patent office as I do, but I doubt very much his ability to maintain any infringement suit that he might enter after he has the patent.

Early in 1917, while I was working as a designer in the Navy Department, the question of the standard type of airplane hangar to be built abroad arose. The steel market was swamped, and studies were made for timber hangars. Ellis P. Abbott, under whom I was working, submitted to me an article from some engineering magazine describing and showing drawings of a curved-chord timber truss similar to the one in the current article. These had been used in Chicago for roofs of garages. The design was modified and changed to save material and to meet the required conditions. The principal change that we made in the design as shown by the old magazine article, was rearrangement of the web members. These were uniformly spaced in the original Chicago garage trusses, and spaced quite closely. As shipping space was at a premium we made a more thorough analysis, and were able to leave out many web members near the center, so that the spacing was closer at the ends, a modification which I notice is embodied in the design with which the present article is concerned.

The hangars were 100 ft. wide in the clear and 40 ft. high. No knee braces were permissible, and it was necessary [illegible] ft. deep at the center. The upper chord was made up of ten 2 x 4's, five on each side, curved to proper shape. The lower chord was made up of six 2 x 6's, three on each side, and the web members were 2 x 6. Each truss was made in two halves, the web members being opposite hand. One half was then placed over the other and the chords bolted together. The web members were properly nailed together.

The great advantage of this type of truss for the purpose intended was that it required no framing to erect. All shipment was made in stock sizes and the construction was a case of sawing, bolting and nailing only. As the erection of the hangars was done by inexperienced men, the elimination of framing and the numerous complicated details of workmanship which are necessary to make a good framed timber truss, was considered a great advantage.

Two of these hangars were built in a cornfield near Washington as an experiment, proved very successful, and were put to immediate use. I do not believe that I am violating any naval secrets at the present time to state that these two hangars were erected in 15 days. A large number of them was built abroad. I have seen a number of these trusses in use at various times and places during the past few years. The new Chevrolet Motor building on Gilbert Avenue, Cincinnati, a building several hundred feet long, is the latest that I have seen. The truss is a good one, and ought to have a big field of use, but it is not a new thing.

Cincinnati, Aug. 13. EDGAR DOW GILMAN.

## Unwashed and Ungraded River Gravel Makes Good Concrete

Sir—In developing a new coal mine for the Spruce River Coal Co. at Jeffrey, W. Va., it was necessary to build several miles of standard-gage railroad which crossed two streams requiring bridges. These bridges were of the deck type, with wooden stringers resting on concrete abutments and piers, calling for some 400 cu.yd. of materials.

Although close to the railroad the cost of shipping in sand and gravel for this work was rather expensive. After some investigation it was decided to use gravel and sand from the creek bed at the site of the work.

This portion of West Virginia is quite mountainous and considerable sandstone abounds. The streams are typical mountain streams, almost dry in continued hot weather but rising to rushing torrents after a few hours of heavy rain. Many gravel bars and riffles have been formed by these streams and the materials are excellent if they were cleaned and graded. However considerable loam is mixed with the gravel and in places yellow clay. The stones are of all sizes from ones larger than one's hand on down.

This gravel was excavated and hauled to the site of the work and dumped in piles. When wet it seemed very dirty but upon drying out had a light grey color and the sand seemed sharp although mixed with loam. This material was mixed in a gasoline mixer and proportioned three bags of cement to one yard of concrete. It was poured rather wet and openings were left at intervals in the forms to allow the scum to drain off.

The first few days after the removal of the forms the concrete did not seem to harden as rapidly as it should. The loam seemed to have worked to the face of the forms and made the concrete look dirty and ragged. It has now been completed about six months and is as hard as stone. The dirty, ragged appearance has entirely disappeared and the color is good.

In connection with our new tipple construction we have constructed two retaining walls, one foundation wall and about 75 or 80 piers of the same material. These all appear to be excellent and are of good color and very hard. In the retaining walls we used a great deal of loose rock as well, throwing it into the forms as the concrete was poured. The rocks were sandstone of all shapes and sizes from the size of a footwall on down. We had occasion to drill several holes in one of these walls several days after it was completed and we found it to be very hard, but tough rather than brittle. J. S. KENNEDY.

Engineer, Spruce River Coal Co.

[illegible]

## Shear Resistance in Wooden Beams

Sir—The letter of A. M. Van Auken in your issue of July 21, 1921, p. 119, on the disparity between theory and practice in the design of timber beams for longitudinal shear calls attention to a condition which, though not new, is frequently neglected. Recommended working stresses for timbers are based on tests conducted in accordance with laboratory practice. For flexural tests, the customary practice is to use third-point loading, which means the concentration is placed a distance out from the support equal to four or more times the depth of the beam. On this basis, in the case of southern pine, the computed horizontal shear at failure in tests will average about 1,000 lb. per sq.in. for small clear specimens and approximately 400 lb. per sq.in. for structural-size specimens. Using a factor of 8 on the small specimen results, the value specified in Mr. Van Auken's letter for working stress in longitudinal shear, 125 lb. per sq.in. is obtained. If this stress is to be employed in practice for concentrated loads, it should be under the same conditions of loading as obtained in the tests, that is, under conditions of maximum bending and deflection, and not maximum end-shear conditions.

Under laboratory test conditions, both the transverse and horizontal unit shear have a constant value $\frac{3}{4}W/bd$ from the point of support to the center of the concentration, as shown by the shaded diagram in Fig. 1. In practice, for uniform loads or a series of concentrations the unit shear will decrease from a maximum at the end of the span toward the center. An increase in unit longitudinal shear for design should be permitted to compensate for this condition.

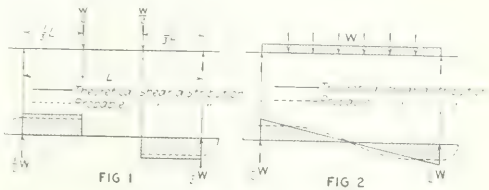
Again, the effects of direct transverse compression at the end bearing and under concentrations when located near the support are also neglected in design. The frictional resistance of wood on wood along the neutral axis under such normal pressures can be evaluated, and should be compensated for in the allowable longitudinal shearing stress. A third factor which increases resistance to longitudinal shearing is the overhang of the beam at the support. The effect of this is indicated in Fig. 2, on the shear diagram for uniform loads.

In the case of a stringer continuous for two spans over a central support, the tendency to longitudinal shear will be still further decreased. Also, by the common theory of flexure applied to a homogeneous material like timber the neutral axis is assumed at the center of the cross-section. As a matter of fact, both the strength values and the moduli of elasticity for timber in tension and compression are different, with the result that the neutral axis probably adjusts itself as in a reinforced-concrete beam. The resulting distribution of shear is probably such as to give much higher longitudinal shear on the compression side of the beam, particularly under concentrations.

The logical method of designing for longitudinal shear would be to establish permissible working stresses based on the distance of the concentration from the end support when placed for maximum end-shear conditions. The resistance to horizontal shear increases rapidly as the load is moved toward the point of support. L. R. Manville and C. R. Hill, in *Engineering News-Record* for July 10, 1919, p. 69, describe flexural tests of 31 longleaf yellow pine beams, in which a special study was made of the effect of position of the applied load on the resulting horizontal shearing stresses. The authors conclude, among other things, that:

1. No horizontal shear failure may be expected with the concentration placed within one beam-depth of the end support;

2. A concentrated load placed three beam-depths from the end support is more apt to cause failure than if placed out a distance of one or two depths, although the computed horizontal shear is less;




SHEAR DISTRIBUTION ALONG A BEAM

3. Beams with a ratio of length to depth of 12 will develop a critical stress in horizontal shear simultaneously with a critical stress in bending, while when the ratio of span to depth is less than 12, horizontal shear failures are apt to predominate;

4. With timber selected under the density rule of the U. S. Forest Service, horizontal shearing stresses 50% in excess of the ordinary design unit stresses may be used when the shear is computed by the usual method with concentrations within 1½ beam-depths of the end support.

In those tests, on 4 x 10-in. southern pine beams on 7½-ft. clear span, horizontal shear failures occurred at computed shears of 580 lb. per sq.in. with the concentration 3 beam-depths from the support, and at computed shears of 920 lb. per sq.in. with the concentration at 1½ beam-depths from the support. Where failure occurred by rupture of extreme fiber, 7,000 lb. per sq.in. was developed as an average modulus of rupture. Tests of the Forest Products Laboratory on 6 x 12-in. dense southern pine selected in accordance with the select structural grade rules of the Southern Pine Association, on 15-ft. span, developed a modulus of rupture of 8,000 lb. per sq.in., with an average computed horizontal shear of 400 lb. per sq.in., the test loads being applied at the third-points of the span (see table herewith). It is manifestly unjust to the timber to limit working stresses to values as low as those generally recommended, which are based on test interpretations not consistent with practice, particularly when careful inspection of the timber and application of strict grading rules are introduced.

The practice of designing timber stringers with a horizontal shearing stress of 200 to 225 lb. per sq.in. appears warranted when the stress is computed for maximum end-shear conditions with concentrations spaced within 1½ to 2 beam-depths of the end support, and successful practice would appear to justify these values.

GEO. E. STREHAN,
Consulting Engineer.

New York City, Aug. 3.

TESTS OF FOREST PRODUCTS LABORATORY ON SELECT STRUCTURAL GRADE SOUTHERN PINE TIMBERS

Timbers 6 x 12 in. x 16 ft., test span 15 ft.

| Piece No. | Rings per Inch | Summer Wood, Per Cent | Specific Gravity* | Moisture Content, Per Cent | Modulus of Rupture, Lb. Sq. In. | Fibre Stress at Limit, Lb. Sq. In. | Modulus of Elasticity, Lb. Sq. In. | Computed Hor. Shear, Lb. Sq. In. | Defects and Failure |
|---|---|---|---|---|---|---|---|---|---|
| 9 | 24 | 58 | 0.57 | 12.6 | 9,850 | 7,110 | 1,950,000 | 483 | Light season checks, tension failure |
| 2 | 19 | 55 | 0.58 | 15.8 | 7,540 | 4,900 | 1,977,000 | 366 | Diagonal Grain, Vol. 1. Irregular Grain, Vols. 2 Tension failure |
| 8 | 20 | [illegible] | 0.55 | 12 | 6,580 | 6,580 | 1,702,000 | 324 | Cup shake at top, tension failure |
| 9 | 12 | 45 | 0.55 | 16.6 | 8,840 | 5,780 | 1,940,000 | 414 | Light season checks, tension failure |
| 15 | 9 | 42 | 0.60 | 15.7 | [illegible] | 5,780 | 2,181,000 | 412 | Radial shakes both ends, slight checking, horizontal shear failure |
| 19 | 10 | 39 | 0.56 | 15.7 | 8,190 | 4,770 | 1,853,000 | 411 | Small knots in Vols. 1 and 2, tension failure |
| 17 | 12 | 52 | 0.73 | 16.4 | 7,760 | [illegible] | 2,498,000 | 386 | Radial shake, both ends, small cup shake at butt, horizontal shear failure |
| 13 | 2 | 37 | 0.70 | 16.2 | 6,700 | [illegible] | 2,029,000 | 343 | Light shakes both ends, considerable checks, horizontal shear failure |
| Average | 14.6 | 46 | 0.61 | 16.3 | 7,960 | 5,750 | 2,016,000 | 396 | |

*Oven-dry weight and volume.

# HINTS FOR THE CONTRACTOR

## Belt Conveyor Used in Placing Concrete

By John Stearns

FOUNDATION work at the Tuckerton station of the Radio Corporation of America presented a problem of unusual interest, both in distributing material and in mixing and placing concrete. In the solution of this problem the use of a belt conveyor for elevating concrete to the mast foundation forms aided materially. The station is situated on the New Jersey Meadows about six miles from Tuckerton where the soil is of such a character as to be incapable of sustaining any but the lightest kind of construction equipment. The station was built by the German government prior to the entry of the United States into the war and later acquired by the Radio Corporation of America, who desired to increase the antenna capacity by the erection of six steel masts each 350 ft. high, and by the installation of the latest design of radio equipment.

In order to avoid the possibility of ice piling up against the guys and masts the concrete foundations were extended from 8 to 10 ft. above the elevation of the meadows. One mast and four anchors required approximately 250 cu.yd. of concrete, which was placed in about five equal pours. One-bag mixers with extra wide-tired wheels were particularly adaptable for this work. These were operated in conjunction with 30-ft. portable belt conveyors, as shown in the attached photographs, which raised the concrete to an elevation that would permit of its distribution into the forms by chutes. The distance the concrete was elevated was 15 ft. and the length of the conveyor was 28 ft., making the angle of inclination of the conveyor around 33 deg.

Concrete was dumped from the mixer into a wooden hopper having an opening directly over the conveyor (the belt traveling just under the hopper opening), picked up the batch and elevated it to the chute. On top of the chute and underneath the returning belt was placed a wiper of rope or belting so that all of the concrete would be taken from the belt. On the chute also was placed a baffle board which returned any sand that might have separated from the batch on its trip up the belt to the chute, to become re-consolidated with the batch. There was a tendency of the sand to separate due to the fact that it left the conveyor with a greater velocity than the rest of the batch. The concrete thus poured was wet enough to run freely.

The conveyor equipment was also used to pour the foundation for the second alternator. The set-up was made outside the building and the conveyor, passing through the power-house window, dumped the batch into the chutes and thence to the forms. By this means the concrete was mixed in the open and distributed without interfering with the operation of the station.

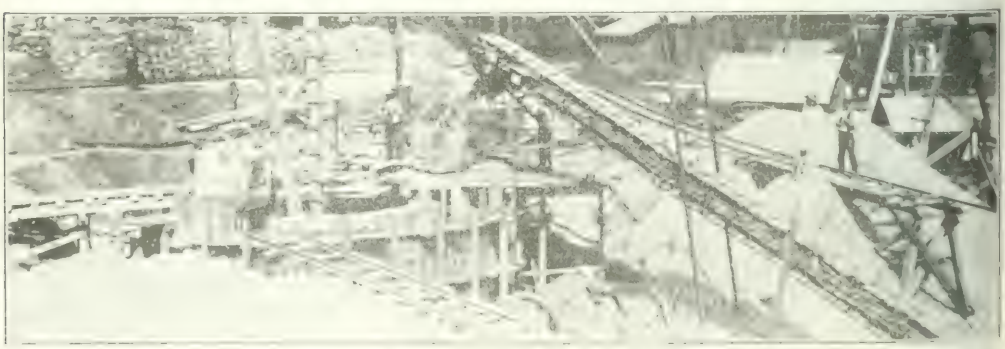
## Wireless Tower 200 Ft. High Moved

By A. T. Colwell,

[illegible] U. S. A., Fort Sam Houston, Tex.

ONE of the wireless towers at Ft. Sam Houston, Texas, was recently moved 250 ft. on street-car trucks running on specially placed street-car track. The towers are 200 ft. high, 26 ft. square at the bottom, tapering to 8 ft. square at the top, and the four principal uprights taper from an 8-in. angle at the bottom to a 3-in. angle at the top. Their weight is approximately 40 tons each. The original sending power was tripled, making it necessary to move the towers so as to utilize all the induction.

In moving the tower a street car was removed from its trucks, and four trucks were used for the job. Two 12 in. x 12-in. pieces 15 ft. long were laid on the axles, and held in place by 2-in. angle irons underneath. The four concrete foundations for the new site were laid, and track was laid from the old site to the new. Eight screw jacks were used to raise the tower, and the track was laid over the old foundation, the trucks run in and the tower lowered upon them. Two men working a 5-ton chain block moved the tower up a 1 per cent grade to the new site. The trucks were not anchored to the track, as the top of the tower was at no time more than 4 ft. off, and the center of gravity fell well within the base. The tower had two 12 in. x 12-in. timbers bolted to the bottom of each leg, and when it was in position over the new site, it was jacked up by means of these members, the trucks and track removed, and a grillage built up. The tower was then lowered, the grillage being removed 6 in. ahead as it came down.



# NEWS OF THE WEEK

New York, September 8, 1921

## rauss Sues Seattle for Infringing Bascule Bridge Patent

Alleging that the city of Seattle inged on its patent rights in the conuction of three bascule bridges oss the Lake Washington ship canal l Lake Union, the Strauss Bascule dge Co. an Illinois corporation, has d suit in the federal court to reer damages of $353,140.85 and inest. The finance committee of the council had previously rejected a im presented for that amount. The pany, which is represented locally Robinson, Murphy & Murphine, atneys, asked for a permanent injunction and for a provisional injunction ining officials from proceeding with bascule bridge work now contemed.

he three bridges involved are the Ave. Northwest, the Fremont Ave. the Tenth Ave. Northeast structs. For each of these the company ms damages equal to three times per cent of the cost. The complaint l recites that similar suit was ght against the city of Chicago infringements in the construction en bridges of the bascule type, reing in a decision by the master in cery of the U. S. District Court llinois favoring the company. The sion was appealed to the U. S. Dis: Court, which sustained the order he lower magistrate and was taken he U. S. Court of Appeals, where company's suit for damages was n granted. In this case the com- was awarded damages in the sum 349,500, the complaint alleges.

## esolution for Illinois-Indiana Harbor Commission

resolution has been introduced in gress authorizing the appointment he Interstate Harbor Commission llinois and Indiana, following acts he Illinois and Indiana legislatures investigate and report upon the ibility of a public interstate harbor. harbor would be "at and near Wolf e and Lake Michigan, lying partly ne cities of Hammond and Whiting, . and partly in the city of Chicago."

## ew Members of International Road Congress

t its last meeting the Permanent mission of the International Asson of Road Congresses announced the following governments have n membership: Servia, Croatia, Slonia and Czecho-Slovakia. During last year 116 new private members been admitted, forty of them as members, while fifty-nine new corions have also joined.

## Free Port Zone Advocated by Senate Committee

Establishment of foreign trade zones in ports of the United States is recommended in a report of the committee on commerce of the United States Senate. A bill is reported which will make such a zone possible.

## New England Water-Works Men Announce Convention Program

The New England Water Works Association announces the following program of technical papers and reports for its 40th annual convention to be held at the Stratfield Hotel, Bridgeport, Conn., Sept. 13-16:

*Sept. 13, 2 p.m.*—"The Water Works of the Bridgeport Hydraulic Co.," by S. P. Senior.

*Sept. 14, 8:30 a.m.*—Report of committee on standard specifications for water meters, W. W. Brush, chairman; "Manganese Bronze for Valve Stems," by W. R. Conrad; "Monel Metal," by H. S. Arnold.

*Sept. 14, 2 p.m.*—"Economy of High Initial Cost and Extreme Care in Service Pipe Installation," by Reeves J. Newson; Disappearance of Coating from Cast-Iron Pipe While Stored in Yard," by Samuel E. Killam; "Control of Water Waste by House-to-House Inspection," by Gordon Z. Smith.

*Sept. 14, 8 p.m.*—"Reinforced Concrete Pipe," by W. G. Chace; "Selection of Pipe for Water Works," by J. W. Ledoux; "Chlorination of New England Water Supplies," by W. J. Orchard.

*Sept. 15, 9 a.m.*—"Electrolytic Generation of Chlorine at Its Point of Application," by C. W. Marsh; "Typhoid Fever Epidemic at Salem, Ohio," by W. H. Dittoe; "Significance of 'Hydrogen-Ion Concentration' in Water Purification," by Harrison P. Eddy.

*Sept. 15, 2 p.m.*—"Can High-Value Watershed Lands Be Put to Profitable Use?" by S. P. Senior; "Economies of the Several Lines of Defense in the Protection of Water Supplies," by Allen Hazen.

*Sept. 15, 8 p.m.*—"Appraisal of Quality of Water Supplies in Massachusetts," by Prof. George C. Whipple; discussion of water works accounting.

*Sept. 16, 9 a.m.*—"Pollution of Streams Affecting Industrial Uses," by J. Frederick Jackson; "Repairs to Standpipe at Bath, Maine," by Clarence E. Carter.

The convention will end with a picnic and shore dinner at "The Farms," arranged for by the Water Works Manufacturers Association.

Samuel P. Senior, chief engineer of the Bridgeport Hydraulic Co., is chairman of the local committee on arrangements.

## Object to Hudson River Pontoon Bridge

### Shipping Men Condemn Project as Menace to Navigation at Hearing Before Army Board

In a hearing before a board of army engineers in New York Aug. 31 on the proposed pontoon bridge across the Hudson River at Yonkers, river-steamer and canal-barge shipping men vehemently opposed the bridge project. Favorable arguments having first been presented by the company and by citizens of southern New York and northern New Jersey west of the Hudson, the opposition was represented by F. Coy Kendall, of a barge-towing company, Capt. Keller, in charge of one of the large Hudson River passenger steamers, Capt. Davis, representing the Masters, Mates and Pilots' Association, and a number of other river captains and officials of freight and passenger steamer companies. Prof. William H. Burr expressed views similar to those of the shipping men.

As stated by Gustav Lindenthal, engineer of the company, and George A. Post, president, the latest plans for the bridge contemplate providing a fixed span 270 ft. clear opening, with 45-ft. vertical clearance, to accommodate barges and low vessels, and a draw span for large steamers and masted vessels. However, the shipping men claimed that these proposed openings were impossible of navigation against unfavorable wind and tide conditions, as instanced by the fact that tows have hard work in passing under the Poughkeepsie bridge, with openings of about 500 ft. and the weaker tidal current.

Capt. Keller claimed that if a river steamer encountered a tow of barges in the draw it would mean an accident. Capt. Davis said that the bridge would be destroyed by ice, and that the plan to keep the ice broken up by towboats could not be carried out. Others spoke to the same effect. Prof. Burr stated various objections, among them that the lift span would be a menace to boats below, in wind and current, and expressed the view that the proposed structure is not entitled to confidence structurally, and should not be built either across the Hudson or elsewhere.

## $15,000 for Sealing Reservoir

The city of Seattle will continue its efforts to seal the Cedar River basin, back of the city's masonry dam, as evidenced by the introduction of a bill in the council authorizing the continuation of the work and making an appropriation of $15,000 for the purpose. The bill was referred to the finance and city utilities committees.

## Federal Permits for Water Powers in Idaho and Virginia

Announcement has been made by the Federal Power Commission that a preliminary permit has been issued to the Utah Power and Light Co. for extensive power development on the Bear River in southeastern Idaho. The projected works will impound water for irrigation as well as power. The project will complete the utilization of the river for power purposes at all practicable points from Bear Lake and the mountains of Idaho and Utah to Great Salt Lake and will add 21,500 hp. to the generating capacity of the company's system, now capable of developing about 165,000 hp. The transmission will be 134 miles to Salt Lake City.

Developments under the new scheme will be in four sites on the upper part of the river, two of which, with heads of 75 and 85 ft. each, will have each a primary capacity of about 6,500 hp. The two lower sites will develop about 9,800 hp. Three plants already exist in the upper district and one in the lower so that the river will, when the new scheme is complete, have eight power plants. The company has 33 months within which to make a study of the character of the foundation for the projected dam and for the amount of water available for power purposes at each site.

The Roanoke River Development Co., of Richmond, Va., has also been granted a preliminary federal permit for a power project to be located at Buggs Island in the Roanoke River near Clarksville, Va. Two years are allotted to investigate the development which is planned to consist of a dam 60 ft. high across the river with a power house across the river with a power house located at the dam, by which means 10,000 primary horsepower can be developed as well as a secondary development aggregating perhaps 6,000 hp. The primary power will be used for general public utility and industrial purposes and the secondary power for chemical plants in Richmond.

## Improved Rail Income Laid to Deferred Expenses

That the improvement in railroad operating income has been brought about in large part by deferring expenditures for maintenance and by drastic cuts in forces is indicated in an analysis of operations for the first six months of the year, made public by the Bureau of Railway Economics. Of the decrease in total operating expenses as in comparison with 1920, 45 per cent, or $44,748,799, occurred in June from reduced transportation expenses, and 55 per cent, or $54,256,689, from deferring expenditures for maintenance of way and equipment. While reduction in transportation costs naturally follows falling traffic, it is pointed out that reduction in maintenance is merely a postponement of expenditures that will have to be made up at a later date.

## Confident of Road Bill's Passage

(Washington Correspondence)

It is the consensus of opinion in Washington that the highway bill will become a law before Nov. 1. It is a matter of disappointment to Senator Townsend that an agreement was not reached prior to the Congressional recess. The differences between the bill as it passed the Senate and the bill passed by the House were not many. There was a feeling on the House side, however, that they would occasion more discussion than the very limited time, prior to the recess, would have permitted. As a result the differences will have to be harmonized after Congress reconvenes.

There is no disputing that several influential members of each House of Congress are not enthusiastic over the project of appropriating $75,000,000 at this time. They are in a position to delay the time when this money will be made available. They may recognize an overwhelming public demand for the highway money, however, and forego dilitory tactics. On the other hand it is not to be supposed that they will abet any effort to make the appropriation available with unprecedented promptness. As a result there is some uncertainty as to just when the new federal-aid appropriation will be available for distribution, but no doubt is expressed in any quarter as to the final passage of the bill.

## War Department Permits Chicago to Reclaim Lake Front

A permit has been issued by the Secretary of War granting Chicago the right to extend the shore line of Grant Park 300 ft. east into Lake Michigan. The permit makes possible the construction of a boulevard that will run directly north from the recently opened Field Museum and south to Jackson Park, using a $20,000,000 bond issue already voted upon favorably to carry out the plans of the Chicago Plan Commission. These plans have been worked out in conjunction with the War Department represented by Col. W. V. Judson, corps of engineers, the South Park Board, the City of Chicago and the Illinois Central R. R. The work will be carried out under the direction of the South Park Commission which is now preparing construction plans for breakwaters, filling and structures. A 200x600-ft. pier and slip for the headquarters of the U. S. Naval Reserves is included.

## St. Paul Union Station Work To Be Shut Down

It has been announced that the St. Paul Union Depot Co. will discontinue work on the new station at St. Paul, Minn., at the end of this season's work because of the present financial stringency, especially in the railway field. This season's work will permit six new elevated tracks to be used and will enlarge the conveniences to the public somewhat. The waiting room has not been built and the business lobby will continue to be used for that purpose.

## Niagara River Bridge Project Again Active

A bill for a Congressional charte for the construction of a Niagara Rive crossing at Buffalo has been introduce in the House of Representatives. authorizes twenty-five named person among whom are J. W. Cowper, W. A Eckert and E. P. Lupfer, to construc and operate a bridge across the Nia gara River or, with the consent of th Secretary of War, a tunnel. Constru tion must be begun within two yea and completed within five years fro approval of the act. A joint commi sion of five men each from the Unite States and Canada is at work on th project, under prior Congressional aut orization.

## Motion Picture Shows New Yor Freight Terminal Movements

A motion picture illustrating th movement of freight in the Port of Ne York was presented in New York Ci recently by the recently constitute Port of New York Authority. The fil was prepared under the direction of t old New York, New Jersey Port a Harbor Development Commission a illustrates the recommended deep-tu nel, automatic-electric railroad for t distribution of Manhattan freight.

The film is now presented by t Port Authority for public considerati It is introduced by maps and airpla views of the port district, followed motion pictures of ocean steamsh railroad pier operation and the ra road yards. The recommended belt li system is shown graphically. The p ture also includes a comparison of t journey, and its cost, of "Mr. Potat through the New York terminal present methods and by the propos automatic-electric system.

## Low Bids for Sixteenth St. Brid at Pittsburgh

Bids received by Allegheny Cou Aug. 27 on substructure and sup structure of the proposed Sixteenth bridge over the Allegheny River Pittsburgh, designed by Warren Wetmore, architects, with H. G. B com as engineer, proved unexpecte low and showed active competition. the substructure, for type of constr tion with concrete core and st veneer, the bids were: Vang Constr tion Co., $457,220; Dravo Contract Co., $497,292; Foundation Co., $527,9 The foregoing amounts do not co the concrete floor filling and pavi which is to be let subsequently; estimated cost is $110,000. Bids on construction of the steel superst ture (about 5,200 tons) were: F Pitt Bridge Works, $541,822; McCl tic-Marshall Co., $565,570; Ameri Bridge Co., $649,874; Independ Bridge Co., $822,400. On the electri equipment, the City Electric Co. was l bidder, at $5,755.04. On Sept. 1 county commissioners awarded the s structure contract to the Vang C struction Co. and the superstruct contract to the Fort Pitt Bridge Wo

## Concrete Arches Over Scioto Opened to Traffic

Two new concrete arch bridges, the road St. and Town St. bridges, across e Scioto River at Columbus, O., re- acing bridges destroyed in the great 13 flood, have been opened to traffic, llowing the opening of the Mound St. idge on July 2, as noted in our issue July 28, p. 166. They are now open foot and street-car traffic and will open to vehicle traffic as soon as the ving now in progress is completed. ey were built by Franklin County, a cost of about $600,000 each.

## Tentative R.R. Valuations

Additional tentative valuation re- rts, including the Mobile & Ohio and orida East Coast properties, have en handed down by the Interstate mmerce Commission. The reports of June 30, 1916. Final value of Mobile & Ohio is given as $43,279,-

| Name of Road | Final Value | Cost of Reproduction New | Less Depreciation | Outstanding Capitalization |
|---|---|---|---|---|
| rion & Rye Valley Railway Co. | $317,177 | $408,800 | $317,731 | $274,500 00 |
| bile & Ohio Railroad Co. | 43,279,997 | 46,784,157 | 35,231,583 | 37,807,800 00 |
| rior River Southern Ry. Co. | 770,000 | 840,605 | 715,939 | 1,081,171 53 |
| twood & Eastern Ry. Co. | 340,000 | 361,211 | 276,408 | 100,000 00 |
| ida East Coast Ry. Co. | 46,931,947 | 43,707,785 | 38,736,375 | 47,300 00 |
| ntic & East Coast Terminal Co. | 1,200,000 | 296,230 | 265,507 | 603,502 87 |
| kakee & Seneca Railroad Co. | 800,000 | 975,359 | 720,407 | 852,399 58 |
| nete Belt Railway Co. | 62,654 | 78,190 | 49,548 | 75,000 00 |
| endon & Pittsford Railroad Co. | 490,000 | 594,588 | 448,924 | 270,000 00 |
| coe, Snyder & Pacific Ry. Co. | 558,394 | 619,691 | 463,362 | 307,511 46 |
| land Terminal Company | 7,022,530 | 6,001,170 | 4,382,255 | 5,752,000 00 |
| sboro, Lake City & Eastern R. R. Co. | 1,117,328 | 1,264,884 | 968,543 | 1,294,934 83 |
| ago, Wabash Valley R. R. Co. | 455,500 | 439,028 | 376,339 | 1,012,853 05 |
| dgeville Railway Co. | 70,551 | 88,659 | 64,580 | 125,481 95 |
| roe Railroad Co. | 119,000 | 131,040 | 94,963 | 237,207 31 |
| ar Land Ry. Co. | 484,983 | 525,552 | 407,645 | 509,880 00 |
| hassuck Valley R. R. Co. | 160,404 | 128,451 | 94,414 | 250,000 00 |
| gor & Aroostook R. R. Co. | 21,500,000 | 29,352,360 | 22,776,234 | 24,249,600 00 |
| thern Maine Seaport R. R. Co. | 3,850,000 | 4,655,574 | 3,639,413 | 5,140,000 00 |
| Buren Bridge Co. | 77,500 | 77,869 | 76,257 | 500,000 00 |

, as against an outstanding capital- ion of $37,807,800. Final value, t of reproduction and outstanding italization of properties reported on given in the accompanying table.

## reate Safety Section of A.R.A.

ollowing the meeting in Chicago be- en R. H. Aishton, president, Ameri- Railroad Association, and twenty- safety representatives of leading roads, a safety section of the .A. has been created by the board directors, carrying out the recom- dation of its chairman, Daniel Wil- , president of the Baltimore & Ohio . The general object of the safety ion is co-ordination of safety meth- and development of unified plans effecting safety measures. Per- nent officers of the section will be ted at the next meeting in Boston, t. 26, 1921. In the meantime the owing temporary officers have been sen: Chairman, E. M. Switzer, Chi- o, Burlington & Quincy R.R.; first -chairman, John T. Broderick, super- ndent of safety, Baltimore & Ohio .; second vice-chairman, Isaiah Hale, te Fe R.R. A board of direction and mittees to formulate a plan for pre- inary work were also appointed at meeting.

## 1921 a Big Highway Year

*(Washington Correspondence)*

Judging from the information now before him, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, states that 1921 will be the banner year in highway construction. The year 1920 saw the execution of several times more highway work than ever had been done in the United States in a similar period of time. Enough data now are available to indicate that the 1921 record will exceed that of 1920 by a considerable margin.

An idea of how rapidly highway work is progressing in some states may be gained from the 1921 accomplishments of the Pennsylvania highway authorities. On Sept. 1 they were well beyond the 400-mile margin of paved road construction. This is more than 100 miles in excess of all paved road construction done in Pennsylvania during 1920.

The assurance that the highway bill will become a law shortly after the reconvening of Congress on Sept. 21 will make it possible for highway construction to proceed during the calendar year of 1922 at an unprecedented rate. The certainty that this legislation will be enacted already has stimulated construction in many states. As soon as the bill becomes a law, Mr. MacDonald states, it will release a large number of projects, particularly in the West. He also calls attention to the fact that these projects are in an area in which unemployment is acute.

## Reservoir Safe, Court Rules

In a recent decision in the Supreme Court, contrary to the decision of the Superior Court, the injunction restraining the Seattle City Council of Seattle, Wash., from erecting a new and enlarged reservoir in Volunteer Park, is dissolved. The injunction was granted in the Superior Court, upon appeal of Pierre F. Ferry and other citizens owning valuable property in the vicinity of Volunteer Park. The Supreme Court has ruled that fears of damage or disaster by residents of the Volunteer Park section in Seattle lack insufficient basis as against the engineering showing of safety. The injunction granted is set aside and the action dismissed.

## British Engineer Studies American Roads

### A. Dryland, County Engineer of Middlesex, a Pioneer in the Tarring of Highway Surfaces

A. Dryland, county engineer of Middlesex, England, past-president of the British County Surveyors Society and pioneer in the field of road tarring, is in the United States on a trip of inspection of American roadbuilding practice. His professional experience covers a period of forty years as county engineer and surveyor in half a dozen of the principal districts in England.

He began his engineering work in 1880 by being articled to A. W. Conquest, borough engineer of Folkestone, who had received his training on the main drainage works and pavements of London under Sir Joseph Bazelgette. At that time municipal work was just developing into a field of importance and Mr. Dryland's early duties involved road construction and maintenance, seaside defenses, parks, and drainage.

#### First to Tar Roads

After three years in a subordinate capacity, he was appointed borough engineer of Deal, then a town of 9,000 population on the east coast. Here he served for seven years, until 1890, and for the fist time in that part of England employed tar for treating roads. This was before the advent of heavy motor traffic and curiously enough the tar application was made not to reduce dust or to improve the wearing qualities of the highway surface, but to reduce the noise of metal-tired vehicles passing the Town Hall of Deal, about which complaint had been made. The treatment proved so successful, however, that it was soon extended to other routes of the borough. In addition to his road work at Deal, Mr. Dryland was called upon to build many sea defense works, and by timely construction he was able to save the greater part of an old castle, built by Henry VIII, which the sea had undermined.

When county councils were first being established in England in 1890, Mr. Dryland was called to Kent and appointed county engineer of that district. Roadbuilding then was at a low ebb, but through his efforts new routes were constructed, old ones put in a satisfactory state of maintenance, and many bridges built and repaired. After two years' service in Kent he became county engineer and surveyor of Herefordshire, where he took charge of about 500 miles of roads and 400 bridges. On this work an extensive bridge strengthening program was undertaken due to the development of traction engines weighing 18 tons and

hauling three trailers, a train of this sort often reaching a gross weight of 50 tons. Mr. Dryland's administration was marked by an extensive program of surface treatment of roads with tar.

THE "APOSTLE OF SIDE SUPPORT"

In 1906 he was called to take charge of a larger county, Wiltshire, where he served to years. Here he reorganized the administrtion of 800 miles of main roads and introduced on an extensive scale methods of surface tarring and penetration work. In 1908 he became surveyor of Surrey County, to the south of London. Surrey is the playground of the metropolis and consequently handles a huge volume of motor traffic. Mr. Dryland devoted a great deal of his time to an alleviation of the dust problem by treating road surfaces with tar, and this form of protection was extended to every main road in his county. It was here that the introduction of heavy motor trucks began pushing the tartreated surfaces and road bases toward the sides of the road, leading Mr. Dryland to insist upon the use of concrete curbs from 9 to 12 in. in depth to hold the foundations in place. His experience has made him a consistent advocate of this policy and he has become known among his associates as the "apostle of side support."

He resigned his position in Surrey in 1920 to become county engineer of Middlesex, a territory surrounding the London County Council area on the north side. The establisment of scores of military training camps in this district during the war, particularly at Aldershot, placed a heavy burden upon the county roadbuilding and maintenance forces. After the war Mr. Dryland's chief problem was on the arterial road system for which a large construction program had been prepared as a means of giving employment to ex-soldiers. Most of these arterial roads are 100 ft. wide, consisting of two 24-ft. trafficways with a space between for tramways and heavy trucking. At the present time only one of the 24-ft. roadways is being developed.

Mr. Dryland has been active in engineering society affairs in England. He is a member of the Institution of Civil Engineers, past president of the County Surveyors Society, member of the council of the Institution of Municipal and County Engineers, member of the council of the Institute of Transport, and has served as a member of the engineering advisory committee of the British Road Board, the predecessor of the Ministry of Transport.

## Leland, Not Lekinol

Through a typographical error, the name of the dean of the college of engineering, University of Minnesota, was given in *Engineering News-Record*, Sept. 1, 1921, p. 379, as O. M. Lekinol. The name should have been O. M. Leland, newly appointed a commissioner for the Costa Rica and Panama boundary.

## Cable Erection For First Suspension Highway Bridge To Be Built By New York State—Rondout Creek Bridge at Kingston

With a channel span of 705 ft., the Rondout Creek bridge is 1,100 ft. long over all. It carries the main highway along the west bank of the Hudson River, replacing an ancient chain ferry. The deck, 22 ft. wide, is a reinforced-concrete slab on steel framing, designed for carrying the heaviest trunk-line highway traffic.

Two 9-in. parallel-wire cables are the main supporting members. The photo, taken ten weeks ago, shows the start of their construction, temporary footwalks for the cable-spinning having just been placed. At present the cables are completed and the suspenders are being hung.

The bridge will cost about $700,000. Daniel E. Moran is consulting engineer for the foundations, and William H. Yates for the superstructure. Terry & Tench, Inc., are the contractors; Holton D. Robinson is their consulting engineer and W. L. Jordan their field superintendent. The work is being done for the state highway commission. Herbert S. Sisson, commissioner, and F. W. Sarr, first deputy. The department's engineers in charge are James H. Sturdevant, division engineer, and W. E. Joyce, resident engineer.

## Philadelphia Engineers' Club To Discuss City Paving

A two-day meeting to discuss the general subject of city paving, in which the cities of Philadelphia, Baltimore, and New York, University of Pennsylvania, and the Philadelphia Chamber of Commerce will be represented, will be held at the house of the Engineers Club of Philadelphia, 1317 Spruce St., Oct. 20 and 21. Morning, afternoon, and evening sessions will be held on each day. The meetings will be devoted to a consideration of administration, repairs and maintenance, new pavements, and foundations.

There will be two principal speakers for each session and their papers will be prepared, printed, and distributed in advance so far as possible. Synopsis of these papers will be read, occupying not more than 15 to 20 min. each, to be followed by verbal discussions limited to 5 to 10 min. each speaker.

## Snare & Triest, Old Contracting Firm, Changes Name

The Snare & Triest Co., contracting engineers, New York City, announces a change in its firm name to the Frederick Snare Corp. No recent change has been made in personnel, the latest changes having been noted in an issue of *Engineering News-Record* several months ago. The Snare & Triest Co. has been operating for twenty years in practically every branch of constr tion work, though its specialty has b port and terminal development w and large industrial plants.

# ENGINEERING SOCIETIE

## Calendar

### Annual Meetings

AMERICAN INSTITUTE OF MININ AND METALLURGICAL ENG NEERS, New York, N. Y., Sec Annual Assembly, Wal Pa., Sept. 12-15.

NEW ENGLAND WATER WORK ASSOCIATION, Boston, Mass Annual Convention, Hartford Conn., Sept. 13-16.

AMERICAN SOCIETY FOR MU NICIPAL IMPROVEMENTS, Annual Convention, Atlantic City, N. J., Oct. 24-28.

CITY MANAGERS ASSOCIATIO Eighteenth Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGU New York City, Annual Meeting Nov. 16-18.

The Kansas Engineering Society [illegible] meeting at Hutchi Kan., Dec. 22 and 23, 1921.

The Brooklyn (N. Y.) Engine Club will celebrate its twenty-fifth niversary at a dinner to be held in Chamber of Commerce, 32 Court Brooklyn, Oct. 8.

## PERSONAL NOTES

HARLES M. LEWIS, division gineer of the Erie R.R. at Susquehanna, Pa., has been transferred to rsey City, N. J., and will have jurisdiction over the New York division and e lines, including a part of the New rk, Susquehanna & Western division.

. O. ROSE, formerly structural ftsman with Stone & Webster, Bos-, has accepted a similar position h the Southern California Edison , Los Angeles.

. M. SMITH, designing engineer the bridge department, Canadian ional Rys., has been transferred n Winnipeg to Toronto.

. I. ROGERS, formerly roadter of the Iowa division, Illinois tral R.R., has been appointed chief ineer of the Peoria & Pekin Union with headquarters at Peoria, Ill.

RWIN E. TRUEBLOOD, for 15 rs connected with the Missouri Val- Bridge & Iron Co., Leavenworth, ., has been appointed county engi- of Douglas County, Kan.

. H. SCHIMMEL, formerly en- er maintenance of way, Monongaa Valley Traction Co., Fairmont, Va., is now chief engineer of the ey Construction Co., Clarksburg, Va.

UDLEY & GLEASER, Manter, N. H., is a new firm of con- ng civil engineers recently organ- by Arthur W. Dudley, who has spe- zed in water-works construction ughout New England for about ears, and Frederick Gleaser, for- y landscape engineer and superinent of parks for the City of Tren- N. J., and, at one time, section neer for the Board of Water Supl of the City of New York on the truction of the Kensico dam and voir. The firm will specialize in r-supply and sewerage design and truction.

S. TOUR, chemical engineer of nitrate division, Ordnance Depart-, U. S. Army, has been made dean he department of chemical engi- ng, University of Cincinnati, Ohio.

ROF. DAVID FRIDAY, of the omics department of the Univerof Michigan, has been elected dent of Michigan Agricultural ge, East Lansing, Mich.

WITT V. MOORE, engineer and actor, Indianapolis, has been made tary of the newly appointed Engi- Registration Board of Indiana.

H. PAUL, assistant chief engineer Miami Conservancy District, as- s on Sept. 1, the position of chief er. Announcement of this change made some time ago. Arthur E. an, formerly chief engineer, now s consulting engineer.

ED J. POSTEL, supervising en- r, Illinois Department of Public Works and Building, has resigned and returns to consulting engineering practice as head of F. J. Postel & Co., Chicago. Mr. Postel withdrew from active participation in the affairs of the company during his four years' service for the state. His department has been consolidated with the architectural division. The work of the two offices is under the direction of the supervising architect, Edgar Martin.

DAVID C. FINSTON, formerly resident engineer with the American Pipe & Construction Co., Philadelphia, has opened an office in that city for the practice of engineering and surveying.

J. GARDNER BENNETT, instructor of civil and municipal engineering in the extension division, University of Wisconsin, has been appointed city manager of Fort Myers, Fla. Mr. Bennett is a graduate of Cornell College, Iowa, and of the University of Wisconsin. He was the unanimous choice of the commission from more than 100 applicants.

R. C. E. WEBER, assistant engineer, Orland project, U. S. Reclamation Service, has been made project manager. Mr. Weber has been with the service since 1907, spending all but the first year on the Orland project.

J. W. WILLIAMS, who has been chief engineer of the Northwestern Pacific R.R. since 1907, has resigned to become chief engineer of the Western Pacific R.R. The announcement of this change was made at a dinner tendered Mr. Williams by the officials of the Northwestern Pacific Railroad Co. and which was attended by all the executive officers from the president down. Mr. Williams began railroad engineering work with the Santa Fé in 1903 and continued with that company until 1907, when he became assistant chief engineer of the Northwestern Pacific. In May, 1917, he was commissioned a major and assigned to the 18th Engineers. He was advanced to the rank of lieutenant colonel and served with the same regiment in France until his discharge in July, 1919. On leaving the army he was made chief engineer of the Northwestern Pacific Railroad in charge of construction, maintenance and operations.

CHARLES W. MURRAY, formerly city engineer of Miami, Fla., has been appointed acting director of the Department of Public Service, Miami, Fla.

BARTO-PHILLIPS CO., engineers and builders, New York, has been organized by Edmund L. Barto and Harry J. Phillips, formerly sales engineer and chief engineer respectively of The Austin Co., New York, to engage in the engineering design, construction and exportation of all classes of industrial buildings, including power house equipment requirements.

W. E. HOBBS, surveyor for the Manitoba Good Roads Board, has been appointed controller of town planning for the provincial government of Manitoba.

BEN BLOW, for many years manager of the good roads bureau of the California State Automobile Association, has been appointed manager of the Victory Highway Association, which proposes to erect suitable monuments on a transcontinental route that will be dedicated to American heroes of the world war. Mr. Blow has taken an active part in state and county highway bond campaigns and is said to be California's most successful manager of campaigns of that sort. He is the author of "California Highways," reviewed in *Engineering News-Record*, June 17, 1920, p. 1216.

G. H. HICKS, who has been connected with the Northwestern Pacific R.R. since 1912 as valuation engineer and later as principal assistant engineer, has been appointed acting chief engineer.

A. N. BURCH, project manager, Orland project, U. S. Reclamation Service, has resigned. He has been in the service since 1908. After one year on the Umatilla project he went to Orland, first in charge of preliminary surveys and designs of the distribution system and since 1910 as project manager.

## OBITUARY

ANGUS SINCLAIR, civil engineer and railroad contractor, died in Toronto, Ont., Aug. 24. He was born in Chatham, N. B., in 1848. For a time he was on the staff of the Intercolonial Ry., and in 1875 went with the Canadian Pacific Ry. at Port Arthur, Ont. Three years later he engaged in railroad contracting and built many sections of the Canadian Pacific and Canadian Northern systems. He also served on the construction of the Mt. Royal tunnel at Montreal.

## BUSINESS NOTES

THE COCHRANE STEAM SPECIALTY CO. of Massachusetts has been organized, with offices in Boston, Mass., to represent in New England a number of well-known manufacturers of power-plant equipment, including the H.S.B.W.-Cochrane Corp., manufacturers of feed water heaters, meters, etc.; the Steam Motors Co., Inc., manufacturers of steam turbines for driving generators, etc.; and the D. Connelly Boiler Co., builders of water tube steam boilers.

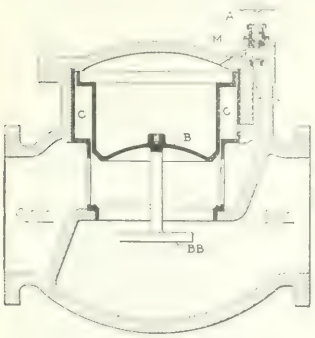
J. D. ACKENHEIL, formerly with the Portland Cement Association as field engineer in the Pittsburgh district, has been appointed special representative for the Heltzel Steel Form and Iron Company, of Warren, Ohio. He has had special experience in the use of steel forms for road work and has had general supervising charge of a number of important highway jobs.

# EQUIPMENT AND MATERIALS

## Automatic Double-Cushioned Check Valve

An automatic double-cushioned check valve, particularly adapted for use in discharge line of pumps to prevent disastrous back flow when the pumps are suddenly shut down, is being put upon the market by the Golden-Anderson Valve Specialty Company, of Pittsburgh. It is furnished in either angle or globe pattern up to 24 in., inclusive, and, in addition to the hand control here shown, may be furnished with electrical control.

The diagram shows the value in open position. Should there be a reversal of flow the pressure acting on the piston *BB* forces the main piston *B* to its seat. Meanwhile, the pressure accumulating in the annular chamber *C* is forced through the ports *L* and *M* to the top part of the valve chamber, thus




effectively cushioning the valve in closing.

When the valve is in the closed position, on the other hand, the pressure acts upward on the bottom of the main piston *B* and the flow through the ports *M* and *L* is reversed. The small control valve *A* is for the purpose of setting the speed of the valve to suit the requirements.

## A New Metal Lath

A new product called "Diamond Rib" lath has been developed by the General Fireproofing Co., Youngstown, Ohio, for use in suspended ceilings or walls and in connection with steel tile and steel lumber floor construction. The new product is similar to "Self-Sentering" and contains the "Self-Sentering diamond mesh, stiffened by cold-drawn U-shaped ribs 4.8 in. on centers and approximately ⅜ in. in height. The mesh forms a base and key for plaster, while the ribs give the strength necessary to stand a wider spacing of supports than is common with ordinary flat lath.

All sheets are 24 in. wide and in standard lengths of 8 ft., and can be furnished in 24, 26 and 28 gages.

## Cable-Pull for Road Grading

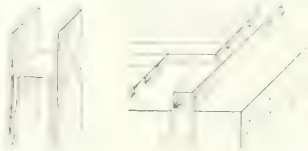
A simple mechanism for operating an endless cable, pulling scrapers for handling earth, is shown by the accompanying illustration. From the machine, the endless cable runs across the fill area to the hill where the cut is to be made. The 7-cu.ft. slips are attached to the cable with a grab. They are drawn by the cable to the loading

point, detached and sent back filled on the return cable.

The machine is the invention of P. M. Caldwell and W. H. Salyers, of Malvern, Iowa, and has been used on a number of earth-moving jobs.

## New Floor Clip Appears

A construction engineer of several years' experience has recently invented what is known as a bulldog floor clip, shown in the accompanying view, and which is about to be put on the market by the Bulldog Floor Clip Co., Winter-



set, Iowa. The clip is designed to hold the floor strip down to a concrete slab without the use of concrete in between the floor strips. Not only is the fill ordinarily used eliminated, but an air space is provided that minimizes the chance of dampness or dry rot.

## Company Donates Machine for Cleaning Up Pueblo

Immediately upon hearing of the disaster at Pueblo, the Pawling & Harnischfeger Co., of Milwaukee, decided to send one of their full corduroy traction excavator cranes to assist in the relief work. The excavator was sent on a special car and with the assistance of the railroad companies and the Pueblo city officials was put through in quick time. The machine is equipped with a clam-shell bucket and is moving a tangled mass of debris consisting of mud, wagons, trees, telegraph poles, telegraph wires, lumber—in fact all of the varied wreckage that follows in the wake of a flood. Two steam shovels are also included in the removal equipment and altogether about 250 men have been engaged on the clean-up work.

## Cuts Grade for Road Forms

The grade for road forms is prepared at the rate of 300 to 700 ft. per hour by the form-grading machine illustrated. Guided by a cord stretched between grade stakes, the machine is almost perfectly accurate when driven by a careful operator. It trims a strip 8 in. wide, thus giving ample room for lining up forms with a 4-in. base. It will cut to a depth of 5 in., but ordinarily, on well-prepared grade, the cut is shallow, the grade merely being trimmed precisely to profile.

The grader has a 4-ft. 10-in. wheelbase, 4-ft. gage, and weighs about 1,250 lb. The construction is particularly accurate, embodying automobile axles and hubs, cut gears, standard chain belts and automobile parts wherever possible. Foot treadles steer the machine and the handwheel lifts and lowers the cutter. The motor is a New Way 5-hp. gas engine. There are two

speeds cutting, traveling and in reverse. A traveling speed of 4,000 ft. per hour is possible.

Several form graders are in operation on concrete road work in Illinois and are stated to be a success. They are manufactured by Edward G. Carr, 224 W. Huron St., Chicago, Ill.

## Trailer for Warehouse and Terminal Service

A trailer, known as the "Brute," designed for heavy duty service with tractors in warehouses, terminals and transfer stations, has been put on the market by the Sharon Pressed Steel Co., Sharon, Pa. It is made in lengths to 72 in., and in width up to 50 in.

The front wheels are castered, all wheels have roller bearings. The frame supports are flush on the bottom, thus affording an even sur-

when the trailer is used in connection with a lift truck.

The trailer was recently given a road test carrying a load of 8,000 lb. and revealed no weakness.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## n Francisco Building Situation Clears Up

y a vote of two to one, unions iated with the Building Trades ncil in San Francisco on Aug. 27 d officially to end the strike with- formal terms. At the same time vote was five to one against adop- of the American plan, which is in t on many San Francisco jobs and h involves the employment of both n and non-union men in the same .

nother recent development in the ling trades controversy was the t action dismissing the charges nst George and Gompertz, officials he Builders' Exchange, who had accused of conspiring to withhold ing materials during the strike. evidence showed, the court ruled, the combination of material men uilding employers was not formed straint of trade but solely to ac- lish certain results in a labor dis- Labor disputes, it was pointed are not within the contemplation e Cartwright act (the California te that corresponds to the Sher- act for interstate cases).

the decision the court quoted the ct attorney's opinion that any idual may refuse to sell his mer- lise to anyone whatsoever. "If he refuse to do so individually," the on continued, "he may refuse to in combination with others if act is in contemplaton or further- of a trade dispute."

the meantime the Industrial Asso- n of San Francisco has laid out n of action for seeing to it that tries are not interfered with by disturbances without proper con- ation of the three interests con- d—the public, the employee and mployer.

vious references to the San Fran- building strike and the adoption e American plan appeared in *ering News-Record*, July 21, p. 128, and Aug. 11, 1921, p. 259.

## deral Recognition Given to Portland Exposition

ong the bills signed by the Presi- just before the Congressional re- last month was the one authoriz- e President to invite foreign na- to participate in the exposition held in Portland, Ore., in 1925 to rate the centennial of the inven- of the electromagnet, the comple- f the transcontinental and Pacific ays and to exemplify the develop- of hydro-electric energy.

order to handle the affairs of the ition in a business-like way, a ration has been organized with a d stock of $5,000,000, whose di- ate is composed of thirty-three g Northwest business men.

## Car Loading

An increase of 7,471 in the number of cars loaded with revenue freight during the week which ended on Aug. 30, compared with the previous week, was shown by reports just received by the car service division of the American Railway Association. The total for the week was 816,436 cars. In the following table is given a comparison with the car loading for the week ended Aug. 30, 1921, as compared with the corresponding week of 1920:

| Classification | 1921 | 1920 |
|---|---|---|
| 1 Total | 816,436 | 968,103 |
| 2. Merchandise and miscellaneous freight | 491,922 | 534,922 |
| 3 Live stock | 29,110 | 27,110 |
| 4 Coal | 154,140 | 204,140 |
| 5. Grain and grain products | 59,875 | 41,638 |

## Retail Food Prices Increase

The U. S. Department of Labor, through the Bureau of Labor Statistics, has completed the compilations showing changes in the retail cost of food in August, in fourteen cities of the United States. During the month from July 15 to Aug. 15, there was an increase in all of these cities. In Philadelphia there was an increase of 6 per cent; in Bridgeport, Chicago, New Haven, Providence, and Washington, 5 per cent; in Kansas City, 4 per cent; in St. Louis, Springfield, Ill., and Birmingham, 3 per cent; in Peoria, 2 per cent; in Salt Lake City, Denver, Little Rock, 1 per cent.

As compared with the average cost in the year 1913, the retail cost of food on Aug. 15, 1921, showed an increase of 66 per cent in Washington, 64 per cent in Providence; 61 per cent in Chicago; 55 per cent in Kansas City and Birmingham; 54 per cent in St. Louis; 53 per cent in New Haven and Philadelphia; 44 per cent in Little Rock; 42 per cent in Denver; and 35 per cent in Salt Lake City.

## Material Dealers in Buffalo Indicted

Indictments were returned last week by the extraordinary grand jury of the supreme court against eleven firms and ten individuals dealing in masonbuilding supplies in and near Buffalo, New York. The defendants are charged with violating the state antitrust laws in that it is alleged they entered into an agreement whereby the prices of about 90 per cent of the lime, plaster, cement, hydrated lime and other materials used in that territory, were controlled. The report of the grand jury is the fourth one made in connection with an investigation of the building industry in Erie county.

Attorneys representing the defendants entered pleas of not guilty. Bail, in the case of the ten individuals, was set at $2,000.

## Outside Builders Received in Chicago

Recent press reports are to the effect that the building industry in Chicago and Cook county, practically closed to outside contractors, has been thrown open as a result of a recent suggestion of Judge K. M. Landis, who has acted as arbitrator in the disputes arising in that city in the building industry. In agreeing to meet any and all competition openly the only stipulation made is that outside contractors become members of either the city or the county organization of employing builders.

## Seattle Raises Its Quota of Funds for Columbia River Bridge

By raising $40,000 through subscriptions by business men Seattle has contributed its quota of the $400,000 needed to construct the proposed Kennewick-Pasco toll bridge across the Columbia River. Plans for the structure are now in preparation in the office of the Union Bridge Co., of Seattle, and it is believed that construction will start this month. The new bridge will obviate the present necessity of tourists taking a ferry, which has kept thousands of tourists off the Yellowstone trail. It will consist of 1,410 ft. of steel structure and about 1,800 ft. of timber structure, and is to carry a 20-ft. roadway. It was originally intended to pave the bridge with concrete, but this idea has been temporarily abandoned.

Quantities included in the proposed structure are 1,000 tons of steel, 7,000 cu.yd. of concrete, and 1,000,000 f*. of lumber. Boring at the pier sites have been completed.

## Car Priority Order Protested

In a letter recently sent out to associations interested in construction and to the Interstate Commerce Commission, R. C. Marshall, Jr., general manager of the Associated General Contractors of America, raises a protest against the possible reinstitution of car-priority orders. In his letter he refers to the opinion recently expressed by the Geological Survey and the American Railroad Association that a shortage of open-top cars is liable to result from any sudden revival in industry.

"Last year's disaster," runs Mr. Marshall's letter, "did happen and will doubtless happen again should priority be reinstituted. Therefore, in order to provide against this contingency, it is essential that no priority shall be established without due regard for the rights of each industry involved."

It is the assertion of Mr. Marshall that millions of dollars were lost to the construction industry last year through inability to move materials though

these construction firms were bound to both private and governmental agencies by rigid contracts which penalized them for delayed completion.

The possible loss to construction companies of money is not the only consideration, Mr. Marshall finds. He asserts that if any priorities were established the construction industry should be one of the first to be considered inasmuch as the country is so short of housing facilities, and inasmuch as the need for construction work of all kinds is so general.

## Illinois Has Awarded 283 Miles of Hard-Surface Paving

Up to and including Aug. 20 the Illinois Division of Highways, Department of Public Works and Buildings, had let during 1921 contracts for the construction of 282.69 miles of hard-surface roads. In addition to this amount it is expected that contracts will soon be let for the construction of 87 miles.

Besides the paving work, the Illinois Division of Highways has let contracts this year for 265.24 miles of hea grading, the cost of which is $1,24 229. Contracts for 65 bridges h also been let, the total cost of wh amounts about $850,000.

Though no definite program accomplishment for the 1921 constr tion season had been decided upon the state highway engineer, a tentat outline of a possible 500 miles was h in mind early in the year. About per cent of that amount will have b finished by the end of the curr calendar year.

# Weekly Construction Market

THIS [illegible] publishes [illegible] weekly for the purpose of giving current prices on [illegible] construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for important cities. The last complete list will be f in the issue of September 1, the next on October

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Mont |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | [illegible] | $3.50 | $4.00 | $2.88 | $3.10 | $4.00 | $3.70 | $4.00 | −$4 |
| Structural rivets, 100 lb. | −3.70 | 5.25 | 5.50 | −3.68 | −4.15 | 4.25 | 5.50 | 5.25 | −6 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2.78 | 3.20 | 3.50 | 2.78 | 3.18 | 3.57½ | 2.35 | 3.75 | −3.7 |
| Steel pipe, black, ⅜ to 6 in. lap, discount | [illegible] | 52 6⅔-5% | 45% | +48½% | 53 0-5% | 30% | 40 25% | −48½% | 5 |
| Cast-iron pipe, 6 in. and over, ton | −43.30 | 43.33 | 53.30 | −45.60 | −50.80 | 57.50 | 60.00 | −60.00 | −70.0 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.60@2.70(del.) | 2.75 | 2.80 | 2.17 | 2.41 | 3.10 | 3.09 | 3.10 | 3. |
| Gravel, ¾ in., cu.yd | [illegible] | 2.25 | 3.00 | 1.80 | 2.00 | 2.50 | 2.25 | 1.50 | 1. |
| Sand, cu.yd | 1.25 | 1.35 | 2.50 | 1.80 | 1.00 | 1.10 | 1.50 | 1.50 | 1. |
| Crushed stone, ¾ in., cu.yd. | −1.80 to 1.90 | 2.25 | 2.80 | 2.00 | 2.25 | 3.50 | 2.25 | 3.50 | 2. |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 45.00 | 38.00 | 35.00 | −46.00 | 34.00 | 49.00 | 30.00 | 21.50 | 120.0 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 20.00 | 29.00 | 30.00 | 25.40 | 24.00 | −21.0 |
| Lime, common, lump, per bbl. | [illegible] | 1.50 | 2.75 | 1.65 | 1.50 | 2.95 | 2.25 | 2.75 | 15.0 |
| Common brick, delivered, 1,000. | +18.40@19.40 | 10.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | −16.0 |
| Hollow building tile, 4x12x12, Block | Not used | .14 | .124 | .0926 | .092 | .09 | 12½ | .11 | |
| Hollow partition tile 4x12x12, block | +.11370 | .14 | .124 | .07410 | .092 | .10 | 14½ | .12 | |
| Linseed oil, raw, 5 bbl. lots, gal. | −.78 | .86 | .98 | +.87 | .90 | .98 | .95 | .79 | + |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | [illegible] | 35 | [illegible] | 1.00 | .50 | .50@.63½ | .81½ | .75 | |
| Common labor, non-union, hour | [illegible] | .20 | .35@.45 | .40 | .50 | .37½@.50 | .50@.55 | .50 | .3 |

Explanation of Prices—[illegible] tracted discounts [illegible] from previous quotations are indicated by [illegible] vailing discount from list price is given: 4-in. [illegible] discount of 45 and 5 per cent. [illegible] a range of 40 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.80 for Kelly Island and $1.65 for Sheboygan Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton at head of quarry. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. houses except C. I. pipe, which is mill plus freight to railway depot at any minal. Lumber prices are delivered ship tackle in San Francisco ex Seattle quotes on Douglas fir instead pine; and on lime in paper bags. Mont quotes sand, stone, gravel and lump per ton. Cement, lime and tile are livered; sand, gravel and stone, on sid brick f.o.b. plant, steel and pipe at y house. Cement price is in Canadian f exchange with the United States being per cent at present. Bag change is per bbl. Discount of 10c. per bbl. for ment within 20 days from date of shipm

## Changes Since Last Week

Structural steel shapes have been quoted in Pittsburgh as low as $1.70@$1.75, with soft steel bars at $1.60@$1.70 per 100 lb. New York quotes mill shipments of structural shapes at $2.13@$2.23; bars at $2.08. Structural rivets are quoted at $3.70 as against $4.40, at New York warehouses.

Denver reports mill price of steel shapes at $3.24½ including freight and war tax; stock and warehouse price $4 as against $4.10. Reinforcing bars are quoted at $3.57½ as compared with $3.97½ previously. Sharp decreases in structural rivets are shown in New York, Chicago and Minneapolis. Mill shipment price, in Seattle, of steel shapes is $75.20 and the stock price $110.20 per ton. Mill shipments, Minneapolis, are quoted at $2.51, all rail; $2.45 per 100 lb. lake and rail. Steel pipe has advanced in Chicago and declined in Seattle. Decreases ranging from $2 to $5 per ton in cast-iron pipe prices are reported in New York, Minneapolis and Seattle. Chicago price has been reduced from $46.10 to $45.60 per ton.

Market for concreting material remains firm throughout the country. New York reports a reduction of 10c. on crushed stone, making the present price $1.80@$1.90 as compared with $1.90@$2 per cu.yd. formerly. This reduction has been made possible by economies having been effected in delivery methods.

Chicago reports the only reduction in lumber prices; quoting pine, base [illegible] at $46 as against $49 per M ft. b.m.

An advance of $1 in the price common brick is shown in the New York market; the present quota being $18.40@$19.40 per 1,000, livered. The demand for common b still continues in the New York dist with the price but little in advanc the cost of production.

Hollow partition tile has adva slightly in New York and droppe Dallas, during the last two weeks.

Linseed oil has advanced 7c. in cago and 2c. per gal., in 5 bbl. lots Montreal.

Common labor, non-union, is av able in Montreal at 20c., as against regular schedule of 30c. per hour.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 87 — NEW YORK, SEPTEMBER 15, 1921 — Number 11

## The Coming Victory

ON OCT. 5 the ballot on the constitution of the American Society of Civil Engineers will be canvassed. We thought that the debate on the subject was long since over, but the fight is still on. Witness the letters elsewhere in this issue. Two prominent revisionists oppose the proposed revision. What will be the next engagement in this long-drawn-out war? According to Mr. Humphrey the triumph of the revision will be a defeat for the society, and defeat of the revision a triumph for the old constitution, which he and his associates tried so hard to change. We are in the position of little Peterkin, and when the next skirmish is over on Oct. 5, we shall confusedly ask, "But what good has come of it at last?" We fear that some thousands of members of the society will answer, with Southey,

"Why that I cannot tell,
"But 'twas a famous victory."

## Taking Ourselves Too Seriously

ALL THIS bickering in the American Society of Civil Engineers prompts the inquiry whether ever so many of us have not been entirely too serious about this whole business. We will admit that we ourselves have been. There was needed a goodly group to sit on the fence and plainly tell each side its shortcomings and laugh at the foolish points in its campaigning. The fence sometimes is not a bad place to be. For one thing the man sitting there would plainly see in this prolonged fight that the society is a thing bigger and higher than either of the groups temporarily in control or fighting for it. And seeing that, he could afford to smile. Setbacks there may be, but the virile strength of the society will eventually assert itself. Even in the most conservative days of a conservative past the society continued to grow and its prestige to increase.

## At 60 per Cent Capacity

FREQUENT occasion has been taken in these columns to point out the present status, as regards activity, of the construction industry. We fully realize that it does not help the feelings of the man who has no work to know that the construction industry operated at 60 per cent of last year's capacity in the first half of this year, and is above that figure now. Nevertheless, it is a salutary thing, whether for better or for worse, to know where one's industry stands with reference to the other industrial activities of the country. In the case of the construction industry, we would say that the situation a present is "for better." The steel industry, for example, operated at 29 per cent capacity in August, the machine-tool industry at about 9 per cent, while the automobile industry was somewhere between 60 and 70 per cent. The figures of the construction industry certainly compare well with these, and particularly with the steel and machine-tool trades. On the other hand, there are industries that are doing much better. The cotton industry, for example, is operating at practically 100 per cent capacity, and the woolen industry at about 80 per cent. Given branches of the construction industry, too, are in better shape than the industry as a whole. The cement plants, as we know, are operating at practically last year's capacity. On the whole, the construction industry has reason for congratulation. As we have previously said, the margin between good times and bad—for the individual at least—is a very narrow one indeed. All of us have not been working, but, taken as a class we have been distinctly better off than our fellows engaged in other lines of endeavor.

## Last Week's Wage Reduction

BY FAR the biggest piece of news last week on cost matters was contained in the Navy Department's wage reduction and the decision of Judge Landis, as umpire, on the Chicago building-trades wages. The Navy reductions, made after lengthy investigation, ranged between 13 and 14 per cent, while those in the Chicago case ranged from 10 to 33 per cent. More important, though, in the latter case is the abrogation of restrictive working agreements, which abrogation alone will reduce costs as much as would a 20 per cent wage reduction had other factors been held the same. Judge Landis' decision is of the same quality as the acts which have won him such a large following in the Middle West. The decision may be styled as that of "more than a judge." Instead of splitting hairs, in approved legal fashion, he goes to the core of the situation. With one stroke he breaks down the restrictions by which the employers of Chicago have kept out outsiders, and with another breaks down working agreements which he does not hesitate to characterize as having been created to give the parties a monopoly and to produce waste for the mere sake of waste. He calls a spade a spade, not in any bitterness but by baldly stating facts. At this writing some of the trades are appealing for a rehearing. It is to be hoped, however, that the force of public opinion will induce them to stand by their agreement to accept the umpire's award. The whole country will benefit by Judge Landis' work, however, even though the Chicago unions show themselves poor sports and refuse to accept the award.

## Overlaps and Confusion

OVERLAPS in state departments are created as fast as or faster than they are removed. In our issue of Aug. 4 we outlined the transfer of certain engineering functions in New York state departments and questioned the wisdom of dividing responsibility for state control of the sanitary-engineering plans of cities into engineering and sanitation, so the duty of passing on certain municipal plans is vested in the state engineer's

office while the supervision of the operation of water-supply and sewage-works is left with the health department. Scarcely has such legislation to amend the state health and conservation laws gone into effect when the Conservation Commission announces the organization of a Bureau for the Prevention of Stream Pollution. True, this is designed to protect fish and shellfish, but why should not everything pertaining to water pollution be vested in a single bureau of a single department instead of being scattered among three bureaus of three departments? With the new bureau in operation, sewage disposal in New York State will be under the control of the state engineer as regards plans for new work, under the health department as to the effect of operation on human life and under the conservation department as to fish life. Such scattering of responsibility makes for neither economy or efficiency.

### Automatic Control

HYDRO-ELECTRIC plants are now being provided with many automatic features that tend to increase safety, economy or smooth operation and which were entirely unthought of a decade ago. The Kern River No. 3 plant built in California recently, in addition to being of interest as the highest-head turbine plant yet put in service, probably comes nearer being automatic, "fool-proof" and safe in emergencies than any other plant of its kind ever built in this country. In fact, automatic devices in this plant involve so much purely mechanical and electrical detail that the greater portion of its equipment is more properly in the fields of mechanical and electrical designers than of the civil engineer. What these devices are designed to do, rather than how they do it, is made the substance of a discussion of the automatic features of the Kern River No. 3 plant on another page. The notable success of automatic substations on electrical distribution systems has probably had a good deal to do with the tendency toward more and more dependence on automatic features in electrical generating plants. Of course, there is the disadvantage of having in such plants, and subject to derangement, all the additional equipment which these operations require, but on the whole with careful machine work, rugged construction and accurate adjustment in installation, this tendency to reduce the manual operation required of the generating-station operator is increasing safety and making for better and more dependable electrical service.

## The Day of Visions

THIS is a workaday world and our task in working hours—unless engaged in research—keeps us down to the practical, immediate money-making affairs of life. When evening comes, though, there should be time for the mind to expand, to wander into fields of speculation, and to rise to new heights in things material as well as spiritual.

In the material way we may feel that the best is behind us and that the rate of acceleration in exploring the unknown will slacken. Have we not in one generation taken electricity as an infant and brought it to manhood with perfection in light, propulsion, and both wire and wireless communication? Have we not developed the self-propelled vehicle from nothing and to a convenience and tool of the masses? Moreover, in a few swift years, have come air flight, tremendous submarine progress, the discovery of new light rays and of the marvels of radio-activity, and the enunciation of the phenomena of relativity. It would seem that the pace must slacken.

Yet, is it not sounder to hold that the new plane to which we have been raised is but assurance of more successful and more rapid attack on the unknown? This thought comes home in reading the inspiring address of Arthur D. Little, of Boston, before the American Chemical Society last week. He sketches rapidly new fields that are beckoning and pictures mighty empires to be conquered. Not all he says is new, but its juxtaposition gives to the whole a great attraction. When will come the day when solar energy will take the place of our dwindling fuel supplies? "The world," he said, "awaits the genius who will convert radiant energy into electric current." The Sahara Desert receives solar energy equivalent daily to that of 6,000,000,000 tons of coal. Further, he intimates that the energy of the earth's rotation may some day be utilized. Sperry has used it with his gyroscopic compasses and stabilizers, and, if this be thought an insignificant use, Mr. Little reminds us of the day when the only known man-controlled electric phenomena was the picking up of a feather by a rubbed bit of amber. He mentions the tides as possible sources of power, and then enlarges upon the inconceivably great stores of atomic energy. These, he says, we now "recognize as of an altogether higher order of intensity and magnitude than the energy derived from burning coal or liberated from the most powerful explosives." That energy may some day be loosed and more than make up for our consumed fuel supply.

Verily, the day of our mastery of the unknown should not be past, nor should the pace slacken.

## Ills of Excessive Mechanization

WHILE thinking of the visions that Mr. Little has painted, it is apropos to look at another phase of our attack on material problems, emphasized at the recent Cincinnati meeting of the American Bar Association by James M. Beck, the eminent New York attorney, now solicitor general of the United States. To the "excessive mechanization of human society" he lays the "economic catastrophe of 1921" (the industrial disruption due to stoppages of work and the lessening of efficiency), which, he believes, is far greater than the politico-military catastrophe of 1914. He holds that the large multiplication of human power by machines has tended to intoxicate man. The lust for power has obsessed him. He consumes the treasures of the earth faster than he produces them. He has multiplied feverishly the things he desired, but even more feverishly his wants. To gain these he has sought the congested centers of life and by uncounted thousands has become a machine tender. The accompanying minute subdivision of labor "has denied to many workers the true significance and physical benefit of labor." It has, too, destroyed the spirit of work. Life has become too easy.

Mr. Beck does not charge that engineers are responsible for this breakdown. His inquiry is entirely impersonal, but no matter how much the financier and the owners of industry may be to blame, his address does fling a challenge to us, the engineers. If we are high priests of an order that, while tending to mak

life more agreeable, is making it less worth while in its intellectual and spiritual attainments, we certainly should appreciate it and be co-workers—yes, even leaders—in working out the remedy. "To rekindle in man the love of work for work's sake and a spirit of discipline," would, Mr. Beck believes, do much to solve the problem, "for work," he adds, "is the greatest moral force in the world." In this direction some engineers and some industrial executives have been working, by various efforts to revive the spirit of craftsmanship and to show the worker his function in the great whole.

Whether Mr. Beck is unduly pessimistic, the individual will judge, but that all is not well is only too clear. Engineers have a special responsibility in working out a solution, for it is upon their work that the present industrial and social order is built. As engineers, they cannot alone attain the desired good results. As citizens, as men, they can influence those civic and spiritual forces which must be co-workers in the task.

## Lesson of the Salina Failure

SO MUCH was wrong with the design and construction of the Masonic Temple at Salina which collapsed in July that it would be easy to pass the failure lightly by with the comment that there is no lesson to be learned from it. Everyone knows that successful concrete work requires a fairly close approach to perfection in the selection of materials, the design of the structure and the methods of erection. Neglect in any of these three elements is dangerous; neglect in all three is fatal. The consulting engineers' report, abstracted in this issue, clearly charges the triple neglect. There will be those, therefore, who will say that here is merely another case of the disregard of the elements of structural practice, lamentable of course, but in no way pointing any moral except the obvious one that one cannot violate fundamental principles.

To take this view would be to miss the main feature of the failure, that is the irregularity of the structural framing and the part it played in the collapse. Reinforced-concrete design has progressed most rapidly in the last decade not so much in the detailed designing and computation of the individual members as in the use to which these members are put. The theory of the beam, the column and the slab is under constant discussion and some revision but the effect has been mainly to raise somewhat the unit stresses allowed. Basic design is little different from that of the first Joint Committee report. In the size and framing of the units, however, there has been constant development. Whereas in the early days, in this country at least, the typical reinforced-concrete building was a box-like structure of regularly spaced and squarely placed short-span panels, there have been an ever increasing number of complicated structures with long span floors and roofs, cantilevers, trusses, eccentric columns and all the other irregularities of frame long common in structural steelwork. These complications impose a certain burden on the skill of the designer, but by no means as great a one as on the constructor, because of the fact that reinforced-concrete members are not self-supporting for some time after their placement and the structure during its erection period is in an entirely different state of loading and support than after it is put in service.

The fundamental error of the designers and builders of the Salina temple was that they did not recognize the obligations their elaborate framing imposed. Granting that the concrete was weak, though for what reason the engineers' report does not state, granting that the stresses for ultimate load were unduly high, the real reason for the collapse lay in the use of the reinforced-concrete trusses over the auditorium, trusses which were not even in when the building collapsed. The very fact that these trusses were adopted required that the entire load of the ceiling of the auditorium be carried, through 37 ft., to the floor below, another long-span construction itself carried to long-span beams below. A proper appreciation of the erection conditions imposed by this framing would have led not only to a thorough cross-bracing of the upper shores but to an investigation of the strength of the successive supporting girders and of the clay bottom on which the shores finally came to bearing.

Some thought evidently was given to the matter, or else the shores would not have been carried through at all, but the sin of omission lay in the disregard of the deflection possibilities in the long spans of the auditorium and banquet floors. Instead of the stiff, short spans and frequent columns of the ordinary concrete building, a condition that localizes possible failure during the setting period or throws the load on a capable column, there were flexible girders and joists which transmitted load and movement from floor to floor.

Certainly if the concrete of these lower members had been of proper strength or their design as to stiffness and stress been sufficient, the amazing progressive deflection described by the consulting engineers would not have taken place. Possibly, too, rigid shoring in the auditorium space might have saved the floor above. Neglect here, therefore, contributed to the failure. But the basic error was the attitude toward the structure in its entirety, the light regard in which were held the difficulties of a complicated reinforced-concrete framework. The necessities of good materials, adequate design and proper workmanship have been hammered over and over again. The Salina building may be added to the "awful examples" of what not to do in these respects, but more than that it should go on the records as a warning against too great confidence in the ability of reinforced concrete to stand abuse.

Incidental to the main lesson from the failure is the progressive deflection of the girders under a fixed load. This is a most unusual phenomenon and one on which more data should be given. The consulting engineers' report is much too categorical. Engineers would be better informed were they given the evidence that the bearing on the clay of the basement was insufficient to carry the load, that there were some indications of a punching of the mud sills into this clay, and that there were positive indications of the deflection of the girders under and over the banquet hall. The progressive deflection of five or six months' old concrete beams has been largely a matter of laboratory investigation. Some experimenters, notably F. R. MacMillan when he was working at the University of Minnesota, have noted this deformation under load, but the observation of such conditions in actual structures has been most rare and has never, we believe, been given as a cause of failure. The dangerous possibilities of plastic deformation have been much discussed in academic fashion. Here is an opportunity for practical analysis and no data which would help such an analysis should be withheld.

# Form Settlement Causes Concrete Building Collapse

**Report on Salina, Kan., Masonic Temple States That Top Floor of Inadequate Design Failed Five Weeks After Pouring by Progressive Deflection of Lower Floors Carried to Foundation by Shores**

ALTHOUGH adjudged structurally weak and built of materials giving a concrete of low compressive value, the primary cause of failure on July 11 of the Masonic Temple in Salina, Kan. (*Engineering News-Record*, July 28, 1921, p. 165), is stated to be the insufficient strength in the shores to prevent buckling and collapse when deflections due to settlement of shore foundations redistributed the loads and concentrated

FIG. 1. LOOKING WEST ACROSS SOUTH END OF BUILDING

them on certain points. These are the conclusions of the Condron Co., Chicago, engaged after the collapse as consulting engineers by the owners to investigate and report on the cause or causes of the failure. The failure is one of the most remarkable in the history of concrete because the upper story, where initial collapse occurred, was five weeks old and the lower floors, whose progressive deflection permitted the top floor to sag and fail, were from eight weeks to five months old. Furthermore, all of the later concrete had been placed and cured in temperatures far above freezing.

The Masonic Temple at Salina had an irregular layout of floor heights and beam spacing because of the inclusion of lodge room, banquet hall and auditorium. As shown in the accompanying drawings it was 123 x 169 ft. in plan and 90 ft. high, with six floor levels over part of the area, but with extra high stories at the special rooms noted. It was of reinforced-concrete frame, with practically all square rodded columns, beam-and-slab floors and a terra cotta and face-stone exterior. The columns carrying the roof trusses, noted hereinafter, were 30 to 36 in. square with 25 to 33 in. circular cores inside hoops with 2½ in. pitch.

In the straight story section the beams were 15 to 35 ft. span and framed square to the columns, but over the large rooms girders of spans above 40 ft. were used. The ceiling of the auditorium, which was the floor of the lodge room, was of the special design shown; that is a series of 41 ft. girders on 3 ft. centers framing into columns at their outer ends but into the lower chords of two heavy reinforced-concrete trusses at their inner ends.

At the time of the collapse the structural frame was complete with the exception of these large trusses and the roof, forms for which were partly in place. In consequence, the completed concrete floor of the lodge-room, which in the finished structure would have been supported on the lower chords by the trusses, was supported on shores extending to the auditorium floor, 37 ft. below, and this construction load was further transmitted by a veritable forest of shores through each of the stories in turn to the lowest tier of shores which rested on mud-sills on the ground. The settlement of these lowest shores is given by the Condron Co. report as the primary cause of the failure. The main part of that report is given below, together with drawings prepared to accompany it.

On Fig. 7 will be noted two closely spaced lines of shores (2 ft. c. to c.) placed directly under the bottom chord sections of two 85-ft. reinforced-concrete trusses from which the lodge floor over the main auditorium was to be suspended. Under the remainder of the lodge floor the shores were uniformly spaced under the concrete ribs. Each of the closely spaced shores under the east chord supported 3,454 lb. dead load and those under the west chord, 2,954 lb. On each shore under the east portion the load was 2,159 lb. and on the shores supporting the west portion of the lodge floor it was somewhat less, 1,709 lb., because the roof form above had not yet been built.

The lodge floor concrete was five to six weeks old. On Figs. 5 and 6 it will be seen that part of the shores supporting the lodge floor rested on the long span construction of the central part of the auditorium floor, and that the remaining shores rested on more rigid short spans on the north and south sides and the east end of the auditorium floor. The shores under the second (auditorium) floor rested on the long span construction of the first (banquet) floor. Also under each of the long span girders of the

FIG. 2. VIEW OF ALMOST COMPLETE COLLAPSE AT REAR

first floor, were placed eleven shores which rested on the ground or on the floor of the duct trench.

The second or auditorium floor concrete was more than three months old while that of the first or banquet floor was poured in January and February. Shoring had been maintained continuously under all of these floors. The shoring under the lodge floor was about equally divided between 4 x 4-in. timber and 2 x 6-in. pieces teed.

Eye witnesses stated that there was some bending or buckling observed in the long shores in the east half of the auditorium space underneath the lodge floor about one

hour before the collapse took place. Carpenters were put to work renailing the braces on these shores and additional material was hurriedly ordered with which to reinforce and re-brace the shores which were showing signs of distress. It was also observed that some of the shores were loose and wedges were ordered to be driven between the tops of these loose shores and the ceiling of the auditorium. While this work was going on, one of the long shores toward the east end of the auditorium space broke under its load, and the carpenter foreman ordered all of his men out of the building. The breaking of this first shore was followed by the breaking of a number of other shores, and within a few moments, so much of the shoring gave way as to allow the lodge floor to fall, carrying down with it portions of the second or auditorium floor, the banquet balcony and the first or banquet floor.

A careful investigation of the wreck and a study of the plans disclose that the shores were of sufficient strength

FIG 3. FALLING BEAM BREAKS THROUGH 5-IN SLAB

to support the dead weight of the lodge floor so long as it was uniformly distributed over the great number of shores on which it rested, and so long as these shores remained in straight or vertical positions; also that there must have been sufficient horizontal and diagonal bracing to hold these shores in position during the time that the concrete of the lodge floor was being poured and for several weeks thereafter. According to testimony, no shores, nor the bracing of the same in the east half of the auditorium space under the lodge floor had been removed or disturbed for at least two weeks prior to the accident.

*Analysis of Failure*—A large portion of the shoring supported on the auditorium floor rested on the long span joist construction of the auditorium floor which had a clear span of 43 ft. 10 in. It was relatively shallow and therefore would have deflected under load but for the closely spaced shoring below, which latter carried all of the load directly to the first floor (see Fig. 9). But for the additional shores under the first floor this load would have deflected the first floor long span girders. The loads from these shores were spread on the ground through 2 x 8-in. plank except the center shore of each girder which rested on the concrete slab of the trench floor.

Loads on the lodge floor were much greater than an auditorium floor would reasonably be designed to carry. Especially is this true with regard to the concentrated loads from the two lines of closely spaced shores under the truss chords shown on Fig. 8 as extending from column 46 to column 49 and from column 50 to column 53. However, the strength of this floor was not depended upon to carry these loads, but they were carried by shoring under the auditorium floor, resting on the first floor as shown in Fig. 9.

Loads thus delivered to the first floor were greater than a banquet room floor should reasonably be designed to carry. Here again the strength of this floor was not depended upon to carry these loads as eleven 6 x 6-in. shores or posts were placed under each of the first floor girders, consequently these eleven shores were depended upon to support practically all of the loads coming upon one of these long girders through the first floor.

The loads on these shores, particularly in the case of the girder 21 between columns 51 and 52 shown in Figs. 9 and 10 were so great as to cause compression of the ground and probable breaking of the trench floor slab, with the resulting deflection and overloading of this girder 21. According to the shoring plan two of the shores under each girder 21 were supported on the ground within 2 ft. of the 6-in. tile walls of the open trench, which was 4 ft. deep.

A reinforced-concrete slab or girder will deflect under load, and if the load is excessive, the deflection of the slab or girder will continually increase, either slowly or rapidly, depending upon the amount of stress in the steel and concrete and the strength of the steel and concrete to resist these stresses. In addition to the bending stresses, there will be shearing stresses which are the greatest where the slab or girder connects to its supports. Where excessive shearing stresses occur, diagonal cracks will appear near the connection of the girder to the supporting wall or column. It is reported that such shear cracks had been observed in these long girders 21 under the first floor. A reinforced-concrete slab or girder will fail slowly by fatigue under load which is not sufficiently great to cause immediate or sudden failure. Such progressive failure may require days or even weeks, provided the load is such as to stress the steel or concrete beyond its elastic strength.

The load delivered to the first floor was much greater than a safe load on girders 21, which had a span of 43 ft. 10 in., and so long as all or a large share of this load was carried to the ground by the shores under these girders, there would be slight deflections and corresponding low stresses in these girders, but as the shores pressed into the ground, these deflections and stresses would increase, thus greatly increasing the load on the center shore which rested on the thin concrete floor of the trench. It is therefore highly probable that the tunnel floor slab broke, resulting in a more or less gradual settling of this center shore and corresponding deflection of the girders 21, especially that girder supported by columns 51 and 52, directly under the east truss chord and its closely spaced shoring.

Referring to Fig. 9, it will be seen that there are five of these girders 21 which are located in the central region of the space occupied by the auditorium above. The area

FIG. 4. NOTE WAY LOWEST BEAM ON LEFT BROKE AWAY FROM COLUMN

of the auditorium ceiling is defined by the position of the four columns 20, 27, 69 and 77. The fourteen columns inside of this area shown on the first floor plan, extended from the ground to the floor of the auditorium, but did not extend above the floor of the auditorium. Therefore, the space in the central portion of the auditorium floor was not so rigidly supported as the space outside of and surrounding these fourteen columns. The second floor plan, Fig. 9 makes the above condition even more evident. The auditorium ceiling was of long span construction covering the area defined by columns 20, 27, 69 and 77, while only that

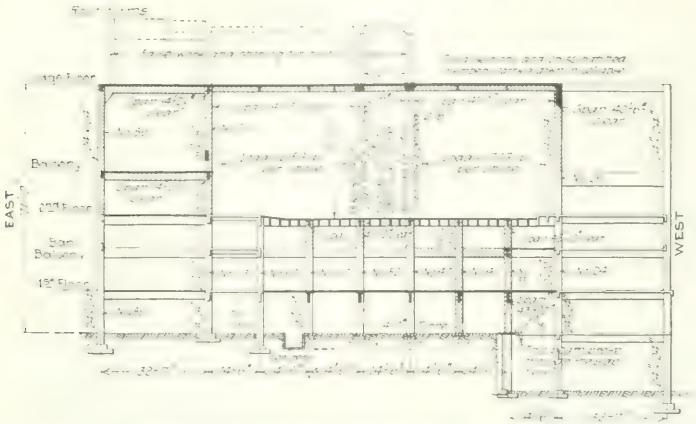



FIG. 5. LONGITUDINAL SECTION LOOKING SOUTH

portion of the auditorium floor defined by columns 23, 26, 64 and 61 was of long span construction.

But for the supporting power of the shores which rested on the ground, any part or all of this long-span floor construction shown on Fig. 8 would deflect much more than than the surrounding portion of the auditorium floor supported by the system or short girders; and with the deflection of the long-span construction, excessive loads would be brought upon the shores resting on the short span construction parts of this floor.

It will be seen from Fig. 7 that the long span joint of the lodge floor construction ran east and west and extended from the row of columns 69 to 77 to the east truss chord between columns 50 and 53, but that there was very rigid support under the east third of these joists, as well as under the north and south sections of this construction. Consequently, that portion at the east end of this joist construction between columns 60, 65, 69 and 77 was supported on shores having very solid foundations on the short span construction below. When the shores under the joist construction began to settle due to deflection of the auditorium floor and the first floor, the loads on the shores that rested on the short span construction were greatly increased, because these shores would remain rigidly supported. As a consequence, the shores that were rigidly supported above columns 61, 62, 63 and 64 became overloaded and began to buckle or bend. The connecting horizontal bracing between the shores would pull other shores out of line, thus increasing the trouble and finally some of these overloaded shores would break, thus precipitating the entire collapse.

*Analyses of Structural Design.*—Stresses in typical slabs, joists and girders of the first, second and lodge floors as shown in the table are greatly in excess of the safe working stresses allowed by city ordinances for ordinary practice. Tests indicate that the concrete in the slabs, joists and girders did not have an ultimate compression strength exceeding 1,000 lb. per sq.in. The calculated stresses are based on the actual computed dead load of concrete and a top finish 1½ in. thick, a suspended ceiling and plaster or plaster on concrete, together with a live-load of 100 lb. per square foot of floor on slabs and joists or a live-load of 85 lb. for main girders.

Tests made at the Kansas City Testing Laboratory of a 6-in. cube cut from concrete from the building [at least

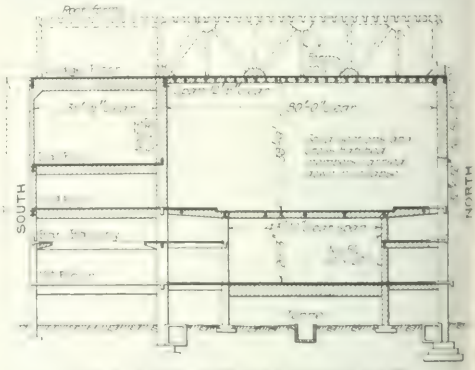



FIG. 6. CROSS-SECTION LOOKING WEST

40 days old] gave a compression stress of 921 lb. per sq.in. With samples of material used on the building mad up of 1:2:4 mix in this laboratory, compression tests o 6 x 12-in. cylinders were as follows:

| Water Content per Cent | 7 Days per Sq.In. | 28 Days per Sq.In. |
|---|---|---|
| 8 | 1,113 | 1,622 |
| 10 | 917 | 1,304 |
| 12* | 677 | 875 |
| 14 | 294 | 443 |

*Probably the lowest per cent of water used in the field.

The concrete in the building shows every evidence having been well mixed and placed. The stone used, however, appears to be soft and probably the strength of the concrete was limited by the strength of the stone. With an ultimate stress of 1,000 lb., the maximum safe working stress would not exceed 400 lb. In such concrete the maximum [safe—Ed.] shearing stress as a measure of diagonal tension in beams when fully reinforced, would not exceed 60 lb.

As that portion of the building which collapsed was supported on falsework up to the time of the collapse, a

CALCULATED STRESSES IN SLABS, JOISTS, BEAMS AND GIRDERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Load Stress Lb. per Sq.In. | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Slab | 5 | 6 | 5 | 175 per Lin. Ft. | 14 | | 22,500 | 885 | |
| Girder 20 | 24x30 | 4 | 7 | 2,770 | 23 | | 30,800 | 860 | 172 |
| Girder 11 | 24x30 | 1 | 8 | 1,602 | | | 36,000 | 940 | 275 |
| | | | | 64,200 lb. | | | | | |
| Girder 21 | 18x42 | 7 | | | 14 | | 26,400 | 500 | 171 |
| Girder 10 | 18x24 | 1 | | | 14 | | 32,000 | 750 | 180 |
| | | | | | | | | | |
| Joist | 8x7 x24 | 2 | | | 14 | | 34,000 | 940 | 171 |
| Girder 23 | | | | | 21 | | 30,800 | 560 | 172 |
| Girder 11 | | | | | | | | | 166 |
| Girder 10 | 9x24 | 3 | 57 | 2,715 | 15 | | 25,000 | 450 | 420 |
| Beam 70 | 9x22 | 2 | | | | | 27,000 | 456 | 260 |
| Beam 20 | | | 66 | 2,920 | 47 | | 21,500 | 380 | 180 |
| Girder 22 | | | 77 | | | | 13,650 | 240 | 178 |
| | | | | 4,200 | | | | | |
| | | | | | | | | | |
| Joist | | 2 | | | 14 | | 34,000 | 940 | 171 |
| | | | | | | | | | |
| Girder 18 | 24x66 | 3 | 48 | | | | 18,900 | 85 | 200 |
| Girder 20 | 10x48 | | | 2,873 | | | 18,400 | 360 | 420 |
| Girder 2 | 10x48 | | | | | | 48,500 | 600 | 84 |

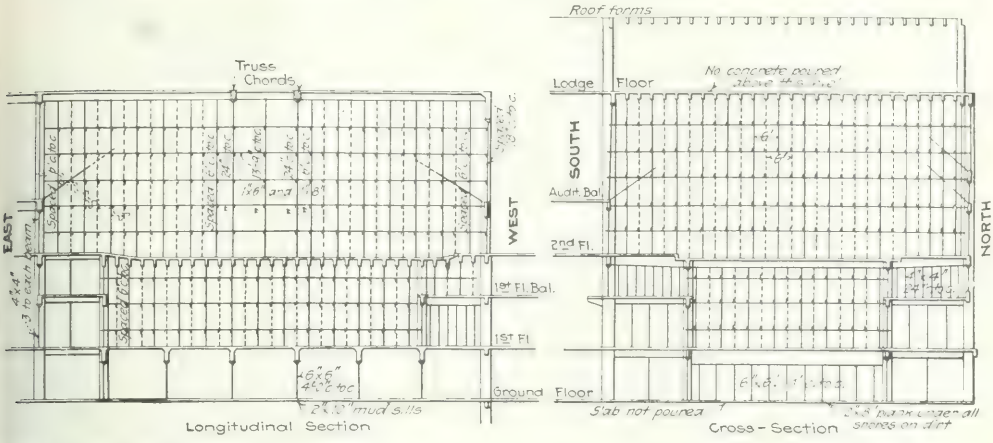



FIG. 7. SECTIONS INDICATING LOCATION OF SHORES ACCORDING TO CONTRACTOR'S DRAWINGS

Longitudinal and diagonal bracing butting against columns, beams, lintels and slabs 2 x 6 in. Other cross-bracing—1 x 6 in. and 1 x 8 in., about 50 per cent of each. Shoring under lodge floor—4 x 4's and two 2 x 6's Teed, about 50 per cent of each. Longitudinal and diagonal bracing butts against concrete members where possible. About 50 pieces 1 x 6 in. x 14 ft. used for diagonal bracing at random through shoring in addition to that shown on sketch.

as the two reinforced-concrete trusses designed to support the central portion of the lodge floor had not been built, this lodge floor could only have been supported by falsework up to the time of the collapse, or until these reinforced-concrete trusses had been completed long enough to have developed their full structural strength; consequently, the structural strength of the lodge floor as designed was not a factor in the collapse. The loads

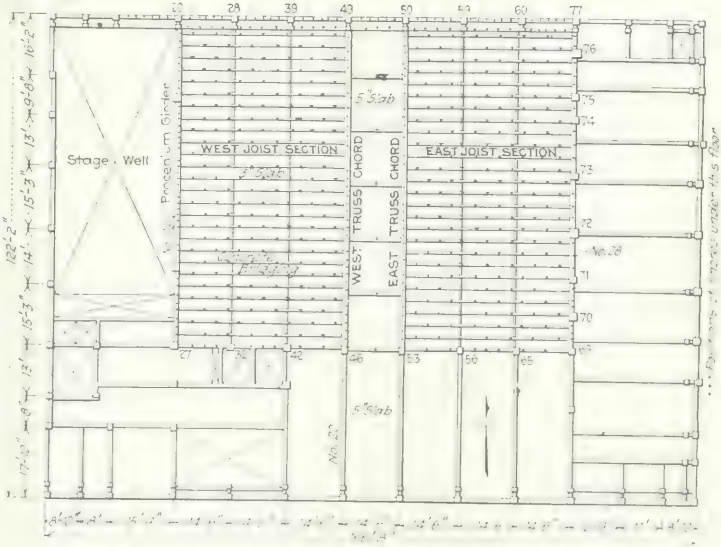



FIG. 8. LODGE FLOOR SHOWING LOCATION OF SHORES BENEATH

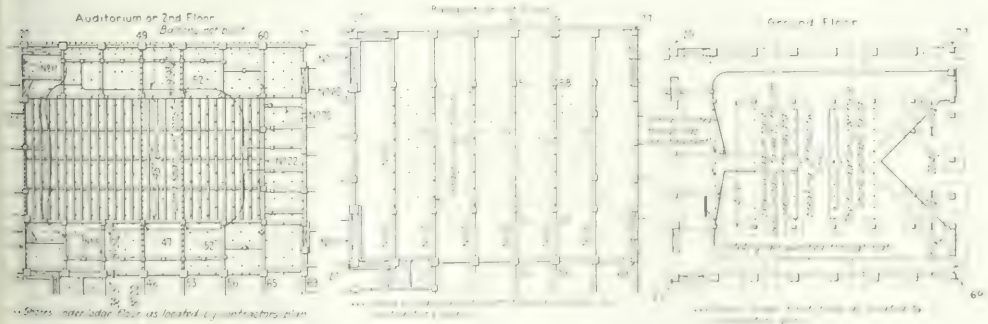



FIG. 9. LOCATION OF SHORES ON FLOOR PLANS OF THE AUDITORIUM AND GROUND FLOOR

from the shores supporting the lodge floor were greater than a floor for an auditorium would be designed to carry. Shoring was in place under this auditorium floor, and therefore, the structural strength of the auditorium floor was not a factor in the collapse. The load brought upon the first floor by the shoring which rested thereon, was a greater than a banquet room floor would be designed to carry, and this floor had sufficient shoring under it to carry its load, provided the foundations under the shoring were unyielding. With the settlement of the ground under these shores, the first floor construction was of entirely inadequate strength to carry this load.

If the girders of this floor had been well designed for 100 lb. per sq.ft. of floor surface as required by the Chicago Building Code, the load coming to this floor by the falsework, which amounted to as much as 265 lb. per sq.ft., would possibly have caused failure of these girders, provided there was no shoring beneath them.

According to our computations, the maximum safe load in addition to the actual weight of the floor construction on these girders would be 25 lb. per sq.ft., provided the concrete had an ultimate compressive strength of not less than 2,000 lb. per sq.in., consequently, these girders could not be relied upon to carry the construction loads without adequate shoring.

*Conclusions* — From our investigation of all the facts and of the conditions attending the collapse of this building, we are of the opinion that the collapse was due to failure of the falsework; that the falsework was deficient in diagonal bracing; and that proper provision was not made for supporting the heavy concentrations of load from the bottom chord sections of the proposed trusses.

The failure of the falsework probably began with the failure or settlement of the foundations under those shores that supported the long girders of the banquet room floor and that rested upon plank mud sills on top of the soil, except that the center shore under each of these long girders was supported on the trench floor. With the probable settlement of these shores, the long girders under the banquet room floor and the long joist construction of the auditorium floor directly above deflected; thus causing a redistribution of the weight of the lodge floor construction upon the shoring supporting the same. As a consequence of such deflection and redistribution of loading, the high shoring near the east end of the east section of the auditorium and adjacent to columns 62 and 63 would, because of its more rigid support in this region, become so overloaded as to fail, and the testimony shows it did fail, thus precipitating the entire collapse.

From our investigation of the structural design of this building, it is our opinion that this design is fundamentally inadequate in strength for a building of its character. It is our opinion that it is not possible economically to reinforce and strengthen that portion of the building which remains standing to make it adequately strong for even a building of this character, especially in view of the serious deflections and cracks that have developed in the beams and slabs which were not involved in the collapse.

According to information given out at the time of the failure the building was designed by William T. Schmitt and Valentyne Welman, architects, of Oklahoma City, Okla., and was being built in accordance with their plans and specifications, and under their direct and delegated supervision, by the Eberhardt Construction Co., of Salina.

## The Road Tax in England

The gross revenue from the duties on motor and other vehicles in England for the five months ending May 31, 1921, is approximately £8,740,000. Of this amount £8,040,000 is from annual licenses and £700,000 from quarterly licenses. The actual amount paid to the highway authorities from the road fund for the same period was £2,863,243. It is estimated that £11,000,000 will be paid out in the year 1921.

## British Housing Nationalization an Expensive Failure

*(London Correspondence)*

THE housing policy of the British Government was an experiment in nationalization, which everyone with experience felt would be an expensive failure. The decision of the government to suspend the financial assistance which has been extended to local authorities in housing was not unexpected by those connected with the trade. The method which was adopted of giving direct contracts for building houses in large numbers to contractors was an expensive and wasteful system. Under this system the loss has been very heavy, and will probably be in excess of £1,000 on each house built. On the 176,000 houses undertaken the loss would thus amount to £176,000,000. This figure does not include cost of administration incurred by the Ministry of Health, the Housing Commissioners and the local authorities, nor does it provide for road making or legal and professional costs. These items will materially increase the total loss and it is reasonable to assume that the final actual loss to the taxpayer will not fall short of £200,000,000.

The 176,000 houses which are to be built by the government contract, and which will take several years to complete, equal only two years' normal requirements for new houses, without making provision for the replacement of old and worn-out dwellings. The total efforts of the government, therefore, [on being brought to an end] will leave the shortage greater than ever.

In the period of restricted rents and high prices when there was no market for the sale of houses as an investment, the house builder could not build as a commercial venture, and some tentative efforts were made to assist private enterprise by the grant of a subsidy toward the inevitable loss. The government has announced that the subsidy scheme will also be withdrawn, and that no grant will be paid on houses not commenced before July 1. It was estimated by the Minister of Health that about 23,000 houses would be built under this scheme. The maximum loss to the taxpayer on the subsidy houses is £260 per house, and it is noteworthy that subsidy houses have been built at a greater rate than contract houses. The government had promised that the subsidy scheme should be continued; it had set aside a sum of £15,000,000 for this special purpose, and passed an Act of Parliament extending the time for the building of subsidized houses to June, 1922. On the strength of these promises builders have purchased land and materials and have plans and schemes in hand for many thousands of houses.

The effect of the new policy will be to hold up all house building for a time until the rent of the house is enough to pay for the cost of building. In view of the gradual fall in prices the subsidy scheme was bringing economic housing within measurable distance and was encouraging the builder to construct with some prospect of an adequate return on his outlay.

The sites which will have to be discarded would have provided for about 10,000 to 12,000 houses, and where local authorities cannot dispose of these on favorable terms, the loss will be met from the government grant.

In addition the government proposes to spend £200,000 a year on improving houses in slum areas rather than on pulling down whole areas and attempting to rebuild them.

## *Impressions Here and There*

### New Orleans—Where Engineers Have Labored and Built Well

NEW ORLEANS as a human city reflects the hospitality of the South, the open-hearted freedom of the West, the culture of New England and to a certain extent the matter-of-factness of the Middle West. Withal, first impressions are decidedly mixed. An excursion by boat around the crescent of the river past the extension harbor improvements could not fail to bring comparisons with New York. But, as has been said before, other ports have the facilities, but New York does the business. So New Orleans has dock facilities aplenty of every kind. But it takes more than facilities to make business. The whole Middle West should, geographically speaking, be sending its farm produce to Europe, to South America and to the Far East, via New Orleans and other Gulf ports. All the facilities are there, engineers have done their part, but custom and rail routes run east and west. Manufacturers have their foreign departments at the eastern seaboard. South American boat schedules and accommodations to New Orleans are second class. Trade follows the passenger business. The Middle West and New Orleans are detached despite the strenuous efforts of the Mississippi Valley Association to bring port, product and shipper together. Nevertheless an enormous raw products business does pour outward through the southern seaport and it is constantly increasing in volume, particularly in grain and manufactured products to the Far East through the Panama Canal.

#### Inner Harbor a White Elephant

Probably the two features in New Orleans of most interest to one of engineering bent is the enormous Inner Harbor lock and canal and the drainage works by which the city keeps itself from inundation. In some circles the Inner Harbor is looked upon as a white elephant. Initially projected to cost perhaps $1,500,000 it has been elaborated upon until it rivals the Panama locks. War time costs have pushed the estimates continually higher until considerably more than $20,000,000 will be involved before the project is completed. Building foundations on the uncertain soils of the Mississippi delta country is expensive. And as one engineer remarked "now we have it, what are we going to do with it."

A few of the shipyards and maritime manufacturers who courageously settled on the Inner Harbor canal and launched their craft through the Lake Pontchartrain end are not going to be extremely busy for some time to come. No one is busy on new cotton warehouses. Certain manufacturing establishments can utilize negro labor and may be induced to settle along the canal but custom is going to operate in favor of the present facilities regardless of the variation in river heights for many years. Five years ago Chicago built a $5,000,000 municipal pier on its lake front and tempted without success the steamboat owners out of the narrow, swift current of the Chicago River. Steamers still ply the river and the pier is idle except for its dance pavillion at the end and Pageant of Progress exposition. So New Orleans is having apprehensions of the difficulties of allocating industries where the engineer has made provision for them.

Interwoven with this problem is the age-old one in New Orleans of the abandonment of the Mississippi River outlet for a slack water non-silting channel via one of the lakes. In the improvement of the lower parts of the river and in the creation and maintenance of a deep water outlet to the sea, they have had the advice, the assistance and the direction of some of the ablest engineers of the world, the backing of the wealthiest of nations and the intelligent co-operation of some of the most competent contractors' organizations ever engaged in similar works. These have all contributed in making of New Orleans a great world port and have maintained a channel to the sea which will accommodate *nearly* every class of vessel now afloat and have been able to keep this channel open for commerce *most* of the time.

No one better appreciates, however, the true conditions down at the "neck of the bottle" than those who have contributed their talents and their time in the maintenance of this channel. It is in no way a criticism of the work which has been done by these men when it is stated, according to one of the city's prominent engineers, that nothing yet has been done which promises to insure an absolutely safe, dependable and permanent route from the Head to Passes to deep water, or to recall that the history of navigation of these waters contains repeated accounts of vessels carried suddenly out of their course, great ships stranded on mud flats and occasional collisions in the restricted channel. The limit of capacity of the main shipping outlet (that at South Pass) has nearly been reached and the results secured from recent attempts to create and maintain a channel through Southwest Pass have not been entirely reassuring. The slack water plan contains no experiments in untried fields of engineering and it would avoid the silt complications and shorten the distance of travel for a large proportion of vessels. But desirable as this proposal may be from the engineering standpoint there are powerful interests, of which the organization of those who pilot boats in and out is not the least, that will make any change a decidedly hard one, politically, to accomplish.

#### The Drainage System

Truly the drainage problem of New Orleans is a marvelous and striking exposition of the engineer's ability to make habitable, sanitary and safe a vast municipal area. George G. Earl, of course, is the engineer to whom one naturally goes for information on the three most essential public utilities in New Orleans, for he is superintendent and general manager of water, sewerage and drainage. All of them have cost $32,000,000 or $400 for each of the 80,000 premises served, $130 for water, $110 for sewerage and the remainder for the drainage system. The tendency toward decreasing density of population due to the widely scattered building in new areas is being watched with anxiety for the Sewerage and Water Board has but one source of construction funds for extension, a fixed rate of tax on assessed valuations. At that Mr. Earl claims that the municipal per capita revenue of New Orleans is by far the lowest of any city in the United States, having a population of 300,000 or more.

The general basis on which the original system was laid out did not contemplate caring for maximum downpours because the people would not pay for such drainage equipment. New Orleans gets occasional rainfalls

ranging from rates producing in 30 min. 5½ cu.ft. per second per acre to a 12-hour rainfall average of 0.75 cu.ft. The maximum rainfall of the average year will show about one-half of these rates and the ability to remove these average year maximums is about the limit to which Mr. Earl feels it is, at present, desirable or practical to develop the run-off capacity of the main drainage system. However, the 8,900 sec.-ft. capacity, which the original Drainage Advisory Board considered would be the final capacity within 50 years is nearly reached with the present capacity of 8,000 sec.ft.

So much for inside data. Out on the physical plant one is impressed with several novel features. Pavement cracks are unusually prevalent, curbs are out of alignment, and A. B. Wood, Mr. Earl's mechanical engineer, tells us the water pipes and sewers are forever breaking due to the settlement and shrinkage. Settlement of 3 to 4 ft. after 4 or 5 years of cultivation is common in the tidal level areas where levees have been built and the surfaces drained. Contrary to ordinary practice, ramming local clay back-filling beyond a certain point is useless and so is flooding, because the clay volume varies with the water content, the more water the larger the volume, which only increases subsequent shrinkage.

### Automatic Pumping Stations

The automatic electrically-operated underground pumping stations for sewage with kiosk openings onto the street need mention, for many of them have been in service more than 5 years without opening the pumps or other repair. One hardly could realize that automatic float valve electrical control could be so fool-proof but the rugged character of the mechanism bore testimony to the fact that the designer preferred to pay interest on investment rather than high upkeep. This "hell-for-strong" idea is everywhere in evidence. Perhaps the most unique experience is to lower one's self into the core of one of the largest drainage pumps and within this hollow-egg-shaped support for the inner bearing of the 1,200-sec.-ft. screw pump hear Mr. Wood tell of the pump's performance. No repair wrenches have yet broken the gloss of the original paint applied five years ago when the pump was installed. "The original oil is still in use and no bearings ever run warm" says Mr. Wood.

When the New Orleans rapid sand filters were put into successful operation 12 years ago sanitary engineers felt assured that no water existed which could not be handled. They were doubly elated because many years previously the attempts to filter the river water had signally failed and with that failure carried to bankruptcy the water company. New Orleans gets good water now. The chemical treatment is lime and iron which, as everywhere, incrusts the filter sand. Here it has solidified also the gravel support and John Porter, superintendent, in overhauling one of the filters was drilling out the cemented gravel with bull points. However, said John, the $1,200 cost spread over 12 years only amounts to 9c. per million, which is not prohibitive.

All in all one gets the impression that engineers in New Orleans have done a big work for the city. In fact but for him and his work there would be no city of consequence there. Much yet remains to be done but it is not of the former spectacular type.

One cannot refrain from commending the Sewerage and Water Board for maintaining the continuity of its engineering staff. As Mr. Earl says, the nucleus of this splendid organization developed through 25 years still is retained. Not a single employee has lost his position by reason of political consideration. Because of the loyalty of the board to the men in making promotions from within the service and of expecting and permitting its employees to exercise the character of initiative a spirit of reciprocal loyalty has been developed, which gives to worth-while men such an interest in their work that they will sacrifice much of personal advantage rather than abandon it.

July 15, 1921. W. W. DeB.

## Tests of Small Eyebar Heads for Airplane Lugs

SEVERAL series of tests to develop the best proportions of plate lugs or eye links for airplane brace connections have been made at McCook Field, Dayton, Ohio, for the U. S. Army. The eye ends of these lugs are closely similar to the heads of eyebars used in bridges, and the conclusions drawn from the tests are of interest in connection with practice in proportioning large eyebar heads, as discussed by Josef Beke in *Engineering News-Record*, Aug. 11, 1921, p. 234. The lugs tested ranged in capacity from 1,600 to 20,000 lb. The following note on the test results is taken from a summary report on the subject by B. C. Boulton, of the Airplane Section, Engineering Division of the Air Service, U. S. Army.

Some of the lugs tested had "concentric" heads, that is, circular heads with pinholes in the center of the head. Other heads were "offset," the semicircular end of the head having its center beyond the pin center. The concentric heads broke generally at a section whose original position made an angle of 45 deg. with a diameter through the center of the pin hole. Tests of lugs with "offset" of ⅛ to ¼ in., showed that by thus increasing the diagonal area through the eye it was possible to develop the full strength of the metal in tension at the minimum section, i.e., at the sides of the holes. The general range of eccentricity being established, any lug could be designed and its strength computed directly, because failure, if in the head, occurs on a section through the eye at right angles to the axis of the bar at a stress equal to the tensile strength of the material. Results found with dead annealed, cold-rolled and heat-treated steel, either carbon or alloy, were similar.

The lug designs that were worked out as the result of these tests were based on making the area through the head at the back of the pin hole (in the line of the axis of the bar) from 30 to 40 per cent greater than the section through the sides of the pin hole. The larger sizes of lugs were given the greater excess area, "since the portion of the stress around the eye due to bending increases at something less than the square of the pin diameter." The offset from ⅛ in. in the smallest size of lug to ⅜ in. In the series of designs, with bars ranging from ⅜ x ⅛ in. to 1⅜ x ¾ in., the pin diameter varies from ⅜ in. to ½ in., being 50 to 60 per cent of the bar width. The cross-section through the head at right angles to the axis of the bar has an area slightly less than the cross-section of the bar; but this latter is designed with an excess of strength of 20 to 25 per cent, to allow for additional stress arising from the fact that the bar (shank of the lug) is usually

bent. The section through the side of the head therefore represents an excess of 15 to 20 per cent over the bar strength.

With respect to pin diameter, the tests showed that bearing stress was never a contributing cause of failure, as the lugs in which the bearing stress did not exceed twice the tensile stress in the bar indicated no failure in compression at the back of the pin hole; even where there was a slight piling up of the material at this point in the test, the grains of the metal, examined by a microscope, gave no indication of the excessive compression. It was concluded that a 100 per cent excess of bearing stress over tension is a safe maximum for airplane lug design. The calculated shearing stress in the pin under full load was found to range from 21,000 lb. per sq.in. for the smallest lug to 51,000 for the largest.

Check tests of lugs according to the design just indicated showed breaking strengths substantially equal to the tensile strength of the material in every case (2 or 3 specimens of each size tested). Practically all the specimens failed in tension on a section through the center of the eye. It was found in these tests also that the bearing pressure on the pin can be increased for the thicker material, the heavier eye being stiffer on account of the mass of material which resists the tendency to a closing in of the pin hole on the sides of the pin.

## The Blue River Sewerage Problem, Kansas City, Mo.

THE Blue River (drainage area 265 sq.mi.), which extends along the easterly limits of Kansas City, Mo., and flows north into the Missouri River, has become little more than an open sewer in dry weather. About 58 per cent of the area and about 50 per cent of the population of Kansas City is tributary. The sewage of the Blue River Valley together with the sewage of the entire metropolitan area discharges into the Missouri River which a few miles below is used as a source of water supply by the city of Independence, Mo. The problem of the Blue River sewerage project therefore includes an intercepting sewer and sewage treatment. The intercepting sewer is needed to relieve the Blue River of its present objectionable sewage pollution. There is involved primarily the capacity of the intercepting sewer and the probable development and use of the Blue River. Affecting this part of the problem are considerations of population, park development, rainfall, run-off, existing sewerage works, probable construction costs and sewage quantities. Affecting the sewage treatment parts of the problem are considerations of the rates of flow in the Missouri River, the population on the drainage area, the uses of river water and probable construction costs.

A report with recommendations has recently been submitted to the Board of Public Works of Kansas City, for which Robert W. Waddell is engineer and Paul A. Hartung is engineer of sewers, by Pearse, Greeley & Hansen, consulting engineers, Chicago. A bond election is set for this month. The problem has been studied for many years by the Sewer Department and much information was available. Following a thorough discussion of intercepting sewer practice (see table) are the following recommendations for the intercepting sewer:

1. Where possible, separate sewers should be provided in districts as yet undeveloped.

2. Where the intercepting sewer is planned to prevent the pollution of park ponds or lagoons, a capacity of 400 gal. per capita daily, equivalent to only four dilutions, is not too low for Kansas City conditions. For such relatively intense developments a flow at the rate of 500 gal. per capita daily of tributary population would not be unreasonable.

3. For portions of the intercepting sewer designed to protect a flowing stream passing through industrial districts, a capacity for not less than about 200 gal. per capita daily would relieve the stream sufficiently to prevent the too frequent occurrence of objectionable conditions of relatively long duration.

4. It is not unreasonable to plan sewer capacities at the above per capita rates of flow for a population of 25 per acre from the tributary areas.

5. The estimated construction cost of the intercepting sewer on this basis is around $2,000,000.

6. Should the capacity of the Blue River intercepting sewer, as built, prove too small at a later date to afford sufficient protection to Blue River, as developed, it would be feasible to install at the principal overflows treatment plants for the storm sewage and thus provide a further protection to the water course. This treatment can be first by sedimentation and later by filtration should that be found necessary.

DESIGN DATA ON INTERCEPTING SEWERS

| City | Gallons per Capita Daily — Ave. Flow Dry Weather | Intercepting Sewer Design | Ave. Water Consumption | Population per Acre Intercepting Sewer Design |
|---|---|---|---|---|
| Rochester | 120 | 420 | 109 | 30 |
| Detroit | 155 | 329 | 152 | 42 |
| Syracuse | 160 | 375 | 152 | 35 |
| Toledo | 128 | 295 | 185 | 20 |
| Milwaukee | 150 | 364 | 120 | 23 |
| Louisville | 146 | 290 | 106 | |
| Cincinnati | 175 | 366 | 131 | 30 |
| Dayton | 125 | 250 | 120 | 20 |
| Cleveland | 145 | 405 | 120 | 25 |
| Albany | 200 | 450 | 224 | 16 |
| Fitchburg | 75 | 445 | 93 | 10 |
| Kansas City | | | | |
| Ludlow | 100 | 520 | 125 | 25 |
| Hartung | 100 | 193 | 125 | 26.7 |

In the discussion of the problem of sewage treatment along the Missouri River there is indicated a total pollution for the Kansas City metropolitan area of 465,000 population and an additional pollution from industrial sources of 430,000 more equivalent population. The following recommendations were made:

1. From the standpoint of sewage pollution and stream flow, the river below the city has not yet reached a condition of nuisance requiring the installation of sewage treatment. On a low flow of 10,470 sec.-ft., which is available 98 per cent of the time, the dilution of the domestic and industrial sewage is equivalent at present to 11.8 sec.-ft. per 1,000 population.

2. The normal growth of population and industry along the Missouri River and the present available data relating to the condition of the river water point to the need for a comprehensive policy as regards sewage treatment and water supply. A comprehensive survey of the Missouri River through Kansas, Nebraska, Missouri and Iowa should be made to determine the conditions and lay down a definite basis of co-ordination of effort in lines of water purification and sewage treatment.

3. At the present time, therefore, extensive or complete sewage treatment is not considered necessary for the Blue River sewage. However, in our opinion, partial sewage treatment by rough clarfication with chlorination will be needed in the near future for Kansas City sewage. It seems to us reasonable, therefore, to make a start on sewage treatment in a moderate way at the present time in order to determine the working of a sewage treatment plant with Kansas City sewage. This conclusion in favor of moderate sewage treatment at the present time is further reinforced by the protection it will afford to the Independence intake, particularly during times of epidemic, and also by the prevention of deposits of sludge in the lower Blue River.

# Oklahoma Engine Terminal and Line Revision; M., K. & T. Ry.

## Extensive Improvements Cover Terminal and Freight Facilities and New Entrance to City—Novel Turntable—Coal, Ash and Water Softening Plants

AS PART of a program for remodeling and enlarging engine terminals, in order to provide for increasing traffic and the introduction of heavier locomotives, the Missouri, Kansas & Texas Ry. has recently completed a new engine terminal at Oklahoma City, Okla., at a cost of approximately $1,000,000. This new terminal includes a ten-stall roundhouse with machine shop annex, 100-ft. turntable with special end supports, 300-ton coaling station, power-operated ashpits, water softening plant, storehouse and minor buildings as well as tracks and facilities for freight car repairs and for cleaning and storing passenger cars. About thirty locomotives are handled daily at this point.

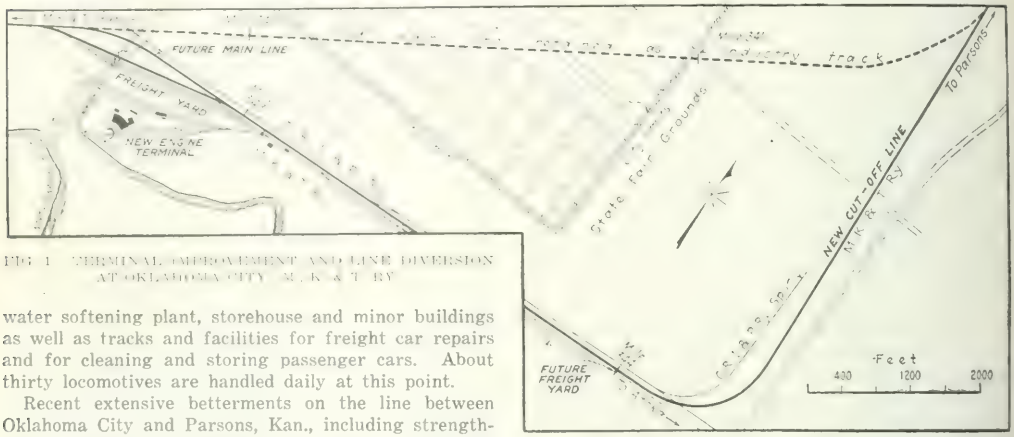



FIG. 1. TERMINAL IMPROVEMENT AND LINE DIVERSION AT OKLAHOMA CITY, M., K. & T. RY.

Recent extensive betterments on the line between Oklahoma City and Parsons, Kan., including strengthening of trestles, reballasting and heavier rails, have made it possible to operate larger and more powerful engines on this division. The old engine terminal, built in 1903, was inadequate for the equipment now in use, but the site afforded no space for expansion and it was decided to construct an entirely new plant at a location where ground is available not only for immediate requirements but also for future growth. A new main line approach was included in the improvements, as shown by the general plan, Fig. 1.

### Relocation of Main Line Approach

To improve the approach to the new engine terminal and freight yard and also to improve the main line entrance to the city by eliminating ten street crossings at grade, a 2¼-mile cutoff has been built, as shown in Fig. 1. The passenger station is at the end of a stub track connected to two main lines running north and east, the old main line from the north traversing a district laid out of residential development. To avoid this district the cutoff leaves one line north of the city and connects with the other at a point east of the engine terminal, as shown. A three-span concrete viaduct carries 23rd St. over the cutoff and 10th St. is carried under it by a concrete subway. There is a grade crossing of the Rock Island Lines, but all main track movements through the yard are protected by automatic block signals.

In the new engine terminal, Fig. 2, the track plan forms a flat triangular layout with direct connection to the turntable from each end of the yard. In anticipation of future yard extension, the plans for which include a new train yard east of the present yard (see Fig. 1), the main approach is from the east, three engine tracks leading from the throat of the yard to the turntable. Two of these are served by ashpits and two by the coaling station, while water columns serve these three tracks and also the fourth approach track at the west end, which is mainly for the use of passenger engines, the station being west of the engine terminal. Two stub tracks serve the ashpits and the coaling station. Along the north side of the layout is a thoroughfare or running track connecting the two approaches. The roundhouse is served only by the turntable, no through track or rear entrance being provided. Adjacent to it are five open radial tracks, without repair pits, for holding engines which do not need attention. These tracks are equipped with steam blower pipes for the engine fires.

Since the site included swampy ground a consider-

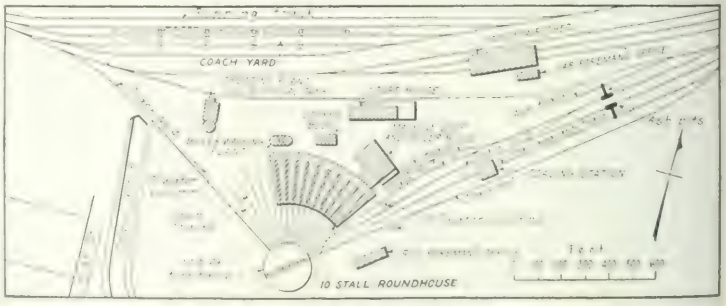



FIG. 2. LAYOUT OF ENGINE TERMINAL

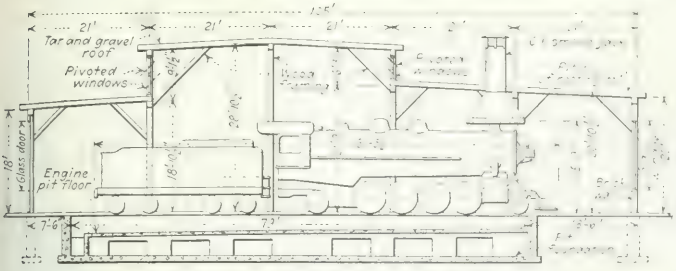



FIG. 3. CROSS-SECTION OF ROUNDHOUSE

able amount of filling was required, and a creek forming a surface drain for part of the city was diverted so as to pass under the end of the yard in a concrete double-barred box culvert having two openings 5 x 8 ft. to give ample flood capacity. Before the filling was placed, the roundhouse foundations and pits were built

FIG. 4. GLASS WALLS MAKE LIGHT ROUNDHOUSE

to rail level, or 7½ ft. above the original surface, thus saving time, although the cost was slightly greater than if the filling had been placed first. Most of the foundations are on about 4 ft. of loam overlying a 28-ft. bed of quicksand, the surface of which is 8½ ft. below rail level.

### Roundhouse and Engine Pits

Timber frame construction, with brick and glass walls and timber roof, was adopted for the roundhouse for economy and light weight in view of the foundation conditions. The building, Fig. 3, is 105 ft. deep, divided into five 21-ft. bays, the inner and two outer bays having a low roof while the others form a wide and high monitor. An exceptionally well-lighted interior is obtained by the extensive use of glass, as indicated by Fig. 4, wood sash being used in the monitor and the flat skylights over the outer bay, and steel sash being used in the walls and swinging doors. These doors have an unusually large proportion of glass. Diffused light for night work is provided by electric flood lights set on the rear wall, between the stalls.

In each stall is an engine pit 79 ft. long. Two of these pits are connected by a transverse drop pit for handling driving wheels and two other pits are similarly connected by a smaller drop pit for truck and trailer wheels, a traveling pneumatic jack being operated in each drop pit. The engine tracks are carried over these drop pits by removable rails 10 ft. and 6 ft. long respectively, each of these being 100-lb. rail trussed by a road with flattened ends riveted to the rail base, as shown in Fig. 5. Between each pair of stalls are arranged four pipe lines; one for hot water for washing out boilers, a steam blower line for starting fires, an air line for operating pneumatic tools and testing brakes, and a water line for fire protection and general utility. The boiler washing plant operates on a circulating system, sludge and scale being removed from the return water so that the water can be used over again and heat thus saved.

To reach a good foundation the pit walls had to be carried to a depth of about 8 ft. Concrete was saved by leaving an open space under the pit floor and by forming openings in the lower portions of the side walls (see Fig. 5). Projecting curbs at the top protect the heating pipes laid along the walls. The pit tracks are of 100-lb. rails, secured by clips and nuts on anchor bolts and resting on ½-in. plates spaced 2 ft. apart. At the ends and middle of the pit the walls are increased in thickness and capped with 7 x 16-in. jacking timbers. A 4-in. brick floor is laid on 2 in. of sand and 6 in. of cinders, with grated sumps draining into the pits, as shown.

A one-story brick building 80 ft. square, with flat roof supported by combination trusses, adjoins the roundhouse and contains a machine shop for running repairs to the locomotives, an engine room and a boiler room. The boilers, served by a 100-ft. reinforced-concrete chimney, supply steam for an air compressor and

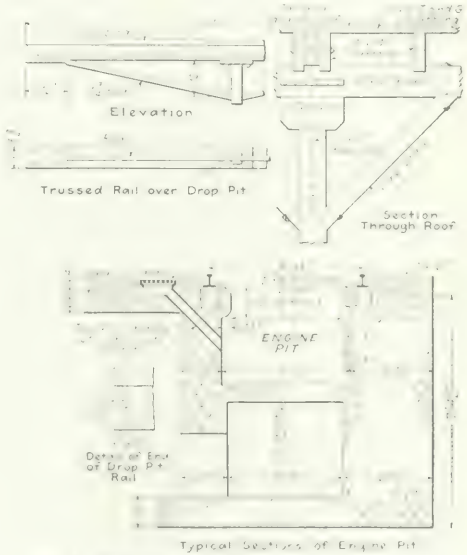



FIG. 5. ENGINE PIT, DROP PIT, RAIL AND ROOF FRAMING

FIG. 6. TURNTABLE WITH TRACTOR AND END TRUCKS

the boiler washing plant and also for heating the buildings and the cars in the coach yard. Concrete is used for the boiler room floor and mastic on concrete elsewhere, except that a cinder floor is used for that part of the shop assigned to blacksmith work. Steam pipes

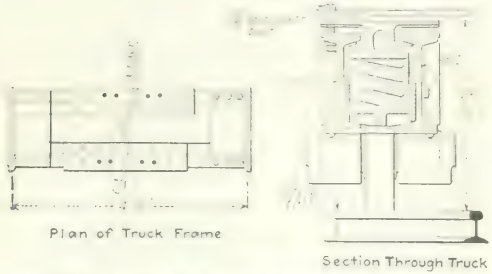



FIG. 7. DETAILS OF SPRING TRUCK FOR TURNTABLE

carried underground in the buildings are insulated and laid in split tile conduits. Concrete conduits are used for steam and other piping laid in the yard.

### Turntable Truck Design

Shock absorbing end carriages or trucks are special features of the 100-ft. center-bearing deck girder turntable, Fig. 6. The trucks (Fig. 7) are of I-beam construction, each fitted with a pair of cast steel bearing blocks separated by two 8-in. M. C. B. coiled car springs. The roller wheels just touch the circle rail, and the usual 1-in. play between rail and wheel is provided between the bearing blocks by means of the springs. A load of about 24,000 lb. or a net impact load of about 20,500 lb. on the end of the table is required to close the blocks together to a solid bearing. Shoulder bolts between the upper flanges of the I-beams and the upper block on which the main girder rests, hold the trucks in place, lifting those of one end when the opposite end of the table is depressed, all wheels remaining permanently in contact with the circle rail. It is thought that this type of truck provides maximum flexibility in the rocking of the table, relieving it of the greater part of the impact load as engines enter and leave the turntable.

A 35-hp. motor-driven tractor operates the turntable. Foundation piles are placed under the center pedestal and under the circle rail, which is laid on a bench in the concrete pit wall. The radial tracks diverge at an angle of 5 deg. 52 min. and are spaced 14 ft. 1½ in. c. to c. at the roundhouse doors. Flood lights mounted on the roundhouse wall and in the coaling station provide exceptionally good lighting for the turntable and its approach tracks.

As the hard city water is not suitable for the locomotives or stationary boilers, a water softening plant with a capacity of 20,000 gal. per hour has been installed. Soda ash and lime are used ordinarily, in proportions varying with the quality of the water, but an iron solution is also used as a precipitant when the water contains a large amount of solids in suspension. Storage for 100,000 gal. of softened water is provided in a 26-ft. steel standpipe 44 ft. high, Fig. 8. The dosing chamber is on top of the tank and the machinery for mixing the solution is installed in an adjacent building. The sanitary sewer system of the terminal is connected to a city sewer.

A reinforced-concrete coaling station, Fig. 9, of the automatic single-bucket type, electrically operated and with 300 tons storage capacity, serves engines on two tracks leading to the turntable. On account of the nature of the soil, the pit is of the shallow type with a cross feeder or transfer car feeding the 2-ton elevator bucket, the arrangement being similar to that of a plant described in *Engineering News-Record* of March 11, 1920, p. 520. Coal is delivered to a track hopper on a stub track which passes under the coal bin

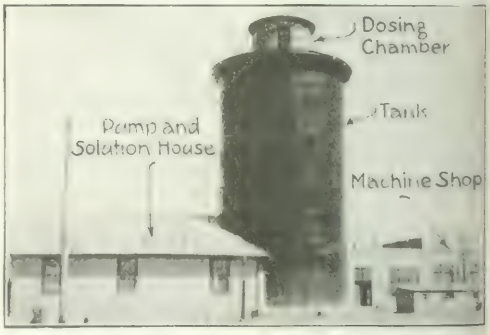



FIG. 8. WATER SOFTENING PLANT AND 100,000-GAL. STANDPIPE

and has a slight ascending grade, the cars being pushed to the end of the track and then fed back by gravity to the coal hopper and ash-handling plant as required. Sand-handling facilities include a 200-yd. open bin for wet sand storage and two steam dryers, the dry sand being conveyed by compressed air through pipes to a 20-ton bin in the top of the coal bin. On each side of the coaling station are two coal spouts and sand pipes, so that four engines can be supplied simultaneously.

Each ashpit has a steel bucket or car to receive the ashes from the engines, the car being operated on an

inclined track at right angles to the engine track by means of a cable and air cylinder, as shown in Fig. 10. The track extends above ground on steel bents to such a height that the drop-bottom bucket delivers the ashes into a gondola car on an adjacent spur track, a third rail supporting the hinged bottom of the car being curved so as to allow the bottom to drop.

### Miscellaneous Facilities

Three car repair tracks with capacity for 45 cars and with a shed 145 ft. long over two of them are located between the roundhouse and freight yard. There are also three coach tracks, with capacity for twenty-one coaches, the coach yard being served by pipe lines supplying water, steam, air and gas for lighting. A brick storehouse 30 x 103 ft. with concrete basement for oil storage and 2,950 sq.ft. of open platform, is located between the roundhouse and car repair facilities, to handle supplies for the entire plant. Lavatories, lockers and toilets are provided in a separate brick building, 24 x 45 ft.

Although the improvements now recently completed did not include extension of the freight yard, which is planned for later construction, they did provide a rearrangement of the east ladder track in line with plans for later enlargement of the yard. They include also the installation of a new 50-ft. heavy-duty track scale with capacity of 75 tons per section, designed to meet the latest specifications of the American Railway Engineering Association and U. S. Bureau of Standards. The scale is located on the main switching head, and at an elevation which forms a modified hump, giving gravity movement off the scale and through the ladder track into the yard.

Grading and culvert work were done by List & Clifford, Kansas City, Mo. The contractor for the buildings was H. D. McCoy, Cleburne, Tex., and on this part of the work the railway's building inspector was A. E. Reily, architectural engineer, Kansas City, Mo., who has furnished much of the information for this article. The water softening and storage plant was built by Graver Corporation, the coaling station by Roberts & Schaefer, the ash-handling plant by William Robertson & Co., and the boiler washing plant by the National Boiler Washing Co., all of Chicago.

Design and construction of the terminal and its connections were under the direction of Frank Ringer, chief engineer of the Missouri, Kansas & Texas Ry., with the construction in direct charge of J. M. Metcalf, principal assistant engineer, and D. I. Stephens, assistant engineer.

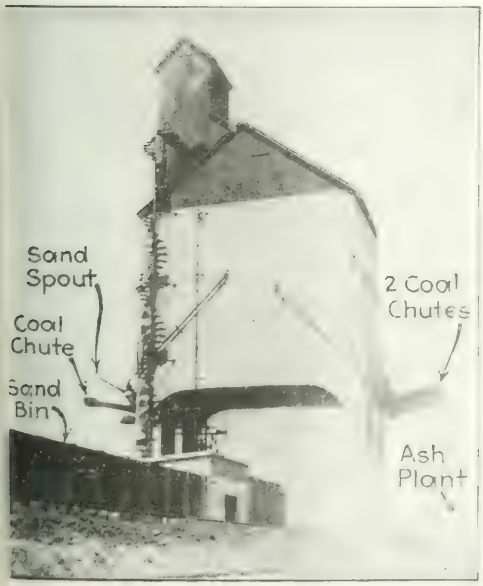



FIG. 9. CONCRETE COALING STATION — HALLOW PIT TYPE

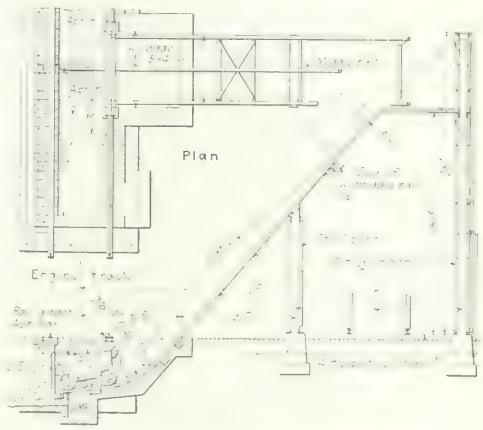



FIG. 10. AIR-OPERATED ASH-HANDLING PLANT

## Virgin Growth and Second Growth Timber

Specifications often call for virgin growth or second growth timber, yet the terms are without fixed significance, and the material when delivered cannot be identified positively as belonging to one class or the other.

Virgin growth is generally thought of as slow growing timber, while second growth, due to more favorable conditions, is relatively rapid. A faster rate of growth is evidenced by wider annual rings, which are popularly supposed to indicate stronger and tougher wood in the hardwoods, such as ash, hickory, elm and oak; and weaker and brashy wood in the conifers, such as pine and fir. Hence, for uses in which strength and toughness are essential, second growth is sought among the hardwoods; in conifers virgin growth is desired.

As a second growth forest attains maturity, the rate of growth slows up, and the annual rings may be no wider than in virgin growth timber of the same size. On the other hand, when a slow-growing suppressed forest tree is freed by removing the neighboring trees, it may grow rapidly for a long period. Therefore, it is possible to have some wood with the characteristics of virgin growth and some with those of second growth in the same tree. Furthermore, individual trees in a virgin growth forest may have the characteristics of second growth throughout and vice versa. The Forest Products Laboratory, Madison, Wis., considers it advisable to disregard rate of growth and rely upon density as a guide to quality.

# Problems in the Chlorination of Water—II

## Seventeen Water-Works Operators Give Experience on the Effect of Temperature on Wastes and Odors. Corrosion of Metals and Efficiency Factors

*The data and opinions on tastes and odors and on corrosion of metals due to chlorination were given in the issue of Sept. 8. The present article concludes the symposium.*—EDITOR.

### Efficiency Factors

OPINION appears to be about equally divided as to whether it is expedient to hold filters responsible for full bacterial efficiency or to depend on chlorine for bacterial results, letting the filter remove particularly the visible impurities. This question is a vital one and the original idea of emergency use only for chlorine has given way, in many cities, to material reliance on it for bacterial efficiency, with the result of prolonging the life of many filters which had long ago reached the obsolescent stage. Many wooden tub filters 25 to 30 years old will have to be replaced now because of actual decay of the staves rather than for inefficiency of final results.

Another efficiency factor is the amount of organic matter chlorine can handle. Undoubtedly water heavy with turbidity and organic material is far more difficult to sterilize. The mass making up the separate particles mechanically offers a barrier to the penetration of the chemical to the bacteria inclosed. Although some of the answers indicate that there is a limiting amount of organic matter, a few operators report no lowered efficiency due to certain kinds of organic matter. Algae, as brought out in the last question, usually reduces the efficiency because it absorbs an extra amount of chlorine, but this effect is not invariable. Not every operator has yet got over the idea that he must meet the U. S. Public Health standards which were never intended for general application. The questions and answers follow:

9. *Does the bacterial reduction effected by an excessive use of chlorine warrant letting down on the possible efficiency of filter plants? In other words, should filter efficiency be allowed to drop with the idea that the bacterial efficiency may be raised by a liberal use of chlorine?*

10. *Can a water be efficiently chlorinated which carries a large amount of organic matter? Does it pay to aid excessive amounts of chlorine in an attempt to remove bacteria to meet the U. S. Public Health standards when the water to be treated carries large amounts of organic matter, especially algae growths?*

11. *What effect have algae growths in reducing the efficiency of chlorine which has been applied to water for sterilization?*

*Mr. Gettrust*—9. Why excessive use of chlorine? Plants with daily technical supervision should be operated as economically as possible. The present high cost of coagulants warrants the operator in using just sufficient to obtain a clear effluent and obtain the bacterial efficiency by a proper dose of chlorine.

10. Cannot be answered offhand. Each supply has its peculiarities which require separate study.

11. No trouble from algae in our filtered water, but it has been my experience that waters very low in oxygen consumed are difficult to treat successfully with liquid chlorine and avoid troubles due to taste.

*Mr. Ellms*—9. A reasonable reliance may be placed upon chlorine disinfection to offset lowered filter efficiency. The extent to which one may go depends entirely on the original quality of the raw water, and upon the efficiency of the filters where the latter are used. The use of large amounts of chlorine for such purposes does not seem warranted, but if, in the ordinary course of operation, filter efficiency does fall off, and disinfection is able to maintain a good over-all efficiency, the writer can see no laxity or disregard of the sanitary quality desired if advantage is taken of the efficiency of disinfection.

Attempting to meet the U. S. Public Health Service standards may be commendable but by no means always necessary. These standards, in the writer's opinion, cannot possibly be met in some cases, although easily reached in others. It is very questionable whether these so-called standards are generally applicable to the varied classes of water met with in public supplies, or that non-conformity to them is indicative of a poor grade of drinking water. Here also each case must be considered upon its individual merits.

10 and 11. The disinfection of waters containing much organic matter is difficult, and may be inefficient. Where algae growths are the cause, it would seem as though filtration should be used to remove them, and this treatment be followed by disinfection. If dissolved or colloidal organic matter is present in large amount, the problem is more difficult. Each case would have to be considered by itself.

#### REPORT FROM BALTIMORE

*Messrs. Walden and Powell*—9. Undoubtedly water from filter plants inefficiently operated can be chlorinated so as to produce a water of satisfactory bacteriological content to meet the U. S. Public Health standard. The writers believe that intentionally permitting low filter efficiency and covering the defect by sterilization is poor practice and should be discouraged in every instance. However, where it is necessary to filter at a high rate it is desirable to chlorinate the filter effluent in order to produce water of a satisfactory quality.

10. Where it is very difficult to chlorinate a water which contains a large amount of organic matter, particularly those with heavy growths of algae and allied organisms it has been our experience that an excessive amount of chlorine does not always accomplish the desired results. Apparently there is a peak in the curve when chlorination treatment is efficient and beyond this point little can be accomplished by excessive dosing.

11. Algae growths unquestionably reduce the sterilizing efficiency of chlorine. A water so heavily treated with chlorine as to completely remove algae will be most objectionable from after-tastes and odors due to this treatment. It is much more desirable to remove the algae with copper sulphate or by filtration than by chlorine.

*Mr. Armstrong*—9. The efficiency of a filter plant should not be lowered in any respect with the idea of making up for careless operation by the use of chlorine. To some people a slight taste of chlorine is very obnoxious, and in winter when there is great danger of the taste there might be some justification in reducing the amounts.

10. We believe that water containing large amounts of organic matter can be effectively chlorinated. When the water with which we deal contains considerable amount of organic matter, if chlorinated enough to have a residual chlorine several hours after application, the bacterial reduction will be good. It is also noted in the warmer months that there is an increase of bacteria after the free chlorine in the water has disappeared. Sometimes this increase amounts to more bacteria than were in the water before chlorination.

11. Algae growths in the water increase the amount of chlorine required, as the presence of these organisms in the water increase the amount of oxidizable organic matter.

*Mr. Van Loan*—9, 10 and 11. No results in Philadelphia with such waters.

*Dr. Hale*—9. New York City does not operate filter plants at the present time, but it is our opinion that the use of chlorine to produce bacterial efficiency justifies higher

rates of filtration, provided the water is properly clarified and purified and provided the question of continuous efficiency of the chlorination is taken into account, i.e., adequate supervision to prevent any breakdown of service.

The question of meeting the U. S. Public Health standard depends, to my mind, entirely upon knowledge of the kind and amount of contamination, probability of typhoid, character of supply, etc.

10. New York's supplies carry only small amounts of color and organic matter with the exception of algae growths at periods.

11. Algae increases the dosage required to maintain efficient B. Coli removal, but not to excessive amounts. A maximum dosage of our supplies would probably be 0.4 to 0.5 p.p.m. However, we regulate algae growths by various other means, such as treatment with copper sulphate, storage, aeration and change of draft from one level to another and one reservoir to another.

*Mr. Laboon*—9. Emphatically no. We are of the same opinion as the state boards of health in this section of the country, which demand that the filter efficiency be maintained at the highest degree possible so as to furnish a safe, potable product. Chlorination is resorted to as a precautionary rather than a primary measure.

10. A water carrying a large amount of organic matter can be efficiently chlorinated, although the element of taste and the question of desirability enter in. Regarding the addition of excessive amounts of chlorine in an attempt to remove bacteria to meet U. S. Public Health standards, this must be done if it is desired to use certain waters on interstate carriers. For ordinary purposes the U. S. Public Health standard is at times too rigid for practical adoption, especially where large amounts of organic matter and algae growths are present.

11. Algae growths reduce the efficiency due to the absorption or oxidation of the algae by the chlorine; although this reduction we believe is but very slight. Local conditions, we believe, have considerable bearing on all of these matters and our answer is but a generalization.

### Indianapolis Practice

*Mr. Jordan*—9. Your question reminds me of the effort people in Indianapolis made in 1908 to control the operation of the various parts of the filtration plant. The real question, as I see it, is in what rests the safety and satisfaction of the consumer. Does it make any difference to him if filter 4 has not shown a satisfactory percentage removal of B. Coli on the last day of February? So long as the final product is healthful and not distasteful I do not see that it makes any difference what is the operating efficiency of the different parts of the purification plant. Provided (spell this word provided with capital letters) that the care of the chlorination apparatus is good and that there is a duplicate or triplicate installation of chlorine machines, so that not for an instant will the chlorination be stopped, and provided that the supply of chlorine is kept on hand. Naturally, it would not be proper to reduce the efficiency of operation so that if there should be a half hours' interruption of the chlorination process there would be an ill effect upon the health of the public.

10. Broadly speaking, No. Referring to the U. S. Public Health Service standard for water on interstate carriers, I beg to remind you, like a great many other people, of the emphatic language of Mr. Phelps at the meeting, in 1915, of the Indiana Sanitary and Water Supply Association, that this standard was not to be interpreted as extending to the control of public water supplies. There has been no official modification of the original language used which justifies using this standard in connection with the rating of the public water supply.

11. I have had no experience with an algae growth so heavy as to appear to affect the efficiency of chlorine. It would occur to me that the algae would manifest their presence in other objectionable ways rather more quickly than would be noted in reduced chlorination efficiency.

*Mr. Buzzell*—9. In a well regulated plant the treatment should be properly balanced in all steps throughout the process, and only an emergency should warrant an excessive use of chlorine to take care of any let-up in the efficiency of the other important steps of the purification treatment.

10. This question could be more easily answered had it designated between chlorination alone or in connection with coagulation and filtration. Some waters carrying a large amount of organic matter are difficult if not impossible to chlorinate efficiently without leaving a disagreeable taste.

There are well regulated filter plants producing an effluent which does not meet the U. S. Public Health standards for a drinking water 100 per cent of the time, yet the water is perfectly safe. We have found, in highly colored waters demanding a high chlorine feed to meet the U. S. Public Health standards, that they contain more non-fecal B. coli than water of low color. We believe it does pay to aim to meet U. S. Public Health standards at all times with our local conditions of raw water.

11. We have some trouble in late summer with anabaena and other green algae on filter walls and troughs. Scrubbing with a solution of copper sulphate kills the growth. Chlorine at this station is applied to the filtered water. We have, therefore, never had trouble due to algae.

### Report From Milwaukee

*Mr. Bohmann*—9. No. Filter efficiency should be kept at as high a point as possible at all times, so that if there should be any leaks, or any sudden increase in the bacteria going to the filters, the small amount of chlorine used after filtration will be able to cope with the increase.

10. Decidedly yes. Even raw sewage can be efficiently chlorinated. No matter how much organic matter is in the water, if enough chlorine is added to keep the free chlorine between 0.02 and 0.08 p.p.m. a good reduction in the bacterial count can be effected.

11. From our experience with the experimental filter plant on days when the algae were exceptionally high in count, up to 600 to 1,000 per c.c., there was no difference in the bacterial reduction produced by the chlorine. The effectiveness was always as usual, giving about 95 to 98 per cent reduction, and also the usual reduction in the B. Coli.

*Mr. Graf*—9. When the cost of coagulants required to produce a water of desired purity is out of all proportion to the cost of the chlorine necessary to produce the same results, the use of a large amount of chlorine is warranted.

10. Yes. No. 11. Algae growths, after water has been sterilized with chlorine, show no effect on bacterial content.

*Mr. Birdsall*—9. Decidedly No. (See *Journal* American Water Works Association, May, 1920, p. 384.) 10. No, the water should be filtered and copper sulphate used for algae elimination. 11. No experience.

*Dr. LaCroix*—9. No. I do not consider this a safe expedient. 10. It depends on amount. If the water is of zero turbidity, chlorination will produce a satisfactory water, provided the organic matter is not too high. The question of meeting the U. S. Public Health standards is more or less a local problem, varying with the character of the raw water, method of treatment, and public attitude toward slight tastes and odors. I believe an operator should strike a reasonable balance between the number of bacteria present, their character, and public sentiment regarding tastes and odors.

11. I have never been able to determine beyond a doubt what effect the algae growths have in reducing the efficiency of chlorine, but it has been noticed that the after-growth is much harder to eliminate when algae are present.

*Mr. Gillespie*—9. My feeling is that the bacterial efficiency of filters need not be kept at its maximum if chlorination is employed, but that such bacterial efficiency in the filters should be obtained as accompanies 100 per cent efficiency in clarification. 10. This seems to be the most serious condition to face, from the standpoint of possible complaints. The water can be disinfected but there are sure to be complaints from consumers due to tastes.

11. As an indication 4.0 to 4.5 lb. per m.g. are necessary when algae are excessive and 0.8 to 1.2 lb. are sufficient at other seasons. Algae and other factors conducive to taste should be recognized only with a view to their elimination and not as a reason why chlorination should not

be employed. The stand should be taken that waters that need disinfection must have it, taste or no taste. No other method of disinfection on a practical scale has yet appeared.

*Mr. Wilhelm*—9. There should be no letting down in the efficiency of the filter plants at any time with the idea that chlorine can do the work of filters. The efficiency of chlorination depends to a great extent upon the clarity of the water after filtration. The excessive use of chlorine in many cases seems to be the result of an effort to sterilize water by chlorination rather than by filtration. When this is done there is no doubt a considerable amount of free chlorine left in the water. Our experience has been that water should be in such a state after filtering that a maximum amount of 0.40 p.p.m. chlorine will reduce the bacterial count to not more than 60 bacteria per c.c. with no B. Coli present.

10. It is difficult to chlorinate efficiently water carrying a large amount of organic matter. Organic matter should be removed from the water before chlorination to get satisfactory results.

11. Possibly many of the tastes and odors found in the water are caused from the action of chlorine on the algae growths which have not been removed by filtration. It is also probable that algae would have the same effect of retarding the action of chlorine on bacteria as any other matter which might be in the water and has not been removed by filters.

### On the Canal Zone

*Mr. Bunker*—9. In two of the three purification plants on the Canal Zone there has always been a multiplication of harmless bacteria in the settling basins or filters or both which I have never been able to stop permanently due to certain existing conditions which it is considered inadvisable to change. At these plants chlorinators were installed principally for the purpose of reducing the bacteria in the filtered waters below 100 lb. per c.c. The amount of chlorine varies from 2.5 to 3.25 lb. per m.g. which cannot be considered as an excessive amount. In the third plant during the dry season the raw water becomes quite clear so that a minimum amount of alum may be used to remove all the color and turbidity. However, as there is only one point at which the alum may be applied, i.e., between the aeration basin and mixing chambers, and as the settling period is too long with the normal flow of water through the plant, the amount of aluminum hydrate which reaches the filters and is deposited on the sand is insufficient to form a mat of the proper thickness. As a result there is a drop in the efficiency of the filters and the bacteria in the effluents increases to more than 100 per c.c. As long as the physical conditions of the effluents remain satisfactory I do not consider it necessary to increase the alum to such a point that a heavier mat will be formed on the filters to effect the removal of 100 or 200 bacteria when the normal amount of chlorine in use will reduce the latter to less than 50 per c.c.

It is not advisable to reduce the alum at any purification plant (in order to reduce the cost of the coagulant) to such a point that the physical qualities of the filter effluents will be affected even though the addition of chlorine will reduce the bacteria of the mixed effluents to less than 100 per c.c. Neither should the alum be reduced to such an amount that dirt will penetrate into the main body of the sand.

In those purification plants in which chlorine is added to the filtered waters, I am of the opinion that it is unnecessary to use an excess of alum, above the amount necessary for the removal of color and turbidity, in order to reduce 200 or 300 bacteria per c.c. to less than 100 per c.c. provided that the amount of chlorine required is not so large as to impart a taste and odor to the filtered water.

10. An unfiltered water which contains a large amount of organic matter cannot be efficiently chlorinated, if by this phrase is meant the reduction of the bacteria in all parts of a distribution system to conform with the standards of the U. S. Public Health Service. However, the majority of the water-borne disease germs in polluted water supplies may be killed in nearly all cases if the chlorine is added in as large amount as possible without imparting a disagreeable taste to the water. It would not pay to add an excessive amount of chlorine to a water supply containing a large number of algae for the purpose of reducing the bacteria below 100 per c.c.

11. In the latter part of 1920 a large multiplication of bacteria occurred in an open reservoir in Ancon in which chlorinated filtered water was stored. A sudden growth of chlorophyceae furnished a food supply for the few bacteria in the disinfected water. In this case the plastering of the rough interior walls stopped the multiplication of bacteria by removing the crevices, holes and rough surfaces to which the algae adhered and grew. Similar trouble was not experienced with a covered reservoir in which the same water was stored.

*Mr. Merrill*—9. No filters are used in any of the water supply systems in the Philippines.

10. Our experience with the Manila water supply seems to indicate that water high in organic matter cannot be sufficiently chlorinated. The use of an excessive amount of chlorine with the object of obtaining a higher degree of bacterial reduction has not been found effective.

11. No systematic investigations have been made in reference to the elimination of algae causing disagreeable odor and taste, as these organisms do not in general occur in abundance in Philippine waters and so far have caused no serious difficulties.

Dr. E. L. Walker, of the Bureau of Science, proved conclusively that the amoebae cultivable from water are not pathogenic (see his paper in the *Philippine Journal of Science*, Vol. 6, Sec. B, 1911). No systematic work has been done on the effect of chlorination on amoebae since Dr. Walker's time. We can generally cultivate amoebae from the Manila water supply which has been chlorinated at the outflow of the reservoir.

# New Device for Testing Subgrade Bearing Power

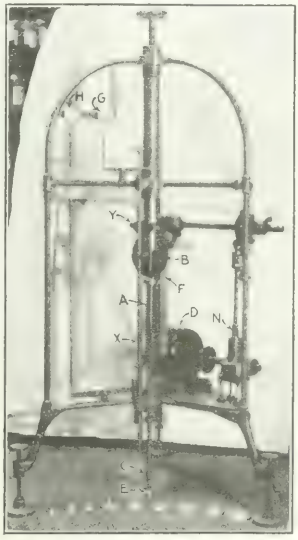
## New Machine Gives Six Loads per Minute, Varying From Zero to Maximum to Zero, Like Passing Vehicle

By H. F. Clemmer
Testing Engineer, Division of Highways, Springfield, Ill.

TO DETERMINE the action of the subgrade under hard-surfaced roads, when subjected to repeated loads such as would be caused by the movement of heavy vehicles on the surface, the Illinois Highway Testing Laboratory has designed a new apparatus termed the repeating-load bearing-power determinator.

The pressures to which a subgrade under a hard-surfaced road is subjected may be of three kinds, depending upon the way in which the load is applied to the surface. If the surface is rough, or if a truck wheel hits an obstruction, an impact force is produced, while if a truck stops for any appreciable length of time a static load is occasioned; the action of the subgrade under these two classes of loads is being studied by use of the Goldbeck impact bearing power determinator and the Illinois static-load bearing-power determinator. The repeating-load bearing-power determinator is being used for making a study of the subgrade when subjected to a third condition—that of a great number of vehicles passing over the surface. With its aid the subgrade action can be noted when subjected to a load increasing from zero to a maximum and then back to zero again in approximately the same time and magnitude as in case of a heavy wheel moving over a rigid surface.

Briefly described, the determinator (see the accompanying illustration) consists of a pipe frame in which is mounted: a spring *A* for producing pressure; a cam *B* which varies this pressure; a plunger *C* which transmits this pressure to the soil; a one-sixth horsepower direct-current motor *D* which drives the cam at a constant speed of six revolutions per minute; a footing *E* which is attached to the bottom of the plunger and distributes the pressure to the soil (footings of different areas are shown at the bottom of the machine in the illustration); a scale *F* upon which the pressure desired is set; an Ames dial *H* which registers the action of the soil under the repeating loads; a wheel *I* which lowers the cam section; and a second Ames dial *G* which registers the vertical movement of this section. Motor power is furnished by a power unit carried on the truck which transports the determinator.



TO TEST ROAD SUBGRADES

The action of the determinator is as follows: The machine is leveled up so that the plane of the footing on the bottom of the plunger is parallel with the surface of the soil. By loosening the set screw *n* and applying a crank to the shaft leading to the cam, the pointer on the upper end of the spring is set approximately to the pressure desired. Fine adjustment of the pressure can be made by turning the lower bearing upon which the spring rests. Set screw *n* is then tightened and the power unit attached. The motor, in causing the cam to revolve, varies the pressure on the soil from zero to a maximum and then back to zero six times per minute. As the soil is deflected under the pressure applied it is necessary to lower the cam section in order that the pressure remains constant. This lowering movement is accomplished by turning the wheel *I* and is registered on the dial *G*. Dial *H* registers to 0.0001 in. the action of the soil beneath the footing.

In order that the soil might be permitted to recover from the pressure without being opposed by the dead load of the plunger section, it was necessary to design an attachment which would carry this load immediately after the pressure was released. A shaft *X* and a counter-cam *Y* were attached to the frame to pick up this load and carry it until just before the pressure was again applied.

Different sizes of footing are being used in order to get some relationship between the action of soil under loads applied to different areas. The loads applied to these footings vary between 5 and 50 lb. per square inch.

This apparatus is at present being used in the subgrade investigation work carried on in connection with the Bates experimental road. With the co-operation of the U. S. Bureau of Public Roads an attempt is being made to correlate the results obtained in the field with the bearing-power values as indicated by laboratory experiments at Washington.

## Timber Surveying and Cruising

A special class of survey work is that of "cruising" timbered areas to make the boundaries, show topography and indicate timber conditions. Details of this work are given in the following abstract of a paper in the *Cross Tie Bulletin* by G. C. Graeter, supervisor of lands of the Western Tie & Lumber Co., St. Louis, Mo.

In cruises made by the U. S. Forestry Bureau and cruising firms on government lands and large bodies of high class saw-mill timber it is general practice to cover 20 per cent of the area by actually surveying two 4-acre lots in each 40 acres, these sample areas being 2 x 20 chains. The surveying or compass party precedes the "cruiser" or tallyman who counts trees and note stheir species and size. Such a party requires at least three men and more often has five: a compass man, two chainmen, an axeman or flagman and the cruiser. Cruising done in this way is too expensive and too slow for the tie business.

For ordinary mapping and cruising by one man the writer has a field outfit consisting of a Brunton hand transit or compass, hand level or clinometer, a 50-ft. metallic tape, a 10 x 12-in. sketch board, a scale divided 66 parts to the inch and cross-section paper divided 10 parts to the inch.

It is the practice to start at some known corner of the tract and proceed around the boundaries of the area, taking bearings with the compass, pacing distances along the outside lines, and locating all points of importance which can be seen from the outside lines. The lengths of the section lines and smaller subdivisions can generally be secured from government maps or from the owner, and if secured in time they should be plotted on the cross-section before starting field work.

On the traverse of the boundaries note is made of all streams and of all slopes over 7 per cent or 4 deg. After the outside lines have been traversed the track is bisected diagonally in both directions from two corners. For every 20 acres a 4-acre area is paced, in which trees are counted and their size and kind noted. On these diagonal traverses the slopes over 7 per cent or 4 deg. are located; also stream crossings and direction of flow, roads, trails, clearings, swamps, houses and all natural features and works of man which would help or hinder operations.

For the timber estimate the Doyle rule, also known as the Connecticut River or St. Croix rule is used. This deducts 4 in. from the diameter of the log as an allowance for slab, squares one-fourth of this remainer and multiplies the result by the length of log in feet; the last result is the content of the tree or log.

A rough sketch of the area is made as the tract is cruised, and ample notes are taken. When the field work is completed the tract is mapped on a scale of 660 ft. to the inch, and all information is placed on the map.

These methods are applicable to a tract of any size, but if the section lines have not been run and cannot be located in the field, they should be run and "blazed." The work should be accurately done with transit and chain or by the transit and stadia method. The latter method is speedier and more accurate in country having steep slopes and gullies, or in flat country if the work has to be done with green and inexperienced chainmen. Corners should be located or determined and set, and should be made as permanent as possible, witness and marker trees being used in and blazed or reblazed, the notes being fully recorded. It is good practice to paint outside boundary and section lines red, half section lines yellow, and intermediate smaller or special lines green. Woods foremen can then readily locate themselves on large tracts with which they are not familiar.

# Chicago Elevated Railway Raised

## Jacks in Timber Bents and Cribbing Lift Cross Girders—Columns Lengthened—Through Span Replaces Deck Span

TO PROVIDE for a new station at Grand Ave., on the Franklin St. line of the Northwestern Elevated R.R., Chicago, it was necessary to raise the rail level 5 ft. and to replace the original deck span across Grand Ave. by a through span with shallow floor in order to obtain headroom for placing the station under the structure and with a clearance of 14 ft. above the street. This change in elevation involved changing the profile for a distance of about 1,100 ft., so that instead of being level it has grades of 1.2 per cent up to the new elevation, with the track level through the station. Fig. 1 shows the work in progress, and the general arrangement of the reconstruction is shown in Figs. 2 and 3.

*Raising the Structure*—In the Franklin St. elevated line four rows of 5-ft. deck latticed girders of 45 to 51 ft. span, forming the track stringers, are framed between 6-ft. cross girders of 43 ft. span, which in turn are framed between the webs of H-section columns at the curb lines. Plate kneebraces stiffen the columns laterally, and for longitudinal stiffness there are diagonal latticed struts from the faces of the columns to the track stringers. To provide for lifting, two four-post braced timber bents were placed near the ends of each cross girder, being supported on cribbing built up to the necessary height in the roadway between the curbs and the car tracks. Screw jacks or building jacks of 15 tons capacity were placed between two courses of the cribbing, there being four or six jacks to each bent according to the location.

To release each column from its foundation it was necessary to remove the concrete filling in the base, in which were imbedded the four anchor rods with upset threaded ends. Some of the nuts on these rods could not be unscrewed and were burned off.

All the work of raising the structure was done during the daytime and without interference to traffic on the elevated line or in the street, except that the timber bents blocked the sides of the roadway. The work of jacking began at both ends and was carried out on one bent at a time, with an average lift of 2 in. at each operation. The total lift for each cross girder was chalked upon the columns and no girder was raised more than 2 in. at a time.

As fast as the jacking proceeded, the cribbing was built up and wedged tightly under the column base and the timber bent, thus keeping the structure in proper alignment and in stable condition. For additional lateral support to the structure, heavy timber inclined braces were set near the crossgirder in alternate spans with their lower ends butted against blocking laid along the face of the curb and their heads notched to fit the bottom chords of the longitudinal girders. In lifting, about 30 men were employed to work on the jacks and to build up the cribs and wedging. A day's work averaged an aggregate lift of 6 ft., and the lifting occupied about twelve working days.

Lengthening of the columns was effected in most places by removing the old column footing or shoe and splicing on a new bottom section, Fig. 4, which fitted into the old shoe. At the lower ends of the inclines where this method could not be used owing to the light lift, castings were placed between the old column footing and the pedestal, or in some cases the old column

FIG. 1. ELEVATED RAILWAY RAISED 5 FT. FOR NEW STATION

A—Cross girders between columns. B—New section spliced on column to increase its height. C—Timber jacking bents under cross girders. D—Cantilever platform girder on top of old cross girder. E—Rear girders of platform. F—Through girder spanning over Grand Avenue, with platform joist on top. G—Hangers. H—Framing of station deck or mezzanine floor.

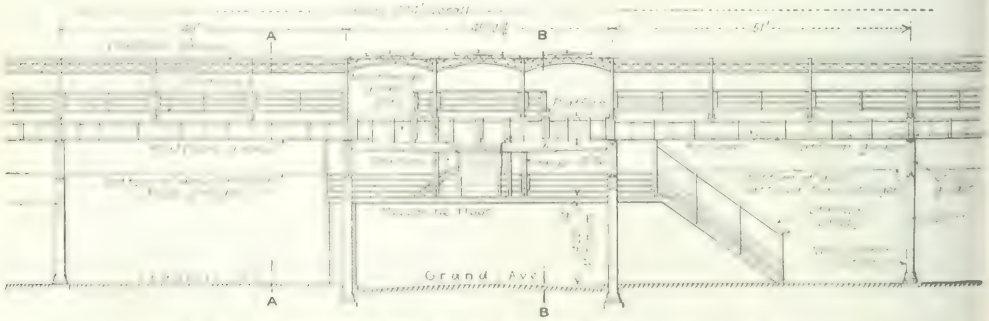



FIG. 2. ALTERATIONS FOR NEW STATION ON THE CHICAGO ELEVATED RAILWAY

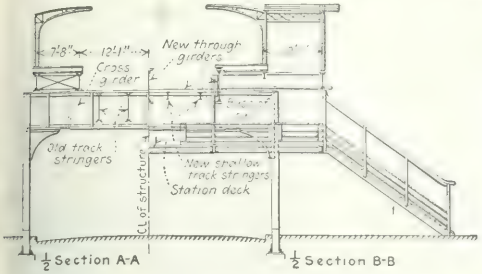



FIG. 3. CROSS-SECTION SHOWING RECONSTRUCTION

was cut off for a sufficient length to permit of splicing on a new bottom section. Where the castings were used, a socketed anchor bolt was screwed upon the original anchor bolt in order to reach the new position of the column shoe (see Fig. 4).

To compensate for the inclined position of the deck, it was necessary to cut out the rivets in the connections of the cross girders to the columns and knee braces, the girders on the new work standing at a slight angle to the columns (see Fig. 4). In some places it was possible to make this adjustment by reaming the rivet holes in the columns and hitch angles on the cross girder, but in other places new connection angles were fitted. All diagonal bracing from track stringers to columns had to be cut loose, as the columns remain vertical while the stringers are inclined. These changes were taken care of by reaming the rivet holes or fitting new connection plates.

*Changing the Grand Ave. Span*—As the 5-ft. deck trusses forming the track stringers of the 45-ft. span over Grand Ave. were too deep to permit of placing the station under them, it was necessary to replace them with through plate girders carrying a shallow floor system. This work was made particularly difficult by the heavy traffic on both streets, coupled with the fact that these streets have double-track car lines with overhead wires and cables. For the removal of the old girders, traffic had to be operated on one track at a time between the two adjacent stations at Chicago Ave. and Kenzie St. As traffic did not permit of this being done on a weekday it was done on Sundays, one day being sufficient for the work on each track.

Owing to the small spaces in the network of wires under the structure it was necessary to cut the girders into small pieces for lowering to the street, this work being done with oxy-acetylene torches. These wires

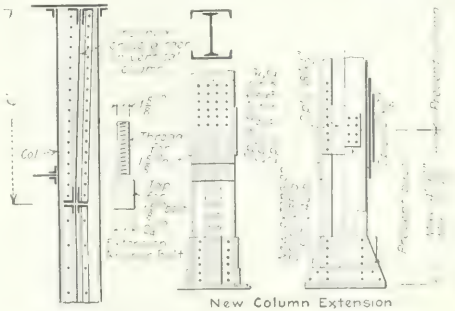



FIG. 4. DETAILS OF RECONSTRUCTION WORK

and the street car traffic also prevented the new girders from being hoisted into place. The girders were placed, therefore, on the abandoned track in the span north of Grand Ave., and were rolled into position before the track was removed. It will be noted that the ends of these girders rest upon the top of the old cross girders, with their chords dropped betwen the latter only a sufficient depth to carry the new floor system.

There are three of these 54½-in. through girders, Fig. 5, the outer ones having the platform joists supported on their top chords. Plate girder floor beams 16 in. deep are riveted to web connections on the girders, and between them are framed 12-in. I-beam stringers upon which the track ties are laid. The two old cross girders were reinforced with two cover plates on each flange.

*Station Construction*—The station building is located on a mezzanine floor approached by stairways from the sidewalks and having stairways leading to the two side platforms. Its deck framing is carried partly by the columns and partly by hangers attached to the track girders and platform girders. Cantilever girders placed on top of old cross girders and extending over the sidewalk carry the outer platform framing at the station stairways. The platforms are 224 ft. long and 10 ft. wide, the width being increased to 20 ft. at Grand Ave. Canopy roofs over the platforms are carried by cantilever ribs forming extensions of posts at the back of the platform. The station proper, about 45 x 40 ft., includes a ticket booth, waiting room space, newsstand, heater, two toilet rooms and a porter's closet.

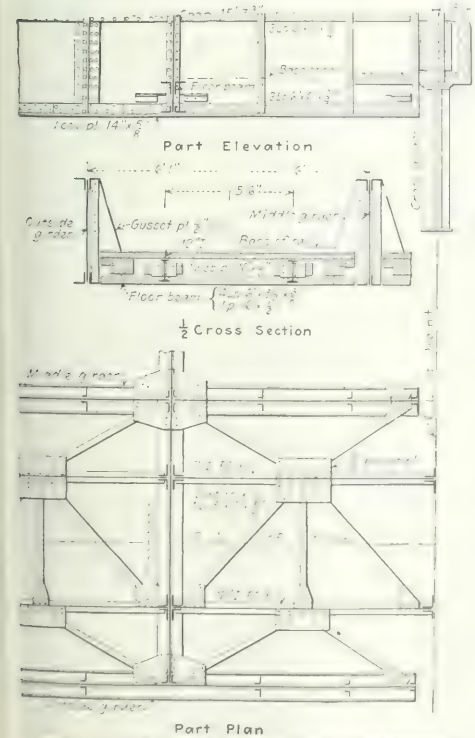



FIG. 5. THROUGH SPAN WITH SHALLOW FLOOR

All work was done by contact, except that the railway company's force made the changes in tracks, third-rails and cables incidental to the replacing of girders in the span over Grand Ave. For the raising of the structure and placing of new steel the contractor was the Brennan Construction Co., the steel being furnished by the Hansell-Elcock Co. The W. J. Scown Building Co. had the general contract for the station building and miscellaneous work. The design and execution of this alteration were under the direct supervision of C. M. Mock, chief engineer of the Chicago Elevated Railroads.

## Outline of Highway Research Program

*A paper by W. K. Hatt, director, Highway Research Committee, National Research Council presented at the Conference on Highway Economics, University of Maryland, July 27, 1921*

FOR the purpose of a co-ordinated and comprehensive program of highway research the writer has been endeavoring to bring into the picture all the elements of the situation in highway transport—engineering, including vehicle and road; economics of transportation; administration; finance. Some comprehensive and logical assemblage will be helpful.

Individuals in industry who have endeavored to state the problem in approximate statistics tell us that there are 10 billions of dollars invested in self propelled vehicles; that the turnover is 3 billions annually; that there are 10 passenger vehicles to 1 freight vehicle; that the problems of speed and safety are most important; and that the annual expenditure for operation of vehicles is 12 times the annual expenditure on the roads. The field of research on cost of vehicle operation arising from the road surface and from the vehicle itself must, therefore, be kept in the foreground.

It appears that there are many dimly seen figures which should be advanced from the background; there is much that is unknown. We may ask a few questions which cannot be completely answered:

### Fundamental Questions in Highway Transport

*The Transport Unit*—(1) What is the economical highway truck unit for each of the several situations, e.g., intercity, farm market? What is the cost of transport arising from vehicle and from road?

(2) What is the relation of this economical unit to other systems of transport, e.g., electric and steam, in a unified system?

(3) To what extent, as a matter of public policy, should any transport unit be indirectly subsidized?

(4) What traffic regulations should be imposed on such economical unit over other types of road? What fees should be charged for service rendered to vehicle by the road?

(5) What should be the proportion of the total traffic supplied by such economical unit to justify a special design of road for such unit?

(6) What prediction can be made of future changes in general traffic and what is the influence of these on the economics of the present situation?

(7) How should passenger traffic over the highway be evaluated?

*The Road*—(1) What type of road paving should be selected for a specified transport unit?

(2) If the road cannot be economically fitted to the truck transport unit, can the latter be modified in design to fit the road?

(3) How should the design of the road and paving be modified to meet changing conditions of subgrade, climate, etc.? How shall sub-soils be improved?

(4) What sum of money is the locating engineer justified in spending to avoid increase in distance, curvature, rise and fall, maximum grade, maximum curve?

(5) What system of maintenance and organization is best fitted for types of roads, differing in traffic, in materials, and in climate?

(6) What is capacity of a road of given width for type of vehicle as expressed in vehicles per hour, ton-miles per year, etc.? What is the appropriate unit for expressing traffic for various purposes?

(7) (In construction many questions arise in selection, production and economical use of materials, standardization and regulation.)

(8) How may the volumetric changes in roads be overcome?

(9) What is the economical life of various types of roads, that is, when maintenance charges exceed earning value?

*Administration*—(1) What should be the policy in control of truck and bus transportation systems, terminals, routing, etc.?

(2) What police regulations should control use of roads?

(3) What is the best administrative and executive organization for administration and operation of roads?

(4) What principles should govern the selection of a system of roads in its various parts, as influenced by inter-state, intra-state, county, local traffic, etc.?

*Financing*—(1) What should be method of financing construction and maintenance of roads? What portions of cost from long term bonds, and what from current funds? What form of bonds should be issued and how create a market for them?

(2) What should be the relation between life of bonds and economical life of road?

(3) To what extent do social betterment, military use, i.e., social value, and other imponderables enter into highway policy?

(4) What should be the distribution of costs as between Federal, State, county, township, property benefited, the user and other units?

(5) How shall the future maintenance charges on completed road systems be met? Shall the user pay all of these?

(6) How shall safety be ensured on the roads?

Answers to these questions cannot be made without data that are at present unavailable. Research is necessary and a mobilization of the efforts of research agencies in a comprehensive program. The highway research committee of the division of engineering of the National Research Council has undertaken the co-ordination of such research. The National Research Council will not engage in research directly.

The tabulation reproduced herewith is devised to indicate the field of research as divided into subfields in which research should be developed and from which data should come to enable answers to be made to these questions among others. Some of the studies that should be made are as follows:

(1) To develop a traffic census blank. Here a traffic classification must be made, the purpose of the census determined, and the various forms and instructions standardized.

(2) In order to determine the cost of transport a statistical table must be made that notes all of the elements of cost; sometimes only a few of these are reported.

(3) To study the operating costs of elements entering into location of highways, such as distance, grade, curvature.

(4) To study loads on roads as produced by the vehicle.

(5) To study design of vehicles with a view to lessening their effects on the road.

(6) To study supporting power and improvement of subgrades and the relations to design of paving.

(7) To study resistance of concrete slabs to alternate stresses and to surface loads.

## TENTATIVE OUTLINE OF THE FIELD OF HIGHWAY RESEARCH

**ECONOMICS**

- Traffic Studies (Regional)
  - Distribution in Region (Traffic Blank)
  - Character
    - Vehicle
    - Weight and Distribution
    - Speed
    - Tire (condition)
    - Commodity
    - Length Haul
  - Method of Expressing Unit of Traffic
  - Predicted Changes
  - Other Traffic on Steam and Electric Roads
  - Central Sources of Traffic
- Community Needs
  - Systems of Roads in Classes for Industries, etc.
  - Intangibles
- Cost of Transport
  - Capital Cost
    - Road
    - Vehicle
  - Fixed Charges
  - Overhead
  - Operation
    - Maintenance
      - Routine
      - Replacement on Road
      - Replacement on Vehicle
    - Equivalent Units
      - X-Auto-Y-Ton Truck, etc.
    - Economic Life
- Economics of Location
  - Cost of Distance
  - Rise and Fall
  - Curvature
  - Ruling Grade
  - Ruling Curve
- Financing
  - Bonds
  - Taxes
  - Fees, etc.
- Highway Valuation
  - Increment of Land Values

**OPERATION**

- Control of Traffic
  - Routing
  - Terminals
  - Franchises
  - Police Regulations
- Accident Insurance
- Planning Systems of Transport
  - Financing
  - Environment
  - Relation to Other Transport Organization
- Financing
  - Bonds, Taxes, Fees
- Distribution of Costs
  - Traffic
  - Property
  - Political Units
- Maintenance Systems
- Maintenance Machinery
- Maintenance Methods
  - Routine
  - Replacement
  - Snow Removal, etc.
- Trail Marking
- Cost Accounting
- Safety

**DESIGN (ROAD)**

- Subsoil Studies
  - Properties
    - Physical
    - Mechanical
    - Chemical
  - Drainage
  - Supporting Power
  - Improvement by Treatment
  - Effect of Road Deformations
  - Effect of Climate
  - Distribution of Pressure
- Base Course
  - Character, Type
  - Thickness
  - Materials
  - Cross Section
- Surface
  - Character
  - Thickness
  - Materials
  - Cross Section
  - Wear by Traffic
  - Wear by Elements
  - Impact of Traffic
  - Tractive Resistance
  - Wear of Tire
  - Wear of Vehicle
  - Dusting
  - Influence of Locality
- Cross Section
  - Width
  - Crown
  - Shoulders
  - Ditches
- Loads
  - Static
  - Impact
  - Surface Integral as Effected by Design of Vehicle
- Design of Integral Slab
  - Strength and Stiffness of
    - Solid
    - Precast
    - Cellular
- Volume Changes
  - Joints
  - Shoving
- Reinforcing
  - Theory of
  - Amount
  - Kind
  - Distribution
  - Direction

**DESIGN (VEHICLE)**

- Design of Vehicle
  - Power Gear Ratio
  - Braking
  - Etc.
  - Etc.
- Effect on Loads
  - Sprung
  - Unsprung
  - Distribution
- Economy of Operation and Maintenance (See Automotive Industry)
  - Economic limit of size of truck in various situations
  - Cost of truck transport (Schedule of elements)
  - Economic limit of haul
  - Cost accounting
- Surface
  - Tractive Effort
  - Wear on Tires
  - Loads
- Maintenance of Vehicle
- Alignment
  - Curves (Speed)
  - Grades
- Cross Section
  - Width
  - Crown
- Safety

**CONSTRUCTION**

- Materials
  - Bituminous
  - Non-Bituminous
  - Fundamental Mechanical Properties
  - Methods of Test
  - Standard Tests
  - Specification
  - Preparation and Treatment (See Special List)
  - Proportioning
- Mixing
  - Efficiency of Mixer
  - Central Mixing Plants
- Placing
- Methods of Testing Roads
  - Instrument
  - Cores
- Design of Experimental Roads
- Drainage (And Drainage Structures)
- Impact on Bridges (See Design)
- Reinforcing (Handling and Placing)
- Inspection
- Plant Design and Control
- Cost Accounting
- Construction Contracts

(8) To study proportioning and use of bituminous materials.
(9) To study bonding of brick surfaces.
(10) To study volume changes and the means of meeting them.
(11) To study operations of concrete mixers.
(12) To study the organization and economics of construction plants.
(13) To study sand-clay, top-soil and gravel roads.
(14) To study cellular and other new types of paving.

There is apparently a widespread activity in highway research throughout the United States on the part of the U. S. Bureau of Public Roads, the U. S. Army, the state highway commissions, the universities and industrial organizations and an earnest desire to put highway construction on a scientific basis. The economic features are under critical examination by such organizations as the National Chamber of Commerce. We should be able to express quantitatively the results of a standardized economic survey of a road project, just as in the case of a water-power project, for instance, except for those imponderables, which, like social betterment and public policy, influence the conclusions so profoundly.

It is not too much to say that the situation is critical, and that the sooner those interested come to a basis of fact, the more assurance we will have that the public will not interrupt progress in providing for highway transport because of a general feeling of insecurity.

### Authority to Order Water Main Moved

The Public Service Commission of Washington, in the case of a petition brought by the city of Yakima to compel the Pacific Power & Light Co. to substitute a metal for a wooden water main, prior to the proposed paving of the street, has ruled that it has no power to order such a change unless it "is necessary to enable the company to render safe, adequate, and efficient service at a reasonable cost to its patrons" (Public Utilities Reports, July 21; Rochester, N. Y.). The commission also ruled that it was without authority to order the city to move the wood water main to a location beneath the parking strip.

# Long Howe-Truss Railway Spans Being Replaced

### New Double-Deck Steel Bridge of Three 173½-Ft. Spans Being Built Over Allegheny by Baltimore & Ohio

WHAT are believed to be the longest Howe-truss spans carrying railway traffic in the eastern part of the United States, if not in the entire country, are being replaced by a new steel structure. Shown in Fig. 1 herewith, the present bridge of the Baltimore & Ohio

FIG. 1. DOUBLE-DECK HOWE-TRUSS BRIDGE CARRYING RAILWAY TRAFFIC

R.R. over the Allegheny River at Foxburg, Pa., consisting of three spans 174 ft. 10 in. long center to center of end bearings. Double-deck steel spans of the general construction shown in Fig. 2 are being erected alongside, to be rolled to place. On Aug. 21 the east span was rolled in, displacing the corresponding old one, without interrupting the train schedule. They are designed for E-50 loading, have a length of 173½ ft. center to center of end pins, are 23 ft. deep between chord centers and consist each of eight web panels.

Originally the Foxburg bridge carried a narrow-gage line of the Pittsburgh & Western R.R.; it was built in 1872 and consisted of three double-deck timber Howe trusses, with the railroad on the top chord and the highway on the bottom chord. It was reconstructed, of similar type, in 1908. Four years later, when the line was changed to standard gage, it was necessary to provide increased carrying capacity, and the timber bottom chord was replaced by four lines of 12-in. 40-lb. I-beams. Until last year the bridge was used by the railroad on a toll basis. The railroad purchased the bridge in 1920 and plans were made for the replacement. Work is now being carried out by the Bethlehem Steel Bridge Co., with J. F. Ritter in charge on the ground. For the railroad, construction is under H. A. Lane, chief engineer, and is under the immediate supervision of P. G. Lang, Jr., engineer of bridges, field work being in charge of A. C. Clarke, district engineer.

# Court Gives City Right to Take Utility Properties

A DECISION affecting the right of municipalities in acquiring properties of public utilities by eminent domain proceedings was recently handed down by the U. S. District Court for the Northern District of California, Southern Division. The case was that of the City of Los Angeles vs. The Southern Sierras Power Co. and the ruling of the court, applying the theory of higher use, allows the city to take certain of the company's hydro-electric properties over the protest of the company. The company has appealed to the U. S. Circuit Court of Appeals by a suit for a writ of error. A resume of the case as prepared by one of the company's engineers follows:

The Southern Sierras Power Co. is a public utility corporation operating under the jurisdiction of the California Railroad Commission. For many years it has generated and supplied hydro-electric power to seven counties in the southwest portion of the state, many sections of which are dependent upon this company as the only available source of hydro-electric power. The combined system of The Southern Sierras Power Co. and its related company, The Nevada California Power Co., includes eight hydro-electric generating plants and about 800 miles of high tension lines. No part of the system, however, comes within 40 miles of the city of Los Angeles, nor is the company's service devoted to the Los Angeles district.

The Southern Sierras Power Co. acquired from the Mono Power Co. 320 acres of land through which the Owens River flows in the so-called Owens River Gorge. In crossing this parcel of land, the stream drops 421 ft., thus affording a favorable opportunity for the development of hydro-electric power. Immediately upon acquiring the property the company began the construction of a power plant to be added to its existing generating and transmission system. Subsequent to this the city of Los Angeles instituted proceedings in eminent domain to secure the right to all of the water flowing through the 320 acres of land purchased from the Mono Power Co., together with a right of way for a tunnel through that property. The city had conflicting plans for development which would completely by-pass the company's plant. The property in question is located more than 300 miles from the city of Los Angeles and is more remote than are many other units of a comprehensive power development plan proposed by the city which includes unfinished power plants along the Los Angeles aqueduct.

The court refused to consider evidence of the service rendered by the company, the absolute dependence upon it for service of certain cities and communities or its relation to these cities and communities as an agent, with rates and service governed by the State Railroad Commission, but interpreted a California statute as holding the demands of a municipal corporation superior to that of any public service corporation, regardless of the service rendered by the latter and regardless of the necessities of the consumers dependent upon that utility. The court gave the city full power to exercise the right of eminent domain and instructed the jury to disregard the value of the plant, most of which had been constructed after the beginning of the legal action, when placing a value on the condemned property. This latter point was contested because the suit was not brought to trial within one year, as required by statute. Under these instructions, the jury made an award of $525,000. The case is now awaiting a hearing before the higher court.

Boards of supervisors of three counties, representing the major portion of the area where the company is selling the power in question, have instructed their district attorneys to enter appearance proceedings before the higher court and will endeavor to show that the counties would suffer if the company on whom they depend were to be deprived of the power rights in question.

## Automatic Features of New Kern River Power Plant

### Reaction Turbines for 810-Ft. Head Have Quickly Changeable Runners—Extensive Automatic Control Equipment

THE recently completed Kern River No. 3 hydroelectric plant of the Southern California Edison Co., is subject to such wide variations in stream flow and power demand that an unusual number of automatic features were considered necessary to insure its continuously efficient operation. Two 25,000-hp. Francis turbines are installed, operating under a static head of 310 ft., which is said to be the highest head ever used on reaction turbines. The plant was started up April 1 and has been in service continuously since that date.

The load requirements of the Southern California Edison Co., make it necessary for the plant to be able to deliver 60-cycle current to the northern subsidiaries at times and at other times 50 cycle current to properties to the south. In order to make this possible the turbines are each provided with two runners, one to operate with highest efficiency at 500 r.p.m., which gives 50-cycle current and the other to operate at 600 r.p.m., giving 60-cycle current. In order to make practicable an arrangement of this sort the turbine was designed with a view to facilitating a quick change of runners. The entire internal part of either turbine is removable from below which obviates the necessity for disturbing either rotor or stator of the generator when dismantling the hydraulic part of the unit. During the test on the plant the runners were changed in 20 hours from the time the unit was taken off the line until it was in service again at different frequency.

The flow of the river is variable and as there are practically no storage facilities for equalizing, there are times when the available water quantity will be only about half the normal supply. Under such conditions the plan of operation at the plant contemplates that one of the turbines will be operated as a master unit at 60 cycles, while any surplus water will be delivered to the other unit which will at that time carry a block load at 50 cycles. The range in flow is expected to be from 300 to 600 sec.-ft. In order to use the flow, whatever it may be, to most advantage, automatic devices are arranged to control the turbine gates in accordance with the quantity of flow in the penstocks.

An automatic control of the wicket gates by means of an interconnection between the two turbine units is so arranged that any quantity of water not required by the 60-cycle unit during periods of regulation or changing load will be absorbed by the 50-cycle unit and thus delivered into the 50-cycle system without loss. In order to make a device of this sort suitable for operation at all seasons or periods of change in the water flow without loss of water, this automatic control has in it a device for resetting the load limit to suit flow changes.

A balanced pressure is automatically maintained on both sides of the turbine runners at all loads so that the duty on the vertical trust bearings which support the entire rotating element is safely controlled. The main shaft of the turbine is provided with a renewable wearing sleeve at the stuffing box and the sleeve has an automatic water circulation for cooling purposes. The guide vanes are counterbalanced to prevent undue wear on the lower throat liner. Any seepage is automatically removed by ejectors.

An automatic pilot valve control is provided on each of the governors so that each entire unit can be completely shut down by simply pressing a push button on the switchboard. The pilot valve itself has a diameter of only ⅜ in. and is thus easily controlled by a push button similar to the ordinary electric light switch. This pilot valve actuates relays which in turn set in operation in proper sequence the machinery for closing down the unit in just the way it would be done if these operations were done manually. The mechanical operation of this automatic control is said to be so simple and so satisfactory that although designed as an emergency and safety feature it is now ordinarily used as the preferred means of shutting down the unit.

The central oil pressure system is arranged to automatically provide any necessary make-up air in the pressure-accumulating tanks. The maximum oil pressure is automatically limited and while the oil pumps are ordinarily driven by electric motors these are so arranged that in the event of failure of the motors or if the current should go off, a small water wheel automatically takes on the pump load and continues to carry it until the motors are again put in operation.

The hydraulic equipment was supplied by the Pelton Water Wheel Co.

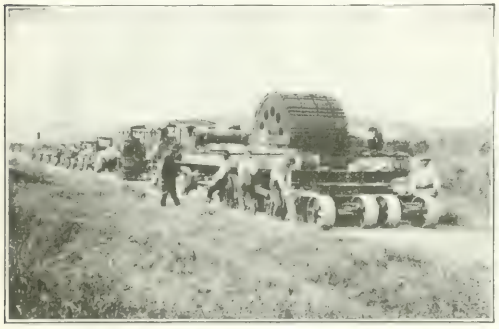
### Quick Replacement of Bridge

According to a description in the *Baltimore & Ohio Magazine*, a three-span double-track bridge on the Washington branch of the Baltimore & Ohio R.R. was recently replaced by a new structure with only 5 min. interruption to traffic. The rolling method of replacement was used, the new structure being erected on falsework alongside and rolled over into position as the old structure was rolled out. The total moving weight in the rolling operation was 350 tons, and the actual time of rolling is stated as 3 min. 30 sec.

# 65-Ton Rotor Rolled More Easily Than Carried

### Comparison of Methods of Moving Heavy Rotors Becomes Possible in Making Delivery to California Plants

IN DELIVERING machinery to San Francisquito power house No. 2 on the Los Angeles aqueduct it was necessary to make the final 10 miles of the journey over roads on which the grades range up to 10 per cent on both up and downhill. The most difficult part of the delivery problem was moving the 65-ton rotors for the two generators. The first rotor was taken in on a specially constructed trailer; the second rotor was lagged and rolled along the road, being handled in that way more easily and with a smaller crew and less power. Both methods required ten days in which to make the trip.



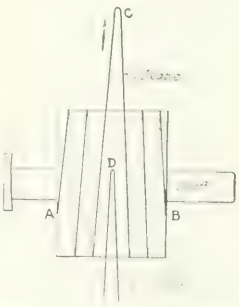
TWO 65-TON ROTORS MOVED BY DIFFERENT METHODS OVER THE SAME ROAD
At left, two tractors and seven trucks pulling rotor on special trailer. At right, duplicate rotor being rolled along by one tractor.

For transporting the first rotor a 50-ton trailer was used in connection with two dollies, an I-beam support being provided to distribute the load as uniformly as possible. With this rig the tractive effort required was very great, the ordinary requirements being two tractors and about seven motor trucks, each with a ballast load of one ton. There was, also, considerable difficulty in negotiating the turns and several break-downs of the trailers occurred when load concentrated on certain points. In bringing in the second rotor only one tractor was used ordinarily, although a second was kept in attendance to aid in holding back on down-grades and in "cutting" the load on turns. Both tractors were rated at 75 hp.

In order to protect the rotor that was rolled from damage in transit a lagging of 8 x 8 in. timber was placed around it and fastened by 8 iron bands placed like hoops on a barrel. These bands were not continuous, the two ends of each band being led to a depression in the lagging where they were connected by a bolt so placed that turning the nut would tighten up the band. The lagging was made long enough to project over each end of the rotor so as to give bearing on a wooden spider or head built up of heavy timbers. This head fitted just inside the lagging as a barrel head fits inside the staves and served as an aid in distributing the stress and preventing the lagging from shifting. The shaft of the rotor was similarly protected by lagging of a lighter weight.

The rotor was rolled by means of a double line of ¾-in. cable; two cables, each 750 ft. long being used alternately. Before starting the first of these cables was put on the rotor in the manner shown in the sketch, that is, with the loop *C* at the middle where the tractor could take hold and the cable wound around the rotor with the ends, *A* and *B*, fastened to eye-bolts sunk in recesses in the lagging.

As the first cable was unrolled, the middle loop of the second cable which was attached to an eye-bolt sunk in the lagging at the middle of the cylinder (*B*, in the sketch,) was wound on in its place. The only time lost for each 375 ft. of progress was in dragging back the unwound cable. While this was being done the ends of the cable which had just been wound on were fastened and the tractor was backed up for a new hold at the point marked *D* in the sketch. A team of horses was used for pulling the cable back, the horses dragging a sled to which a spacer was fastened for keeping the two ends of the cable separate. As the sled dragged from the ends of the free cable as the rotor was being rolled, a desirable tension was caused in the cable which was guided by hand into place on the rotor.




METHOD OF PLACING LINES ON ROTOR

The "cutting" or changing the direction in which the rotor was rolling was first done by a block and tackle while the rotor was standing still, a tractor being used for motive power. This method was slow and damaged the lagging. It was soon found that the standby tractor could easily cut the rotor while it was in motion by pulling on a sling about one end of the shaft, thus effecting the desired turn without delaying progress.

### F. C. Sharrow Made Bolt Bearing Tests

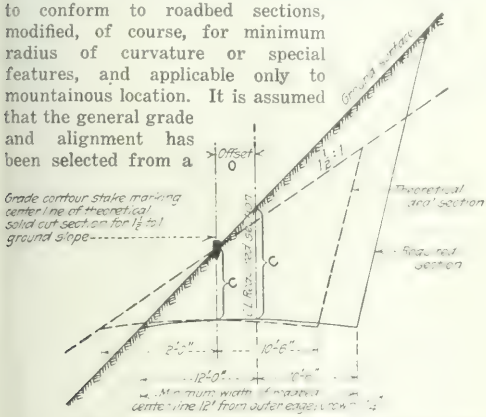
By an inexplicable typographic mix-up F. C. Sharrow, structural engineer, H. M. Lane Co., Detroit, Mich., was not given credit for the authorship of his article "Test Bearing Strength of Bolts Through Concrete Beam," in *Engineering News-Record*, Sept. 8, 1921, p. 413. The name of S. C. Majumdar was erroneously subscribed to the article as author.

# Locating Highway Grades in Steep Side-Hill Country

By George A. Tilton, Jr.
San Luis Obispo, Cal.

FIELD LOCATION of highway alignment in steep sidehill country where the topography is broken, requiring short radius curves and frequent maximum grades, is usually confined to the survey of an angle line with sufficient topography to permit a paper location to be made in the office. Where the ground slopes are steeper than the maximum fill slopes, the roadbed must be in solid-cut or an equivalent section. To locate a center line in the field that will give solid-cut sections without excessive excavation or walls requires considerable more detail than usual in the field.

This discussion is intended to illustrate a method whereby the final center line can be located in the field to conform to roadbed sections, modified, of course, for minimum radius of curvature or special features, and applicable only to mountainous location. It is assumed that the general grade and alignment has been selected from a reconnaissance survey and the field location confined to boxing of a final center line and grade.




OFFSETS FOR SETTING OUTSIDE HILL GRADES

| Slope of Ground | Cut "C" | Offset "O" | Distance Uphill |
|---|---|---|---|
| 24° | 2.25 to 1 | 4.7' | 6.0' | Downhill |
| 26° | 2.05 to 1 | 5.2 | 4.4 | Downhill |
| 28° | 1.88 to 1 | 5.8 | 3.1 | Downhill |
| 30° | 1.73 to 1 | 6.3 | 1.9 | Downhill |
| 33° 41' | 1.50 to 1 | 7.4 | 0 | |
| 36° | 1.38 to 1 | 8.1 | 1.0 | Uphill |
| 38° | 1.28 to 1 | 8.8 | 1.8 | Uphill |
| 40° | 1.19 to 1 | 9.5 | 2.5 | Uphill |
| 42° | 1.11 to 1 | 10.2 | 3.1 | Uphill |
| 44° | 1.04 to 1 | 11.0 | 3.7 | Uphill |
| 45° | 1.00 to 1 | 11.4' | 4.0 | Uphill |
| 46° | 0.97 to 1 | 11.8 | 4.3 | Uphill |
| 48° | 0.90 to 1 | 12.7 | 4.9 | Uphill |
| 50° | 0.84 to 1 | 13.7 | 5.4 | Uphill |
| 55° | 0.70 to 1 | 16.2 | 6.8 | Uphill |
| 60° | 0.58 to 1 | 20.2 | 7.8 | Uphill |

The most important and difficult case arising in location is where the grade is maximum and controls the alignment. If the maximum grade is over five or six stations in length some accurate method must be used to select the center line, so that solid-cut sections, with minimum excavation, will result. The same also applies to any other grade where it is desired to maintain it uniformly for any considerable distance.

To locate alignment in connecting with a grade, some sort of a grade contour must be used as a guide in the selection of curves and tangents. The more accurate the grade-contour is established, the more accurate will the alignment result (in respect to minimum excavation).

For grades less than the maximum, a hand level or clinometer can be used satisfactorily to establish a grade-contour but in the case of a maximum grade it should be traced with a transit, the vertical arc of which should be set to the grade angle. This angle should be about 0.10 per cent less than the desired grade in order to allow for nominal shortening of the grade contour length. However, if a clinometer is used in tracing a grade contour approaching the maximum, as much as 0.50 per cent less grade should be used.

Beginning at the highest control of the grade, the trace of the grade contour should be marked on the ground at short intervals, such as the approximate P. C., I. T. and P. T. of curves, besides all important grade contour deviations. The transit can be set up quickly over each point (without a plumb-bob) and by means of an H. I. rod the grade-contour can be progressively traced for an accurate guide to a final center line. In places where the line crosses a ravine, or other places where a shortening of the grade contour distance is anticipated a still further flattening of the grade-angle should be made.

A three man party can stake about 1½ miles of grade contour in open country and from ½ to ¾ of a mile in brushy country in one day—stakes only set temporarily for a guide.

For actual selection of the final centerline, horizontal offsets are made from the grade contour stakes which are assumed to mark the center line of a theoretical cross-section in full width and a solid-cut section of minimum excavation for a 1½ to 1 ground slope. If a stretch of grade consisted of 1½ to 1 ground slopes, the grade contour as traced could be used and fitted for a center line. Where the slopes are constantly changing, however, offsets must be made in order to bring the roadbed in solid-cut for the steeper ground slope. Take for example the case of a 1½ to 1 ground slope in transition to a 1 to 1 ground slope. In referring to the accompanying table and sketch, it is seen that a horizontal offset must be made uphill of 4.0 feet. In the case of a transition to a flatter slope than 1½ to 1 such as a 24° slope, an offset of 6.0 feet horizontally must be made downhill from the grade contour (assuming solid-cut).

Having flagged out a center line by means of the offsets to a grade contour described above, the curves can be readily fitted, either by the external distance or long-chord, or in the case of reversing and compounding curves, by the sub-tangent. In dense underbrush where a grade contour line has been brushed out the trial deflection method becomes economical in saving excessive brushing.

The centerline selected by this method results in a definite grade and alignment from which little change is required to avoid unnecessary excavation or excessive walls, thus eliminating an office location.

## Two Words Give Full Data for Mapping Lake

In the present official map of California Tulare Lake is shown as covering 153 sq.mi. Much of this area has been reclaimed and brought under cultivation so the Railroad Commission, in preparing a new map, wrote to Roy May, county surveyor of Kings County, in which the lake is located, asking him to furnish the commission with a township map showing the present water boundary of the lake. May returned the commission's letter with the laconic marginal notation: "Plumb dry."

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## Getting the Full Value of Engineering Periodicals

BY PERRY THOMPSON
Sanitary Engineer, Yonkers, N. Y.

I was astonished to learn recently how many of my young engineering friends were not regularly reading *Engineering News-Record* nor other similar periodicals because (1) they were "too busy"; (2) the issues accumulated too fast and occupied too much space; (3) it was difficult to locate articles in back numbers before the index came along, and sometimes even then; (4) the cost seemed large for the few articles of special interest. To them and to others who think likewise but who do read some copies and may read this, I would like to give the benefit of my experience with six technical periodicals:

(1) *Time for Reading*—I doubt if any of my friends are more busy than I, yet I not only find time to read technical papers but clip newspaper and magazine articles occasionally as well. There is much in knowing how. One should not attempt to read every article regardless of whether it is in his special line or not, and perhaps not even then, but he should know there are such and such articles and be able to turn to them later should it then become desirable. An easy and satisfactory way of doing this will be mentioned later.

(2) *As to Occupying Space*—It is indeed true that technical journals occupy space if they are filed just as they come to hand, but this is not necessary. An easy way to reduce their size, if one is interested in the technical articles only, is to open the wire fasteners under the back cover, straighten them with a pair of pliers, file the square edges off their points with a small flat file and then pull off the pages of advertising on that side. Turning the issue over, insert a small screwdriver under the center of the fasteners and extract them. Now remove the index sheet and the pages of advertising on this side, then remove the part containing the articles to be kept, and after placing the index sheet in front put back the fasteners and clamp them with the pliers. Only three small tools and three minutes are necessary.

(3) *Finding Articles Easily at Any Time*—I index the periodicals as they arrive, either as I read them or preferably before, turning down the corners of specially interesting articles for easy identification later, as well as to save time in looking for them again. The index need not be elaborate unless one is specializing along several lines. My index has 20 subjects subdivided; water supply has 70 subdivisions and sewage disposal has forty-five. A card index is most satisfactory, especially if intended to be permanent, but a loose-leaf index will do.

At this point someone will say "too much system," but it does not work out that way, for with very little practice one unconsciously learns his headings or subjects by heart, and knows almost instantly the one most suited to the article, although it is often advisable to index an article under two or more headings. The latter can often be determined only by reading, and would therefore be omitted if left to a subordinate who did not read them.

And then there is the additional advantage that one's own system is likely to be best suited to his needs; but if this should not be so it will at least serve till the printed index arrives. Still another advantage is that one can index an article he may not have time to read, nor any use for just then, but which he might read hurriedly and try to remember if he had no index; the chances being he would hardly absorb it, to say nothing of remembering it.

(4) *Cost*—If one picks out at the end of the year the articles which bear directly on subjects in his special line and applies to them the total cost of the volume, it may seem he has paid well for them; but when he remembers that he is getting later ideas than he can find in any book, and indeed many thoughts he cannot find in books at all, he should feel that he cannot hope to keep abreast of the times and dispense with engineering periodicals; in other words, he should feel that he cannot afford not to take them.

## Improved But Still Deficient

THE ENGINEERING INDEX, 1920—New York City: The American Society of Mechanical Engineers. Cloth; 6 x 9 in.; pp. 586; $6.

Although the present issue of this well-known annual is an improvement over the previous one, just as that was better than still earlier issues, yet the present volume leaves much to be desired both in the way of completeness and classification. The deficiencies in classification may be due to the fact that the several index entries are prepared for monthly publication and thus get what might be called a permanent set month by month, instead of remaining in a fluid form suitable for easy, systematic classification for the yearly volume.

However this may be, the fact remains that the classification—or at least the distribution of many of the entries under the various dictionary headings—is very irrational. This is particularly noticeable in the case of a number of references to water treatment. These are found distributed in a rather haphazard way under two or more of the dictionary headings. To be still more specific, articles on mechanical filters or filtration are entered under: filters; filters, sand; filtration plants; water; and water filtration. Two articles on cleaning sand in the St. Louis water filters, appearing in two different journals, are entered, one under filters, subhead cleaning sand, and the other under filtration plants, subhead cleaning filters.

The same general line of criticism might be applied to the entries under many other topics. Much improvement could readily be made by cutting a considerable number of the dictionary classifications to mere cross references and by a more careful scrutiny of the articles to see where they really belong.

Criticism as to omissions falls under two main heads: (1) Many important articles published during the year

covered are omitted entirely; (2) in the case of abstracts or reprints of society and other papers or articles on the same general subject appearing in two or more journals, the practice is to enter only one.

Taking up the second point first, it may be noted that while bulk and cost may go heavily against duplication of entries, yet it must be remembered that an index that is intended for universal use will go into the hands of one engineers who has one journal and of another with still another, and so on, and that the very nature of engineering work is such that many engineers have access to only one or at most two journals. Therefore, to be of the greatest use to the greatest number, there should be entries—not full summaries in every case—for all the journals, society proceedings, etc., in which an article on a given subject can be found either in its full, original shape, or in substantial abstract.

As to complete omissions of important articles, many such have been noted in the civil engineering field. These cannot be due to space limitations, for under the same subject and from the same journal, at least in the case of *Engineering News-Record*, minor articles are listed and major articles omitted.

## A Bird's-Eye View

ECONOMIC DEVELOPMENT OF THE UNITED STATES—By Isaac Lippincott, Ph.D., Professor of Economic Resources, Washington, University. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 691. $3.50.

By four periods of time the author reviews the economic history of the United States down to the present time. He outlines the growth of population, agriculture, manufactures, commerce, railroads, banking and labor organizations. With so comprehensive a program much of the treatment is necessarily sketchy, but for students and others approaching the general subject for the first time—and for these the book is written—the work promises to serve its purpose.

## Government Control During the War

GOVERNMENT CONTROL AND OPERATION OF INDUSTRY IN GREAT BRITAIN AND THE UNITED STATES DURING THE WORLD WAR—By Charles Whiting Baker, C. E., Consulting Engineer. New York: Oxford University Press. Paper; 7 x 10 in.; pp. 138. $1.

In this monograph the author has presented a broad, general survey of what Great Britain and the United States did in the way of government control and operation during the recent war. After a few introductory pages, in which, among other things, government efficiency is discussed, consideration is given to railways, public utilities (United States), shipping, labor, capital food, and fuel. In a chapter on "The Popular Verdict and the Truth," the author holds that conservative opinion condemns while the popular verdict approves the results of government control. Elsewhere it is maintained that the extension of government control in the future is inevitable. In a chapter on "Conflict Between the Executive and Legislative Branches of Government" it is urged that our state and national legislatures go altogether too far in interfering with the proper duties of executive departments. Although emphasing the grave errors made in government control during the war, Mr. Baker in general holds that the main results were commendable, taking into account that in wartime efficiency is not to be judged by ordinary standards, but by the attainment of the desired end in the least possible time.

## Street Railway Commission Report Digest

ANALYSIS OF THE ELECTRIC RAILWAY PROBLEM: Report to the Federal Electric Railways Commission with Summary and Recommendations, Supplemented by Special Studies of Local Transportation Issues in the State of New Jersey and the City of Denver; with Notes on Recent Developments in the Electric Railway Field—By Delos F. Wilcox, Ph.D., Consulting Franchise and Public Utility Expert, Chief of the Bureau of Franchises of the Public Service Commission for the First District, State of New York, 1907-1913; Deputy Commissioner of the Department of Water Supply, Gas and Electricity, City of New York, 1914-1918. New York: The Author, 73 Gleans St., Elmhurst, L. I. Cloth; 7 x 10 in.; pp. 789; $10 net.

In publishing privately his analysis of the testimony on the financial troubles of the street railways, taken by the Federal Electric Railway Commission in 1919-20, and his suggestions as to the report of the commission, Mr. Wilcox has made available what the commission itself characterized in its report as "a complete and masterful study of the whole electric railway problem."

Mr. Wilcox's method is to analyze and discuss the testimony under topical heads, designed to show the plight of the street railways, its cause and the remedy, always bearing in mind the three great parties in interest, riders, employees and investors, and also taking into account the taxpayers and the public as a whole. This plan leads him to consider at the very outset the street railway as an essential public industry, its capital requirements and why its credit has been lost. Under lost credit, Mr. Wilcox discusses overcapitalization, neglect to amortize both excess capitalization and accrued depreciation, payment of unearned dividends, overbuilding, holding companies and banker control and the uniform 5-cent fare are discussed. After going over many other phases of the subject, including public regulation, jitney competition, labor problems, the depreciated dollar, zone fares, public subsidies, etc., valuation and rate problems are taken up at some length. Toward the end, the author presents four choices: (1) Abandonment of public interest in the street railway industry, which he declares is no remedy; (2) more complete commission regulation, which he characterizes as inadequate; (3) service at cost, which "falls short"; (4) public ownership and operation, which he considers to be "the ultimate solution." The whole case is then summarized under 54 heads, after which the appendices mentioned in the sub-title, as given above, and a detailed index close the volume.

How far the author's conclusions go beyond the recommendations of the commission may be inferred from the foregoing outline taken in conjunction with the commission's recommendations, as printed in *Engineering News-Record*, Sept. 2, 1920, p. 480; but it should be noted that in many respects there is general agreement between the two. The digest partakes largely of the nature of a brief for the public, but always with an honest attempt to consider all the parties in interest. Mr. Wilcox's forceful expression of his own opinions—very properly, since they were virtually requested by the commission—conform with his very decided personal views, based on long and close study.

Unquestionably, Mr. Wilcox has rendered a distinct public service: First in his exhaustive analysis of a vast mass of testimony; second, in his own discussion of principles, practice and experience; and third, in publishing privately what the commission found itself unable to publish and what the American Street Railway Association which published and distributed at its own expense the testimony and the commission's report—was unwilling to print.

## Irrigation and Other Eastern Engineering

REVIEWED BY F. W. HANNA

[illegible] Co., Ltd., Medicine Hat, Alta.

[illegible] AND ON THE WATER SUPPLY OF [illegible]. By [illegible]. Published by the Author. Obtainable from E. P. Dutton & Co. London: George Routledge & Sons, Ltd. Cloth; [illegible] pp. [illegible]

Mr. Strange has brought together in this book notes kept by him during some 30 years of Government engineering experience in India, Ceylon and the Transvaal. As the title indicates, the author has included under one cover information on the subject of irrigation, roads and buildings, and in addition thereto information on town water supplies. The inclusion of so many slightly related subjects in one book is an unusual procedure and one not wholly commendatory except as affording a view of the broad and valuable experience of the life work of a worthy engineer.

As might be expected in the treatment of divergent subjects in a single book, the discussion is unevenly divided among them. Fortunately for the general reader, however, Irrigation (558 pp.), and Town Water supply (147 pp.), have received the bulk of the author's attention. The chapter on Roads (148 pp.) and District Buildings (44 pp.) may be dismissed with the remark that although the author displays a keen knowledge of general road building and architectural principles the material he presents is so localized as to be of benefit mainly to practitioners in the particular districts in which the author has gained his experience. The section on Town Water Supply gives a condensed but comprehensive and readable consideration of the subject but the reader who is seeking for technical help on water supply problems will have to look elsewhere.

The whole subject of Irrigation is treated in a concise manner by summarizing and tabulating principles and facts and supplementing them with brief discussions. There is little technical detail or mathematical consideration, so the careful reader can make rapid progress in grasping the subject matter. The first four chapters on Irrigation deal with definitions of terms, water supply, uses and losses and miscellaneous matters, and the next four with storage reservoirs, dams and outlet works. There are ten chapters on the construction of canals and their accessories on alluvial soils and on the physics and control of large Indian rivers on these soils; one chapter on distributary systems and one on irrigation laws, finance and administration.

In the main the irrigation practice advocated, subject to modifications to meet local conditions, agrees quite well with American practice. Some differences worthy of notice are the narrowness of top widths of earth dams and the use of heavy masonry canal structures to the complete exclusion of reinforced concrete.

The author deserves commendation for his logical, concise and forceful style, for his carefully collected and arranged subject headings and for a good index. The book as a whole is worth reading.

## Cloth Bound, Not Paper; Correction

By mischance, the binding of Hering and Greeley's "Collection and Disposal of Municipal Refuse" was given as being of paper instead of cloth in the review appearing in these columns on July 21, p. 115.

# PUBLICATIONS RECEIVED

ANNALI UTILIZZAZIONE DELLE ACQUE—IDROGRAFIA CONCESSIONI ED ACQUE PUBBLICHE. Vol. III (Monografie, Studi, Legislazione, Statistiche, Recensioni, Bibliografia, Notiziario)—Rome, Italy: Ministero Dei Lavori Pubblici. Paper; 7 x 11 in.; pp. 150. Obtainable [illegible]. Contains [illegible] Giuseppe Albenga, Carlo Bonomi, Luigi Kambo, statistics, list of concessions, etc.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Transactions. Vol. XIII, Part 1. 1920. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. [illegible]; illustrated. $6.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Proceedings. 1920. Valparaiso, Ind.: Charles Carroll Brown, Secretary. Cloth; 6 x 8 in.; pp. 196. Illustrated. $

ANALYTICAL GEOMETRY: A First Course in Plane and Solid with Numerous Examples—By Charles N. Schmall, B.A., Instructor in Mathematics in the Public Schools of New York. Second Edition, Enlarged. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 338; illustrated. $1.75.

BRICK [illegible] and Uses. A Presentation of Facts for Prospective Owners of Houses and Other Buildings and a Manual of Construction Data on Brickwork for Architects, Engineers, Contractors and Builders. By William Carver, Architect. Revised and Enlarged. Cleveland, Ohio: The Common Brick Manufacturers' Association of America. 25c.

Besides serving as a brief and describing the "new ideal wall," this pamphlet contains much useful information for brick users, including [illegible] specifications.

CANAL STATISTICS 1920. Prepared in Collaboration with the Department of Railways and Canals, Canada—Ottawa, Can.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 41.

CHEMICAL AND BIOLOGICAL SURVEY OF THE WATERS OF ILLINOIS: Report, 1918-19, Issued by Edward Bartow, Chief. Division of State Water Survey, Department of Registration and Education. Urbana, Ill. Paper; 6 x 9 in.; pp. 280; illustrated.

Reports of special investigations and several theses submitted to the faculties of the University of Illinois, in addition to report of work of survey, are included. Equipment for a small waterworks laboratory is enumerated.

DIGEST-INDEX OF THE FEDERAL WATER POWER LAW AND REGULATIONS THEREUNDER—By M. O. Leighton, M. Am. Soc. C.E., M. Am. Soc. M.E. Washington, D. C.: M. O. Leighton & Co. Paper; 6 x 9 in.; pp. 19.

EFFECTS ON CONCRETE OF IMMERSION IN BOILING WATER AND OVEN DRYING—By W. J. Schlick. Ames, Iowa: Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Paper; 6 x 9 in.; pp. 24; illustrated.

FARM BLACKSMITHING: A Textbook and Problem Book for Students in Agricultural Schools and Colleges, Technical Schools, and for Farmers—By John F. Friese, Head of the Machine Shop and Forging Departments, Technical High School, St. Cloud, Minn. Peoria, Ill.: The Manual Arts Press. Cloth; 5 x 8 in.; pp. 92; illustrated. $1.25.

GRAPHIC PRODUCTION CONTROL—By C. E. Knoeppel, Member Society of Industrial Engineers, M. A. S. M. E.; Assisted by Various Members of the Author's Firm and Staff. New York: The Engineering Magazine Co. Cloth; 6 x 9 in.; pp. 177; illustrated. $10.

HIGHWAY RESEARCH PERTAINING TO CONCRETE ROADS: Sections and Details of Test Highway as Constructed at Pittsburg, Cal. Preliminary Report, July, 1921. Inaugurated by the Columbia Steel Co., San Francisco, Cal.: The Company. Paper; 7 x 10 in.; pp. 20; illustrated.

One page of text outlines the test highway, on which a motor-truck test to destruction was to begin Sept. 1. Thirteen pages of construction are figured.

HIGHWAY RESEARCH PERTAINING TO CONCRETE ROADS: Sections and Details of Test Highway As Constructed at Pittsburg, Cal.; Preliminary Report, July, 1921 Inaugurated by Columbia Steel Co., San Francisco, Cal. Paper. 7 x 10 in.; pp. 20.

An abstract of these [illegible] appeared in *Engineering News-Record* Aug. 18, 1921, p. 276.

INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS: Proceedings, 1920—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 447.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress, 1920—By Frank Moore Colby, M. A. New York: Dodd, Mead & Co. Cloth; 7 x 10 in.; pp. 775; illustrated. $6.75.

ONE-HINGED STEEL ARCH: An Investigation and Its Comparison with Other Types; A Thesis Presented to the Faculty of the Graduate School, Cornell University, for the Degree of Doctor of Philosophy by Nee Sun Koo, B.S., M.C.E., McGraw Fellow in Civil Engineering, 1920-21. Reprinted from the Cornell Civil Engineer, Mar., Apr., May, 1921. New York: The Author. [illegible] Paper; 6 x 9 in.; pp. 75; illustrated.

OIL FLOW IN PIPE LINES: Comprising Charts Showing the Pressure Loss in Different Sized Pipe Lines, the Conversion of Viscometer Readings, the Horse Power Required for Pumping San Francisco, Cal.: King Knight Co. Paper; 12 x 9 in.; pp. [illegible]

PROVIDENCE CITY PLAN COMMISSION. Reports, 1915-20—Providence, R. I.: The Commission. Paper; 6 x 9 in.; 98 illustrated.

REVIEW OF TEN YEARS' PROGRESS, 1910-20. By John [illegible] McCullough, M.D., Chief Officer, Ontario Board of [illegible]. Toronto. Paper; 7 x 10 in., pp. 18; illustrated.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Humanizing Engineering Societies

Sir—May I express my pleasure at reading the very refreshing words on page 346 of your issue of Sept. 1, under the caption "Honoring Honorary Members?" The concluding sentence correctly expresses a condition which should be changed, as it would be for the better, and more in keeping with the modern attitude toward others in all industrial concerns aiming at the best results. While the honor conferred in such cases is really mutual, it is no more than fair to the individual to make it marked by more than a plain statement of a vote recorded.

Recently in the Boston Society of Civil Engineers a member for some years on the honorary list was asked to address the society on his seventy-fifth anniversary, and there has lately been a feeling among the members that there should be a larger sense of responsibility toward the older members, who for various reasons find it difficult to maintain themselves after passing the age of seventy. In a large society it may be less easy to perform such acts of courtesy but it is certainly worth the trying.

There is no class of men on earth more friendly than engineers, when once the skin is pierced, but they sometimes require a little prodding to see the necessity for a change in program.

FREDERIC I. WINSLOW,
Consulting Engineer.

Framingham, Mass., Sept. 5.

## Am. Soc. C. E. Constitution Again

Sir—A careful reading of the revised constitution of the Am. Soc. C. E. will discover few sections that improve upon the old ones, some that will be much more cumbersome to administer, one that is either meaningless or unworkable, and one that appears to contravene the New York State law.

The provision for the allotment of funds to local sections, which is the chief concession to the twice-expressed wishes of a majority of the society's voters, proves to be permissive rather than mandatory, and therefore adds nothing to the powers of the Board of Direction which has now as much authority to allot funds to local sections as it has to pay traveling expenses to its own members.

Sections 9 and 10 of Article VII read in part:

"No count or listing of votes cast in any society canvass or election shall be permitted until after the polls are closed, and then only by the officially appointed committee of tellers. A voter may withdraw his ballot, and may substitute another at any time before the polls close."

"The polls shall close at 9 a.m. of the first day of the annual meeting," etc.

Just what does this mean? Is it intended that the ballots shall not be classified in any way as received? If so, how is a member's new vote to be substituted for his old one, and how long will it take the tellers to ascertain who of the voters are corporate members, and who of them are disqualified for non-payment of dues? If the votes be classified, is the information so obtained to be at the disposal of the secretary for the mutual advantage of himself and friends, or are all members to have equal access to it? Why was this substituted for the 25-year-old provision of the present constitution that, "The secretary shall make a list of the voters from whom ballots are received, which list shall be open to inspection by all corporate members?"

Judging from Article VII, of the revised constitution, the committee considered the nomination and election of officers to be the prime function of the society, for not only are the members required to vote three times for each officer elected, but it is prescribed that "Every corporate member is expected" to occupy himself diligently, from "Not later than April 1 of each year" until the annual meeting in the following January, in the accomplishment of this paramount object.

It seems to the writer that in the development of this elaborate and expensive scheme which could only be desirable in a social club where the members are mutually acquainted, the committee unwittingly introduced a "joker" with the eleventh-hour amendment which they added at the Houston convention.

In Section 4, of Article VII, it is provided that "No vote of a corporate member for a nominee for director resident outside of the district in which the member resides, shall be counted." Whatever the intent may have been, the language seems clearly to apply to all ballots for nominees which must include the final vote that elects the nominee to be an officer. It is the writer's understanding that the New York statute under which the society is incorporated requires that *all corporate members shall have the privilege of voting for all elective officers.* If the tellers are required by the constitution to cast out the votes of those members who do not happen to live within the same district as the nominee for director will not the above provision of the law be therefore nullified?

In view of the above uncertainties it seems to the writer to be the part of wisdom to stand by the constitution that has well served us in the past, and vote "'No" on the revision.

GARDNER S. WILLIAMS.

Ann Arbor, Mich., Aug. 27, 1921.

[Copy of Major Williams' communication was transmitted to Peter Junkersfeld, of Boston, on Aug. 30, with the following letter from the editor:

"We cannot again permit the internal bickerings in the American Society of Civil Engineers to occupy a great deal of valuable space in *Engineering News-Record* and to crowd out important material awaiting publication. We will publish Major Williams' letter, but will permit only one reply thereto. That reply must not be longer than the protesting letter, and, since we do not want any marathon list of signers, it may be signed by only one name. Since you were chairman of the committee which drafted the proposed constitution, we think it proper to give you opportunity to write the answer."

Col. Junkersfield answers that since the committee on referred amendments completed its work and was discharged at Houston he does not wish to write a reply. He suggests, however, that answers to the criticisms may be found in two communications to members by the acting secretary of the society on March 19 and Aug. 3, 1921, the former including the comments of the committee on referred amendments and the latter the legal opinion of Parker & Aaron, counsel for the society.—EDITOR.]

Sir—An editorial in your issue of Aug. 18, 1921, expresses the opinion that the proposed revision of the constitution of the American Society of Civil Engineers should be adopted by an overwhelming vote.

The adoption of this proposed revision will increase the expenses of the society certainly more than $10,000, and will reduce the available funds possibly more than $23,500 for the year 1922; this increase in expense and curtailment in revenue can only be avoided thereafter by subsequent amendments to the constitution.

This decrease in available funds will result from increases in expense due to extra meetings of the Board of Direction and the excess cost of the proposed over the present method of nominating and electing officers, and the decrease in revenue due to failure to provide for the payment of dues by "members resident outside of North America" and by associates. This will produce a deficit for the year 1922, unless the technical activities of the society are seriously curtailed and the money usually allotted for publications is materially reduced.

Article IV of the proposed revision contains no provision for the payment of dues by members residing outside of North America. There is no provision for the transfer of the present associates to the grade of affiliate; nor is

there any provision for the payment of dues by the present associates.

Dues are payable in advance on Jan. 1 of each year. If the proposed revision of the constitution is adopted it could not be amended before April, 1922. There will be on Jan. 1, 1922, about 600 members who are resident outside of North America who would thus not be required to pay dues aggregating about $12,000, and 175 associates who would thus not be required to pay dues aggregating about $3,000, which amounts the society could not legally collect.

Article VII provides for a cumbersome method of electing officers whereby the services of the clerical forces of the society would be required for a considerable portion of the period beginning Jan. 1 and ending at the annual meeting over one year later. This method would cost the society annually for the necessary clerical help, printing, postage, etc., at least $1,000 more than the method prescribed by the present constitution.

Article VIII makes mandatory provision for six meetings of the Board of Direction each year. By reason of expense to the society and time required for western members to attend its meetings, the Board of Direction has usually met four times each year; and it is proposed to reduce these meetings to three each year. The cost of three meetings of the board for mileage of its members would be about $7,500; in addition there would be the extra cost of arranging for these meetings, of multigraphing and distributing the minutes of the meetings, and other necessary expenses.

The society would face a serious financial burden in the adoption of the proposed revision of the constitution, even should a large proportion of the members resident outside of North America and of the associates waive the absence of a constitutional obligation and pay their dues.

It would be reasonably certain, should the constitution be revised as proposed, and the revenue thereby decreased, that the technical activities of the society would need to be seriously curtailed and the allotment of funds to local sections indefinitely postponed, otherwise, unless the dues of members are raised to provide the necessary funds, there would be a deficit in the finances of the society.

The question naturally arises, "Does the society really need a revision of its present constitution at the expense of its technical activities and the stimulation of its local sections, and, are the debatable benefits of the proposed revision worth the increase in expenses involved?"

The society can function under its present constitution until a proper revision, which does not involve a large and unnecessary financial burden to the society, can be submitted.

There are other serious objections to fundamental provisions in the proposed revision but by reason of the above facts alone the writer is opposed to the adoption of the proposed revision of the constitution and will vote "No" on the ballot to be canvassed on Oct. 5, 1921.

Philadelphia, Sept. 2, 1921. RICHARD L. HUMPHREY.

[As in the case of Major Williams' letter only one reply to this communication will be printed. This letter also was submitted to Col. Junkersfeld, but he preferred not to engage in controversy.—EDITOR.]

## How Can a Coral Strand Be Made Into a Bathing Beach?

Sir: We are interested in securing information on the formation of artifical bathing beaches. A portion of the shore line in question provides a fair bathing beach facing the Atlantic on the north shore of Porto Rico. Certain sections, however, directly in front of park property, are studded with coral rocks.

Information as to whether the dynamiting and removal of this coral rock would enable the natural formation of a bathing beach will be very greatly appreciated. We would particularly like to know from any of the contributors of the *Engineering News-Record* whether this has been done elsewhere and with what results.

W. CRYDER,
Gen. Supt. Ltg. Div.,
Porto Rico Railway Light & Power Co.
San Juan, P. R. Aug. 19.

## Reasons for High Freight Rates on Brick

Sir:—The correspondence in the *Engineering News-Record*, Aug. 4, p. 205, from T. C. Powell, vice-president of the Erie R.R., and R. P. Stoddard, secretary-manager of the Common Brick Manufacturers Association, with reference to "Freight Rates as a Deterrent to Construction," has just come to my attention. Mr. Stoddard's letter confirms previous information to the effect that brick for building construction in the larger cities throughout the country are handled by rail but comparatively short distances from brick yards to city delivery tracks, perhaps five to ten miles, less frequently more, and in some cases from brick yards adjoining or inside the city limits.

High freight rates for this and similar commodities are justified by the fact that this traffic moves but short distances, and is handled over tracks and facilities in large congested cities, making the cost to handle enormously high. In many cities railroads have cost to exceed $1,000,000 a mile; costs up to $5,000,000 and more per mile of road are frequent, not including those portions used almost exclusively for passenger traffic. The Chicago, Milwaukee & St. Paul Ry. is now contesting the demand of a northwestern city for a plan of grade separation which would cost, in addition to the present high cost of the property, more than $12,000,000 for less than two miles of road, the principal traffic over which is freight. The ground area, track and driveways necessarily used for setting out but one car to be unloaded in a team yard will, in many cities, represent a value of $30,000, and not infrequently values as high as $75,000, or even $100,000. On many first-class railroads traffic from brick yards, gravel pits and stone crusher plants could be moved a hundred miles or more in a direction away from the city over tracks and other facilities, the cost of which would not be as great as that for one mile into the city.

The cost of handling freight in the busy and congested terminals of large cities is very great, many times more than for an equal distance in the country, and doubtless in many cases it costs as much time and money to handle a car one mile within the limits of a city railroad terminal as would be required to move it over an entire operating division. There are many reasons for this, the principal ones being the congestion of business, the short and slow movements, and the complications of classifying and bunching the business. There are doubtless many instances in which brick can be trucked thirty to fifty miles from the plant in less time and with less cost than would be involved in moving it one mile from the railroad team track in the city to the building site. Conditions which bring this about are fundamentally similar to those with which the railroads are confronted in moving traffic through the congested and complicated rail thoroughfares of a large city.

Should not freight rates for commodities moved short distances, requiring the use of expensive facilities and difficult and costly transportation service, bear some relation to the cost of the investment necessary for making the transportation possible? If bricks were made on the Island of Manhattan, or near the public square in Cleveland or the loop in Chicago, their cost would be very much increased; for very much the same reasons rail transportation costs in and through large cities must necessarily be very large. The Common Brick Manufacturers Association, as well as others, doubtless quite willingly pay a very much larger price for maintaining an office in Cleveland than would be paid in some small town, conceding the reasonableness of higher office expenses in the large city than in the small one. The same reasoning, I think, applies to the operations performed and the facilities furnished by a railroad in handling freight in the heart of a large city, especially such comparatively cheap, bulky and short-haul materials as common brick, sand and stone.

The facts are that freight rates, and passenger fares as well, have never sufficiently, if at all, taken into account the extraordinarily high investment and operating costs in large city terminals. C. F. LOWETH,
Chief Engineer, Chicago, Milwaukee & St. Paul Ry.
Aug. 27

# HINTS FOR THE CONTRACTOR

## Home-Made Road-Oil Heating Outfit for Small Patching Jobs

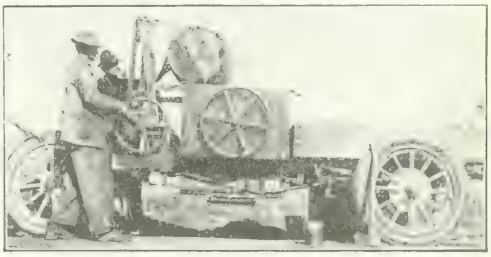
CONVENIENT outfits for making road repairs that require comparatively small quantities of hot oil are built in the division repair shops of the California Highway Commission and used wherever the work is not extensive enough to warrant a large road oiler. Mounted on a trailer, with a little space for tools, materials, etc., the outfit is self-contained and can be hauled by motor truck from one point to another. Some divisions use several such devices. While the endeavor is to use standard parts, so that only assembly work is required in building up the units, each division uses whatever can be adapted to this service in the most economical way. The essential features in any of the outfits are an oil tank with heater and hand pump attachments by means of which hot oil is delivered through a hose to a hand spraying nozzle. The more common type consists of a patching outfit mounted on a steel-wheel orchard trailer.

The trailer in the accompanying illustration was made up chiefly with parts salvaged from a wrecked automobile. The chassis was reconstructed with a

OUTFIT WITH COVER ON READY FOR SERVICE

gooseneck at the front made of 1 x 4-in. iron riveted to the frame. One-inch truss rods and turnbuckles were put on to strengthen the frame; a fifth-wheel was applied to permit of short-radius turning and to reduce the rocking motion; the new front axle was made of square steel, 2½ in. thick and 3 ft. long, turned to fit. The oil-handling and heating equipment includes an electrically-welded 130-gal. kettle, rectangular in plan and semicircular in elevation, which rests in a firebox frame of 2-in. angle-iron sheathed with 16-gage sheet iron. The kettle is heated by two kerosene burners which preheat the fuel and then spray it from the burner under a pressure of 15 lb. per square inch. The fuel tank contains 6 gal. and is equipped with hand pump and gage to secure the desired pressure. Inside the kettle a rotary pump is bolted to one end near the bottom. This arrangement, which keeps the pump immersed, avoids the necessity for heating it separately. The pump is operated by a 24-in. handwheel, outside. The kettle dimensions are such as to accommodate the standard 110-gal. oil drum which is rolled up on skids and into position over the kettle by means of the hand windlass mounted on the trailer frame. While the windlass holds the drum over the kettle the skids are replaced by cradle channels equipped with rollers on which the drum can be turned to replenish the oil in the kettle. These channels are set at a height such that about one-third the diameter of the drum is submerged when the oil in the kettle is at its highest level. A sheet-iron, semi-cylindrical cover fits over kettle and drum to prevent the escape of heat.

Sometimes asphalt which is a solid at ordinary temperature is delivered in wood barrels instead of in the metal drums. The barrels are handled the same as the drums except that the entire contents of a wood barrel is put into the kettle at once. The heads, and ordinarily the wood staves also, are removed before lowering into the kettle. A strainer protects the pump from chips and other foreign matter. The pump delivers to a 16-ft. length of 1-in. armored hose terminating in a pipe about 4 ft. long, encased in wood so the operator can handle it while oil is being delivered at a temperature of about 300 deg. F. Several types of nozzles are used. Any type that delivers a fan-shaped spray and can be controlled by means of a wire running back to a lever on the wooden handle is suitable. The



LOWERING BARREL OF ASPHALT INTO KETTLE

material ordinarily used is asphaltic road oil or grade D or E asphalt.

This outfit cost only $477, because very little special equipment had to be purchased for it. After being in service over eight months, engineers of the highway commission, of which Austin B. Fletcher is chief engineer, report it to be satisfactory.

## Records in Shaft Sinking

A mine shaft sunk 310 ft. in 31 days is believed to be the world's record in shaft sinking per month. This was done by the Crown Mines Co., of Johannesburg, South Africa, in July, 1919, but a very close second is 30[illegible] ft. in the same time by the Van Dyke Copper Co., of Miami, Ariz., in 1920. The previous record had been 279 ft., by the Crown Mines Co. In May, 1920, on the basis of the Van Dyke shaft work, the *Engineering and Mining Journal* offered a gold medal to the crew which should break the record (see *Engineering News-Record*, June 10, 1920, p. 1174). In its issue of May 21, 1921, the *Engineering and Mining Journal* described in detail the work on the Van Dyke shaft and announced that no higher record had been reported.

# NEWS OF THE WEEK

New York, September 15, 1921

## Terrific Rainfall Causes Floods in Texas

### 24-Hr. Fall of 10 to 24 In. in Central Counties, but Worst Damage in San Antonio with 7-In. Fall

RECORD-BREAKING rainfalls throughout central and southern Texas on Sept. 8 to 10 caused floods on practically all the rivers there, with resulting great damage in the smaller streams, particularly at San Antonio, where three creeks run through the business and residential sections. The rainfall is reported to *Engineering News-Record* by B. Bunnemeyer, meteorologist, U. S. Weather Bureau, Houston, as follows:

"The torrential rains in the central area of Texas covered Travis, Williamson, Milam and Bell Counties. Austin reported 18.25 in. for 24 hr. ending 7 a.m., Sept. 10; Taylor, 23.63 in.; Georgetown, 11.30 in.; Cameron, 11.45 in., and Temple, 11 in. Surrounding sections reported much less, San Antonio leading with 3.48 in., but it had 3.36 in. during the preceding 24 hr. ending 7 a.m., Sept. 9. Low places, creeks and smaller streams became rapidly flooded, causing loss of life and great damage to crops, bridges, highways and other property, but the large streams were less seriously affected, due to previous low water and comparatively small areas with excessive rains."

Some confusion exists as to the period in which the maximum rainfall took place. Weather Bureau headquarters at Washington reports it as from "36 to 48 hr." but Fred Morris, observer at Austin, wires, "Total rainfall 3 a.m. Sept. 9 to 3 a.m. Sept. 10 was 19.03 in. Greater part of this fell during last six hours."

#### San Antonio Flood

From Terrell Bartlett, of Bartlett & Ranney, consulting engineers, San Antonio, the following telegraphic statement of the flood conditions in that city was received on Sept. 13:

"A severe rain falling on the night of Sept. 8 and until midnight Sept. 9 on several watersheds above the city of San Antonio caused unprecedented flood heights in the valley of the San Antonio River and in San Pedro and Alazan Creeks, all three traversing the city. No high winds accompanied the rain. Loss of life does not exceed seventy-five, confined almost entirely to Mexicans resident in the low areas along the creeks. Property damage is estimated at $5,000,000, which includes $500,000 to city pavements and bridges, $3,000,000 to merchandise in flooded basements and first floors, and balance in damaged store windows and frame residences. No modern buildings or structures were injured except one concrete girder bridge across the river, which was wrecked by scour undermining the foundations. Several timber bridges had floors washed away and timber floors on steel truss bridges were misplaced. Two-thirds of the flooded wood block pavements laid in 1914 floated off. Both waterworks pumping plants were flooded, but practically all the city was given continuous low pressure service direct from artesian wells. High pressure was resumed within 36 hr. Lights and street car service were entirely interrupted for 24 hr., but almost fully resumed within two days.

"The rain commenced Thursday night, Sept. 8, and continued at intervals through Friday with heaviest fall north of the city early Friday night. The total for the storm at U. S. Weather Bureau in San Antonio is slightly over 7 in. The average for the 40-square-mile watershed of the San Antonio River and dry tributary Olmus Creek was probably 11 in.

"The flood broke the river banks at the north limits of the city about 10 p.m., flooding Brackenridge Park and the residence districts adjacent and below. About midnight the river overflowed its channel immediately above the business district, reaching its crest in center of the city two hours later. Almost the entire center of the business district was inundated. Water in the river, which winds through the business district, reached a height of 2 to 8 ft. above bridge floors, with a maximum depth of 7 ft. in lobby of one of the leading hotels. It discharged south across Houston St. in seven swift channels at as many streets, besides flowing in the river. The depth at St. Mary's St. was 12 ft. It discharged also to the west for 2,000 ft. north of Houston St. over a low divide into San Pedro Creek. The inundated business district measured two-thirds by one-half mile, the residence district in the river valley one-half by two miles above the center of the city and one-half by three-quarters miles below.

"This flood exceeds all others since Spanish records of 1819, when the town was inundated to 5 ft. greater depth than current flood. As a result of an 8,000 sec.-ft. flood in 1913-14 the city last year had a report prepared on flood prevention. This current flood discharge, about 20,000 sec.-ft. or more, will probably result in prompt construction of channels or reservoirs."

## Bridge Accident at Chester Causes 24 Deaths

### Sidewalk Bracket Falls Under Weight of Crowd When Cracket Gusset Plate Tears Apart

A crowd massed on the sidewalk o the Third St. bridge over the Cheste River at Chester, Pa., on the evenin of Sept. 10 to watch attempts at res cuing a boy from the water was throw into the river by the breaking of a de fective sidewalk bracket, and 24 peopl were drowned. The structure itself, half-through plate-girder bridge abou 70 ft. in span, had its sidewalk su ported by 12-ft. brackets cantileverin out from the girders, each bracket b ing about 3 ft. deep at the inner edg and attached to double stiffener angl of the plate girder by gusset plates top and bottom. The brackets we spaced about 12 ft. apart. They we made of angle chords with a web sy tem of four panels in the 12-ft. lengt The upper attachment gusset of one these brackets tore apart, allowing t bottom chord of the bracket to bend its first panel point under the weig of the crowd. As the sidewalk tipp down, some seventy-five persons we thrown into the water.

#### Gusset Plate Examined

Examination of the ruptured guss plate of the bracket showed that it h torn off along the outer edge of t plate girder stiffeners, and that t upper part of the fracture was an o crack. The connection was of inferi design, moreover. The gusset w about 15 in. deep and 15 to 18 in. lo horizontally, by ⅜ in. thick. It w riveted to the top chord of the brack but bolted, with five bolts, to the gird stiffeners; the corresponding plates the other brackets, however, were ri eted. The upper edge of the plate w flush with the top chord of the brack so that the pull was not central. T plate appears to be of wrought ir moreover, and to have its rolling gra running vertical. The bridge was bu by Cofrode & Saylor in 1886, probab with the gusset in question.

For a distance of about 8 in. do from the top, the broken edge of t plate shows by a rusty surface th an old crack existed in the line of t fracture, and that the crack work downward progressively. It has be suggested that the bracket had be damaged by a colliding vessel a numb of years ago, and had been remov for repair, the plate probably bei straightened cold without removing from the bracket angle, and the brack being then replaced and attached bolts instead of the original rive

## Water Rate Increased 20 Per Cent in San Francisco

**Railroad Commission Plans Connection Between Spring Valley and Hetch Hetchy Systems**

"In order to provide an adequate water supply for San Francisco, pending the completion of the Hetch Hetchy project," the California Railroad Commission, as a part of its decision in the Spring Valley Water Co. rate case, presents a plan for a co-operative agreement between the city and the company under which the company would provide more water and the city would build a portion of the Hetch Hetchy conduit and rent it to the company. The company is allowed a 20-per cent increase in the present water rates, which are the same as they were before the war. Certain expenditures by the company are ordered and terms are prescribed for a possible later purchase of the utility by the city. The joint program answers the city's protest against authorizing the company to make large expenditures that would duplicate work proposed by the city for later construction in completing the Hetch Hetchy project. The co-operative arrangement was to become effective Sept. 1 and to continue until Jan. 1, 1932.

Subsequent to the failure on March 7 of San Francisco voters to approve the purchase of Spring Valley properties (*Engineering News-Record*, March 17, p. 483), the company applied for a 15-per cent rate increase. The railroad commission rules that an increase of 20 per cent is necessary to maintain the company's credit, enable it to carry out certain necessary improvements and provide a fair return on its investment.

CALAVERAS RESERVOIR ENLARGEMENT

The commission directs the company to enlarge the Calaveras reservoir so as to add 24,000,000 gal. to the present daily supply. The proposed expenditure of $1,500,000 is conditioned on the construction by the city of the section of the proposed Hetch Hetchy conduit from the Niles screen tank on Alameda Creek to Crystal Springs reservoir in San Mateo County. For the use of this conduit the company is to pay the city not more than $250,000 per annum and is to bear all operating expenses during the life of the co-operative arrangement. Under this arrangement the conduit which the city would be required to build can be located so it will be of maximum service in the ultimate completion of the Hetch Hetchy project. Until it is required for that purpose interest on the investment will be covered by the rental which the private company is to pay for its use. The suggestion that the joint use of such a conduit might be arranged came from city officials.

To protect the city in case it should buy the Spring Valley system, the commission requires the company to sell to the city during the life of the co-operative plan at the $37,000,000 valuation fixed by the commission in November, 1920, plus additions and betterments. The commission's order also requires the company to create a special fund for the amortization of the Calaveras dam expenditures, this fund to be transferred to the city in the event that the utility's properties are purchased.

## San Francisco Bay Bridge Hearing Authorized

A public hearing before representatives of the War Department on the projected bridge across San Francisco Bay has been authorized, according to an announcement made Sept. 3 by Col. Herbert Deakyne, Corps of Engineers, U. S. A., who is stationed at San Francisco. The date for the hearing has been tentatively set for Oct. 7.

In preliminary discussions of the matter Col. Deakyne is quoted as having said that before any plans will be approved they must show provision for "a suitable channel for the free passage of vessels and permit of the free flow of the tides from one part of the bay to the other."

## Course to Train Personnel for Industrial Publishing

*Inauguration on a large scale this fall of a course in industrial publishing, covering the editorial, business and service activities of the field, is announced by the New York Business Publishers Association, Inc., of which "Engineering News-Record" and the other ten engineering papers of the McGraw-Hill Co., are members. The training, which is open to members of the staffs of business and technical publications, as well as to others desiring to engage in this line of work, is designed to develop new personnel and to raise the standards of the industrial publishing business generally.*

*The entire course will last eight or nine months and will combine home study and weekly class meetings. The Business Training Corp. has been engaged to prepare the educational material for the course and to organize and direct the instruction staff. In this work it will be assisted by a co-operating staff of forty publishers, editors, business managers and service department managers. The instruction staff will be headed by Prof. Henry H. Norris, managing editor of the "Electric Railway Journal" and formerly on the faculty of the department of electrical engineering at Cornell University.*

*Further details regarding the course may be obtained by addressing The Secretary of the Course in Industrial Publishing, 185 Madison Ave., New York City.*

## Studies of Chinese Canal Improvement Completed

**T. H. Wiggin, American Engineer, Returns to U. S. After Two Years' Work in Orient**

After spending two years in China on surveys, reports and estimates for the improvement of the Grand Canal, Thomas H. Wiggin, formerly principal designing engineer of the Catskill aqueduct for the Board of Water Supply of New York City, and lieutenant-colonel of Engineers with the A. E. F. in France during the World War, has returned to this country after completing the preliminary studies for the projected waterway improvement and land reclamation, largely in the Province of Shantung. Further progress in the way of actual construction must await a decision as to the financing of the project, which, it is understood, is now under consideration. The concession for the Chinese work is held by the Siems-Carey Railway & Canal Co., working in co-operation with the American International Corporation. John R. Freeman acted as consulting engineer and Joseph Ripley as chief engineer of the Grand Canal Improvement Board.

Mr. Wiggin left the United States for China in August, 1919, and after Mr. Ripley had returned to this country at the end of the year, Mr. Wiggin assumed his duties as acting chief engineer of the board, with headquarters at Tientsin.

SURVEYS IN SHANTUNG

The bulk of the survey work, according to Mr. Wiggin, was carried on in Shantung and involved about 220 miles of the Grand Canal where it is necessary to modernize existing locks and improve the waterway which had been damaged by floods of the Yellow River and other streams in the province. The engineering staff consisted of a field and office force, consisting principally of Chinese, with an American engineer in charge of each subdivision of the work. To his work with the Grand Canal Improvement Board Mr. Wiggin brought an extensive experience in water supply and hydraulic engineering in this country and in France, where he served two years with the American Expeditionary Forces as chief of the water supply section of the Division of Construction and Forestry, which had general charge of all water-supply projects in the area of the Services of Supply, extending from the base ports to the army zone.

In addition to the preparation of designs for locks and river control works, and various reports and estimates of cost, Mr. Wiggin served in an engineering advisory capacity on two other projects, the first, a water supply for the city of Amoy with a population of about 200,000, and the second an irrigation project for the Province of Shansi, the latter in connection with work of famine prevention. At the instance of Chang Chien, director general of the Grand Canal Bureau of the Province of

Kiangsu, Mr. Wiggin made an inspection and report on canal improvements in that territory.

Pending the financing of the Grand Canal improvement work, the engineering staff which Mr. Wiggin headed has been practically disbanded.

## Month's Advance of 591 Ft. Made in Shandaken Tunnel Heading

Excavation of the 18-mile Shandaken tunnel of the Catskill aqueduct, for the additional water supply of New York City, is progressing both north and south from six shafts, and in five of the twelve headings permanent roof support is required. During the month of August, 5,030 lin.ft. of completed tunnel, about 12 ft. wide and 14 ft. high, was excavated, the maximum progress being in the north heading at shaft 3, where 591 lin.ft. was excavated with two drilling and two mucking shifts. The excavation amounts to about 6 cu.yd. per linear foot of tunnel. The average pull per shot in this heading was 10.2 lin.ft. and the average pull per shot for the month throughout the entire tunnel was 8.95 lin.ft.

The tunnel, which is being driven under the direction of the Board of Water Supply of the City of New York, will carry water from the Schoharie River underneath the intervening Catskill Hills into the Ashokan reservoir, within the Esopus watershed, making it thus available for draft through the Catskill aqueduct. Work is being carried on under contract by the Shandaken Tunnel Corp., the active agents being the Ulen Contracting Corp., for which Thomas S. Shepperd is general manager, with headquarters at Allaben, N. Y.

## Cave Creek Flood Does Damage at Phoenix

On the night of the 21st of August, a strip of the western portion of Phoenix, Ariz., from 2 to 10 bocks wide, was flooded by water originating in Cave Creek. No lives were lost and the principal damage in the city was to the state capitol, where water stood about 2½ ft. deep on the first floor. Considerable damage was done to private residences. Ranchers living to the north suffered considerable damage to cattle and crops. L. B. Hitchcock, city engineer of Phoenix, describes the development of the flood as follows:

Cave Creek has a drainage area of 200 sq.mi., and from a point about 12 miles north of Phoenix has no defined channel. The waters of average rains spread over a delta and find their way through the Salt River Valley Water Users' Association canals to the Salt and Gila Rivers. In cases of severe rain it has not been unusual for the water to break through the canals and to flood a wide area.

A heavy precipitation occurred on the 19th, which Cave Creek took care of without serious damage. However, in the night of the 20th and early morning of the 21st there was a much heavier precipitation, and, the ground being saturated, an unusually heavy runoff took place. The flood waters broke over the Arizona Canal, which has a flood capacity of 800 sec.-ft., 8 miles from Phoenix and reached their peak 3 p.m. of the 21st with a flow estimated at 25,000 sec.-ft., receding gradually until 5 p.m., when the flow ceased. At 4 p.m. the water overflowed the Grand Canal, which is parallel to and 5 mi. south of the Arizona Canal. This canal has a flood capacity of 600 sec.-ft. The flood reached Phoenix about 7:30, and reached its peak there at 10 p.m., receding by the following morning.

It is estimated that the property damage in Phoenix is $300,000.

The city had voted bonds for $100,000, which was to be supplemented by amounts from the county of Maricopa, the state, the Salt River Valley Water Users' Association and other interests, to an aggregate of $400,000, for protection against Cave Creek floods. The work had not been begun, pending completion of financial arrangements.

## Fix Height of Rimrock Dam

The exact height of the Teiton dam at Rimrock, near Yakima, Wash., has been determined. The recent conference of government engineers, it is reported, decided that excavations for the corewall underneath the stream bed had reached bed rock firm enough to be tied into and concrete is being poured now 95 ft. below the bed of the river. The crest of the dam will be 222 ft. above the bed of the river, making the distance from the bottom of the corewall to the crest of the dam about 317 ft.

## High Rate of Progress Made in Hetch Hetchy Tunnel

A heading advance of 776 ft. in a month was accomplished during August at Priest Portal heading of the Hetch Hetchy aqueduct tunnel of the new San Francisco water supply. The heading passed through altered slate and schist. Eight headings are being worked, and their advance during August ranged from 273 ft. to the Priest figure; the average for the eight was 436 ft. The Construction Co. of North America, contractor, gives the record of the month's work in the table above.

HETCH HETCHY TUNNEL PROGRESS FOR AUGUST, 1921

| Heading | Tunnel Section Ft | In. | Rock | Holes per Round | Superintendent | Shifts Worked | Progress During Month, Feet | Total Progress to Date Feet |
|---|---|---|---|---|---|---|---|---|
| Intake | 13 | 8 | Monolithic granite | 45 48 | Johnson | 62 | 273 | 7,179 |
| South Fork E. | 13 | 8 | Monolithic granite | 45 | Seterson | 62 | 424 | 7,020 |
| South Fork W. | 13 | 8 | Monolithic granite | 48 | Seterson | 62 | 477 | 2,795 |
| Adit 5-6 E... | 13 | 8 | Granodiorite | 38 | Gallagher | 62 | 300 | 1,017 |
| Adit 5-6 W. | 13 | 8 | Diorite | 34 | Gallagher | 93 | 436 | 1,070 |
| Big Creek E. | 11 | 3 | Diorite | 25 | Fowler | 62 | 414 | 3,125 |
| Big Creek W... | 11 | 3 | Diorite | 25 | Fowler | 62 | 420 | 4,117 |
| Priest | 11 | 3 | Altered slate and schist | 25 | Hickman | 93 | 776 | 11,130 |
| | | | | | | | 3,490 | 37,453 |

## Port Problems Discussed by Civil Engineers

The three-session meeting on "National Port Problems" of the American Society of Civil Engineers was held according to schedule in New York on Sept. 7 and 8. The papers announced in the advance notice reprinted in this journal, Sept. 1, p. 380, were all delivered. Many of them were excellent expositions of certain phases of the port problem. Viewed as an economic and political question, but little of constructive value developed. The discussion was perfunctory.

The following resolution, offered by Col. W. J. Wilgus, was passed:

"Resolved: That it is the sense of this meeting that the proper future planning of our seaports is of national concern from the standpoints both of commerce and of military protection, and that the Board of Direction be requested to urge upon the Secretary of War, if possible in co-operation with the other national engineering societies, the need for prompt and effective action to that end, under the provisions of Section 500 of the Transportation Act of 1920."

## All Cross-Connections at Hartford To Go by Jan. 1

An extension of time to Jan. 1, 1922, for the severance of all cross-connections between the water-works of Hartford, Conn., and private supplies for industrial and fire protection purposes has been granted by the Board of Water Commissioners. (See abstract of report by the George W. Goethals Corp p. 409 of last week's issue.) It is understood that the manufacturers will now co-operate in abolishing the remaining cross-connections with polluted supplies of which there were originally 13 protected by double check valves. C. M. Saville is engineer and manager of the Hartford Water Board.

## Road Materials Survey to be Made in Colorado

By co-operation between the Colorado State Highway Commission and the State Agricultural College a survey is to be made of road materials. Deposits suitable for road making are to be located and mapped as to extent. Samples will be collected and sent to the road materials laboratory of the college.

## Two Bids for Boston Garbage and Refuse Disposal

Two bids were received Sept. 7 for the disposal of the garbage and refuse of Boston for the ten years beginning July 1, 1922. The Boston Development & Sanitary Co., the present contractor for this work, made a total bid of $4,202,000, based on a yearly price declining from $436,000 a year at the start to $402,000 for the last full year and a rate of $400,000 a year for the final half year. Coleman Bros., Inc., bid a total of $3,795,000 at a uniform yearly rate, but with deductions from this price ranging from $350,000 to $745,000 if some one of four modifications of the basic bid were adopted. These deductions were: $350,000 if allowed to establish a hog farm on Spectacle Island where the disposal plant is located; $100,000 if the city purchases the present disposal plant, belonging to the Boston Development & Sanitary Co. (the other bidder); $450,000 if both the first two modifications were permitted, and $745,000 if the city would allow the garbage of Dorchester, the South end and Charlestown to be received at railroad sidings located in those districts and shipped to outlying sections for sale to farmers as hog food.

A report on the bids will be made by Thomas F. Sullivan, commissioner of public works, for final action by the city council in the award of the contract.

The specifications under which the bids were received were drafted by a special garbage committee appointed by the mayor. Dr. W. C. Woodward, health commissioner of Boston, was chairman of the committee. The contract price for the 10-year period ending July 1, 1922, is $1,402,000, on a sliding scale which makes the price for the present year $156,000 and for the final half year at the rate of $160,000 a year.

## Complete Reconstruction of Tehachapi Tunnels

The Southern Pacific R.R. has just completed the 5-year job of enlarging and lining with concrete the tunnels on its line over the Tehachapi mountains in California. The cost of the work in these tunnels has been about $1,000,000 and it has been carried out without delay to trains, despite the fact that the 8 miles of track between Bakersfield and Tehachapi, according to Southern Pacific officials, is the busiest single-track line in the United States. This track serves as a main trunk line for both the Southern Pacific and the Santa Fe systems.

Prior to 1916 the eighteen tunnels on the Tehachapi grade were all of small bore and were lined with timber, except for about 1,000 ft. which was in solid rock. It was then decided that repair and enlargement were necessary and concrete lined tunnels with a minimum width of 16 ft. on tangent and 17 ft. on curves and an overhead clearance of 22 ft. were decided upon. In the reconstruction two of the tunnels were eliminated by relocation, and the others have been enlarged and concreted by methods described in *Engineering News-Record* July 28, p. 134.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

**The Engineering Society of Western Massachusetts**, Springfield, will hold an inspection Sept. 13, of the new highway bridge now being built for the County of Hampden across the Connecticut River between Springfield and West Springfield.

**The Wisconsin State Drainage Association** will hold its summer meeting in St. Paul, Minn., Sept. 22-24.

**The Technical Club of Dallas** (Tex.), at its meeting Aug. 29 which was adressed by Dr. J. F. Kimball, superintendent of the Dallas Schools, indorsed the "Go to School Movement" and indicated its interest in civic affairs by offering to assist the Junior Chamber of Commerce to put Dallas in the lead in scholastic attendance.

# Personal Notes

C. C. Cottrell has resigned as state highway engineer of Nevada to become manager of the good roads bureau of the California State Automobile Association. After attending the University of Nebraska for 2½ years he became assistant to the Surveyor of Nemaha County, Neb., in 1904 and from that time on engaged in road and irrigation work in the West From 1913 to 1917 he was superintendent of construction and maintenance on the San Francisco division of the California Highway Commission. He went to Nevada as assistant state highway engineer in 1917 and the following year became state highway engineer.

George W. Borden, assistant state highway engineer of Nevada, has been named acting state highway engineer, following the resignation of C. C. Cottrell.

C. V. Conner, formerly designing engineering inspector with the Delaware State Highway Department, has been appointed assistant engineer with the North Carolina Highway Commission on the design and general field inspection of bridges and hard surface pavements.

H. C. Lee, formerly connected with the engineering departments of the Philadelphia & Reading Ry. and the American Bridge Co., will, after visiting some of the engineering structures in the United States and Canada, return to China, his native country, to become connected with the Chinese Government Rys.

T. J. Wyche, formerly chief engineer, Western Pacific R.R., has been appointed consulting engineer, with headquarters in San Francisco.

Arthur H. Niles, formerly assistant city engineer of Jackson, Mich., has been appointed city engineer of Sturgis, Mich.

George W. Burpee, formerly managing engineer, Westinghouse, Church, Kerr & Co., and since the merger of that company with Dwight P. Robinson & Co., managing engineer of the latter, has severed his connection with the Robinson organization and has joined the staff of Coverdale & Colpitts, consulting engineers, of New York, specializing in engineering investigations and reports.

G. M. Braune, professor of civil engineering, University of Cincinnati, has resigned to become head of the civil engineering department of the University of North Carolina. He has been connected with the University of Cincinnati since 1912. For 5 years he was engineer with the Southern Bridge Co., Birmingham, Ala., and was later connected with the New York State Barge Canal, part of this time as assistant chief bridge designer.

B. E. Clark, acting state engineer and also acting state highway commissioner of Oklahoma, has been appointed state highway commissioner.

Louis A. Guepel has been appointed sanitary engineer in charge of the Indiana state water and sewage laboratories, succeeding John C. Diggs, who has been transferred to the State Conservation Department.

A. L. Luedke, engineer-economist, U. S. Bureau of Public Roads, Washington, D. C. and formerly assistant to the director of the bureau, has been transferred to St. Paul, Minn. (district 4) reporting to E. O. Hathaway, district engineer.

H. G. Shulde, formerly acting district engineer, district 18, Pennsylvania State Highway Department, with headquarters at Bedford, Pa., has been appointed district engineer, with headquarters at Sunbury, Pa., of district 3, which includes the counties of Columbia, Montour, Northumberland. Sullivan, Snyder and Union.

Col. William Barclay Parsons, consulting engineer, New York City, who was in command of the Eleventh Engineers in France during the latter part of the World War, has been assigned the command of a service engineers' regiment in organ-

ized reserves of the Second Corps Area with headquarters at Governors Island, comprising the States of New York, New Jersey and Delaware.

PAUL BAILEY has been made chief deputy to W. F. McClure, state engineer of California. Mr. Bailey has been in the engineering department of the state water commission for a number of years and under the recent reorganization was made assistant chief of the division of water rights of the state department of public works. In his present position he will still be in the department of public works, as the state engineer's office is now a branch of that department.

G. H. HICKS has been appointed acting chief engineer of the Northwestern Pacific R. R., succeeding J. W. Williams who recently resigned to become chief engineer of the Western Pacific R. R. He has been in the employ of the Northwestern Pacific since 1912, and since September, 1919 has been principal assistant engineer.

U. S. STEPHENS has been appointed county engineer and road superintendent, Runnels County, Tex., to have charge of all road work.

F. A. JONES, formerly supervisor of track, sub-division 1, Boston & Albany R.R., with headquarters at South Station, Boston, has been appointed assistant supervisor of bridges and buildings, Albany division, with headquarters at Springfield, Mass.

V. H. CARTER, formerly chief designing engineer, has been appointed acting harbor engineer in charge of port development, maintenance and reclamation for the Port of Oakland, California.

WILLIAM L. REEVES, formerly a city commissioner of Pasadena, Cal., has been appointed city manager of Glendale, Cal.

## OBITUARY

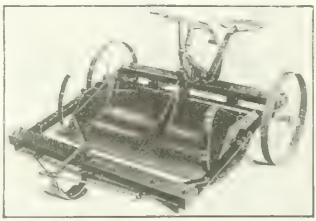
JOHN McMULLEN, president, until February of this year, of the Atlantic Gulf & Pacific Co., and founder of that organization, died in South Norwalk, Conn., Sept. 29, at the age of 73. He organized the San Francisco Bridge Co. and the Puget Sound Bridge & Dredging Co., which were combined in 1899 to form the Atlantic Gulf & Pacific organization. Mr. McMullen was a graduate of St. Charles College, Baltimore, Md., and his early work was in the general contracting field.

CHARLES R. LARKIN, assistant engineer, Bureau of Health, Philadelphia, Pa., died Aug. 30. He was born in Philadelphia in 1881 and received the degree of B.S. and C.E., Villanova College, in 1914. From 1914 to 1916 he was highway engineer with the Union Paving Co., Philadelphia, and since 1916 has been with the Bureau of Health.

## NEW EQUIPMENT AND MATERIALS

### New Wheel Scraper

A wheel scraper, with a body resembling a Fresno in shape and action, is being built by the Miskin Scraper Works, Ucon, Idaho. This scraper is made in several sizes for operation by two, three or four-horse teams or by

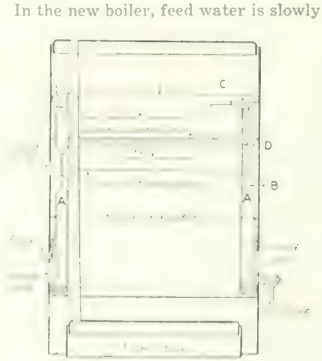


tractors. It is dumped by a foot trip and can be adjusted to discharge the load in a pile or to spread it in a thin layer. Being without a tongue it can be turned in a short radius. While developed particularly for grading land for irrigation the new scraper has been employed successfully for nearly two years on road work in Bingham County, Idaho.

### Scale-Proof Crane Boiler

What is termed a scale-proof locomotive-crane boiler, equipped with an annular scale chamber placed between the tubes and the shell plate of the boiler, is being manufactured by the Industrial Works of Bay City, Mich., builders of "Industrial" locomotives and cranes.

In the new boiler, feed water is slowly



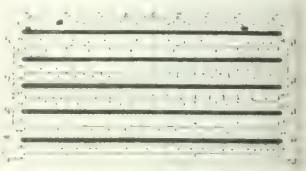

passed through this scale chamber at about 1 200 of the speed through the intake pipe, and attains a temperature at which the scale-forming impurities will be liberated from solution without the use of any chemicals. As the movement of the water is very slow, the precipitates settle to the bottom of the chamber.

The purifier consists of the annular scale chamber *A* with a 1-in. water space *B* between this chamber and the boiler shell. The outlet into the boiler is the slot *C* guarded by the apron *D*. The feed water reaches approximately the boiler temperature before overflowing. The apron keeps out any floating impurities.

Similar types of boilers have been used on steam shovels, dredges, etc., and have proved their value because of their ability to utilize all kinds of feed water.

### Eighteen Scales and Protractor in One

Eighteen scales and a protractor are placed on one 3¾ x 7¼-in. celluloid sheet in the Multo-Scale, which is being put on the market by the Cellu-Technic Co., of Palisades Park, N. J. Each scale has its own edge, the sheet being perforated with five slots, as shown in the illustration. The scales are each 6 in. long and include architect scales of ½, ¾, ⅜, ½, ¾, 1½ and 3 in. to the foot. The engineer scales are 10, 20, 30, 40, 50, 25 and 60 parts to the inch. There are in addition a metric scale, a logarith-



THE HEAVY BLACK LINES INDICATE THE SLOTS IN THE INSTRUMENTS

metic scale (for graphic work), and a scale graduated in thirty seconds. A 180-deg. protractor runs around the edge of the sheet.

The material used for the scale is called Prismatex, a grade of celluloid, and has the bottom side especially prepared to accomplish optically what ground glass does in a camera, gives a white background for the black graduations, even when used on blueprints and vandykes.

The scale comes in a leather case.

### Out-of-the-Ordinary Trade Publications

Contractors whose operations demand extensive excavation, as well as quarrymen, will be interested in a recent booklet issued by the SANDERSON CYCLONE DRILL CO., Orrville, Ohio, which explains in detail the use of Cyclone drills for big blast-hole drilling. Contractors have usually been content with benching, tripod drilling, and coyote hole methods. However, the process of using a glorified well drill for drilling blast holes is fully explained in the booklet. Full details as to the comparison of big-hole blasting with the more common methods are given. Aside from being a publication which has for its prime purpose the exploitation of the Sanderson cyclone drill products, the booklet is a good commentary on drilling operations of all kinds.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Chicago Building Trades Wages Reduced

### udge Landis Makes Cuts of 10 to 30 Per Cent and Abrogates Restrictive Working Conditions

Judge Landis, as sole umpire in the uilding-trades wages controversy in hicago, handed down his decision ept. 7. Skilled wages in Chicago had een $1.25 per hour, wages for common ibor and helpers, $1, and for excavatig labor, 75 cents. These rates are reced from 10 to 33 per cent, as shown the following table. In addition, idge Landis brought about the acptance of a new standard agreement r most of the trades, doing away with strictive working conditions. The llowing are the features of the new reements:

Disputes are to be adjusted peacelly, subject to appeal to the National oard of Jurisdictional Awards; there to be no stoppage of work individuy or collectively under penalties deibed, except when an owner attempts construct a building with non-union en while putting up another building which union men are employed, and en the employer fails to pay emoyees for work done; in case of rcity of help non-union men may rk with union men until such time union men may be obtained; any rneyman may use in his work the ls of any other trade; small tasks not over 30 min. duration in any day, belonging to any trade, may be formed by any other trade at the cretion of the employer; overtime rk during the first 2½ hr. beyond a ular working day to be paid at one l a half times the regular wage; rtime work beyond this and work Saturday afternoons, Sundays, and idays to be paid at double rates; ft work to be paid at the regular rate; contractors not affiliated with employers' associations may il themselves of all the benebe by joining the associations, and union will provide them with the same as members of the ociation; there shall be no rection as to the amount of work an may do, nor against the use of chinery, methods, or appliances, nor inst any raw or manufactured maal except prison made; employers y employ or discharge whomsoever he union they please, and employees y work for whomsoever they see fit, the foreman, if any, is to be exively the agent of the employer.

The wage awards made by Judge dis are tabulated in the adjoining mn, rates being per hour.

ive unions—the carpenters, elevator structors, plasterers, sheet metal kers, painters, glaziers, and fixture gers were not signatories to the arbitration agreement. The following tentative awards were made by Judge Landis if at any time before Nov. 1, 1922, these unions wish to enter the agreement under certain specifications laid down in the award text.

| | Per Hour | |
|---|---|---|
| | New Wage | Old Wage |
| Carpenters | $1 00 | $1 25 |
| Plasterers | 1 10 | 1 25 |
| Elevator constructors | 0 95 | 1 25 |
| Sheet metal workers | 0 95 | 1 25 |
| Painters | 0 95 | 1 25 |
| Glaziers | 0 95 | 1 25 |
| Fixture hangers | 1 00 | 1 25 |

WAGE AWARDS IN BUILDING TRADES

| Trade— | New Wage | Old Wage |
|---|---|---|
| Plumbers | $0 95 | $1 25 |
| Brick layers | 1 10 | 1 25 |
| Boiler makers | 1 00 | 1 25 |
| Steamfitters | 0 95 | 1 25 |
| Hoisting engineers (for operation of high pressure boilers and engines, cable ways, derricks, pile drivers, cranes and cableways) | 1 10 | 1 25 |
| Hoisting engineers (all others) | 0 85 | 1 25 |
| Tile layers (tile progders) | 1 12½ | 1 25 |
| Cement finishers | 0 85 | 1 25 |
| Composition floor finishers | 0 97½ | 1 25 |
| Cement workers, laborers | 0 72½ | 1 00 |
| Stone derrickmen | 0 90 | 1 25 |
| Drain layers | 0 82½ | 1 25 |
| Electricians | 1 10 | 1 25 |
| Gasfitters | 0 95 | 1 25 |
| Ornamental ironworkers | 0 95 | 1 25 |
| Structural ironworkers | 1 05 | 1 25 |
| Common laborers | 0 72½ | 1 00 |
| Caisson men (windlass and niggerhead men) | 0 85 | 1 00 |
| Caisson men (diggers and laggers) | 0 97½ | 1 00 |
| laborers (plasterers) | 0 78½ | 1 00 |
| Excavating labor | 0 47½ | 0 75 |
| Excavating labor (wall men) | 0 55 | 0 75 |
| Composition floor laborers | 0 72½ | 1 00 |
| Lathers | 1 00 | 1 25 |
| Machinery movers and riggers | 0 85 | 1 25 |
| Marble setters | 0 87½ | 1 25 |
| Marble setters' helpers | 0 70 | 1 00 |
| Marble cutters and polishers | 0 75 | 1 00 |
| Scaffold builders and laborers | 0 75 | 1 00 |
| Mosaic and tile workers | 1 02½ | 1 25 |
| Mosaic and tile helpers | 0 70 | 1 00 |
| Pipe and boiler coverers | 0 95 | 1 25 |
| Composition roofers | 0 92½ | 1 25 |
| Slate and tile roofers | 1 00 | 1 25 |
| Stone cutters | 1 02½ | 1 25 |
| Stone carvers | 1 25 | 1 25 |
| Stone planer men | 0 82½ | 1 25 |
| Terrazzo workers | 0 95 | 1 25 |
| Terrazzo helpers | 0 80 | 1 00 |
| Terrazzo helpers | 0 70 | 1 00 |
| Tool sharpeners | 1 00 | 1 25 |
| Sprinkler fitters | 0 92½ | 1 25 |
| Sprinkler fitters' helpers | 0 70 | 1 00 |

| | Per Week | |
|---|---|---|
| | New Wage | Old Wage |
| Corporation engineers | $30 00 | $45 00 |

## Navy Cuts Wages

The Navy Department, after inquiry by a board appointed by the Secretary, has reduced wages ranging from 13 to 14 per cent for all classes of labor. Common labor is reduced to 41c. per hour and skilled labor is lowered to 73c.

Calling attention to the fact that the cost of living, according to the Department of Labor figures, has gone down 16.7 per cent, the investigating board pointed out that the general decrease in wages throughout the country within the last year has been 18.5 per cent; on the railroads, 10 per cent, and in steel plants, 25 per cent.

It gives the average rate of pay in the building trades as 80c. per hour and in the automobile industry as 77c.

## Tile Manufacturers Indicted

On charges of criminal violation of the Sherman anti-trust law, the Federal Grand Jury at New York City last week returned indictments against thirty corporations, thirty-two firms, and thirty-two individuals, manufacturers of building tile and members of the Atlantic Coast District Tile, Grate & Mantel Association. The defendants are charged, on five counts, with conspiracy to eliminate competition, to control prices, and to restrain trade by agreements not to sell tile to general contractors and builders. It is alleged, also, that an agreement existed between the tile manufacturers and an "organization of labor" which prevented non-members of the employers organization from obtaining labor.

United States Attorney William Hayward is quoted as saying: "The fact that labor organizations have not been included in this indictment must not be regarded as signifying that labor organizations which have violated the law will be immune from as vigorous prosecution as those indicted will receive." It is promised that investigation of labor's connection with illegal practices in the building trades will continue, and, where evidence of guilt is found, indictments and prosecution will follow. The indictment of the tile manufacturers is based upon testimony collected by the Lockwood Committee.

Among the methods adopted to stifle competition, according to Col. Hayward, was the "K. O. system" under which, in the case of certain general contractors, tile manufacturer in a position to bid received instructions to "Keep Off," leaving the field to one concern. In such cases accommodation bids all higher than that of the favored manufacturer, were submitted. It is also stated that the manufacturers maintained a black list of builders refusing to pay claims for extra work.

The Government, it is understood, will be ready to go to trial on Sept. 20, the date set for pleading to the indictments.

## Unfair Competition Is Charge Against Gypsum Makers

Complaint of unfair competition has been made by the Federal Trade Commission against the Gypsum Industries Association of Chicago, seven of its executive officers and 24 members in various states. It is claimed that association members endeavored to eliminate mail order competition by restricting sales to dealers with retail establishments and by limiting each member's sales to the territory reached by delivery trucks of retailers to whom he sells. Dealers who sell by mail orders or otherwise are excluded, the complaint alleges.

dealers maintain retail establishments are excluded, the complaint further alleges.

### Approves Freight Rate Cut on Sand, Gravel and Stone

The Interstate Commerce Commission, Sept. 10, approved applications of carriers in eastern trunk-line territory for authority to make heavy reductions on five-days' notice in rates on sand, gravel and crushed stone applicable upon interstate traffic between practically all points in trunk line territory, including Pennsylvania, New Jersey, Delaware, Maryland and portions of West Virginia and Virginia. The new rates are to be published to become effective Oct. 1 and constitute material reductions under the rates now in effect. The basis to be employed in constructing the new rates is 15 per cent higher than the rates in effect prior to the general increase of August, 1920, thus substituting a 15 per cent increase for a 40 per cent increase.

A large volume of movement of these commodities for roads, buildings and other construction work will be affected and it is expected that the annual reduction in transportation charges will be much in excess of a million dollars.

# Weekly Construction Market

THIS market report is designed for the purpose of giving [illegible] construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 1, the next, on October 6.

| Steel Products | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2 88 | $4 00 | $4 00 | $2 88 | $3 16 | $4 00 | $3 70 | $3 75 | $4 00 |
| Structural rivets, 100 lb | 3 70 | 5 25 | 5 50 | 3 68 | 4 15 | 4 25 | 5 50 | 5 00 | 6 50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2 78 | 4 25 | 3 50 | 2 78 | 3 18 | 3 57½ | 2.35 | 3 75 | 3 75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 10% | 52½-5% | 45% | 48½% | 53 -5% | 36% | 40-25% | 48½% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 45 00 | 40 50 | 53 30 | 45 00 | 50 80 | 52 00 | 60.00 | 60 00 | 70 00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2 60@2.70(del.) | 2 69 | 2 80 | 2.17 | 2.41 | 3.10 | 3.09 | 3.10 | 3.10 |
| Gravel, ¾ in., cu.yd | 2 25 | 3 13 | 3 00 | 1 80 | 2.00 | 2 50 | 2 25 | 1 50 | 1 50 |
| Sand, cu.yd | 1 25 | 1 35 | 2 50 | 1 80 | 1 00 | 1 10 | 1 50 | 1 50 | 1 25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 2.80 | 2.00 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M ft | 45 00 | 55 00 | 35 00 | 46 00 | 34 00 | 49 00 | 30 00 | 21 00 | 120 00 |
| Lime, finishing, hydrated, ton | 18 00 | 19 00 | 25 00 | 20 00 | 29 00 | 30 00 | 25 40 | 24 00 | 21 00 |
| Lime, common, lump, bbl | 3 60 | 1.60 | 2 75 | 1.65 | 1 50 | 2 25 | 2 25 | 2.75 | 15 00 |
| Common brick, delivered, 1,000 | 18.40@19.40 | 10.00 | 12 72 | 11.00 | 17 00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | 14 | 12¼ | 09 2 6 | 092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | 11 370 | 14 | 12¼ | 07 410 | 092 | .10 | 14½ | .12 | |
| Linseed oil, raw, 5 bbl. lots, gal. | .78 | .84 | .98 | .84 | .86 | .98 | .91 | .79 | .86 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | 75@ 80 | 35 | | 72½ | 50 | .50 @.55 | 81½ | 75 | |
| Common labor, non-union, hour | | 20 | 35@ 45 | 35 | 50 | 37½@.50 | 50@.55 | 50 | 30 |

**Explanation of Prices.**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or −, respectively. For steel pipe, the discounts given represent those last prices in effect, 15% per cent discount of 1 per cent being equal to 15 per cent. Charge of 15c. per 100 lb. for cutting reinforcing steel into 2-ft. lengths is added.

**New York** prices are delivered except tiles, which are "on trucks." Common lump lime per 180-lb. net cloth bags and hydrated per 50-lb. paper bags. Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement in cars, $2.60 delivered Kelly Island and $1.66 for Sheboygan. Gravel, sand and crushed stone quote at pit. We quote on brown lime, white is $1.80. Common labor not organized. **Denver** prices cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except on pipe, which is mill prices freight to railway depot at any to mual. Lumber prices are delivered ship tackle in San Francisco ex mill. **Seattle** quotes on Douglas fir instead pine, and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered. Sand, gravel and stone, on siding. Brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds exchange with the United States being per cent at present. Bag charge is 5 per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

### Changes Since Last Week

Although quotations as low as $1.70 have been made on structural steel shapes, the Pittsburgh price of $1.75@$1.89 per 100 lb. has prevailed throughout the week. Pittsburgh prices on reinforcing bars and quotations on mill shipments, New York, of structural shapes have remained unchanged. Mill shipments, New York, of steel bars are quoted at $2.03 as against $2.08 per 100 lb. Dallas quotes mill shipments of reinforcing bars at $3.05 per 100 lb. Mill shipment prices in Minneapolis of structural steel remain at $2.45 for lake and rail and $2.51 for all rail shipments. These prices represent the Pittsburgh base price plus 60c. for lake and rail and 66c. per 100 lb. for all rail shipments. Seattle quotes steel shapes at $3.75 as against $4, and structural rivets at $5, as compared with $5.25 per 100 lb. previously.

Declines in cast-iron pipe are reported in two cities. In Atlanta the price has dropped from $43.33 to $40.50, and in Denver from $57.50 to $52 per ton.

Atlanta reports slight declines in cement and gravel prices. The market on sand, gravel and hollow tile is very unsettled and there has been much cutting under in order to meet competition; there is better feeling, however, since the recent advance in cotton.

Long leaf yellow pine has dropped $3 in Atlanta and Douglas fir has declined 50c. per M. ft. in Seattle.

Atlanta reports an advance of 10c. in common lump lime, making the present price $1.60 as against $1.50 per bbl.

Decreases ranging from 2c. to 4c. per gal. in linseed oil are shown throughout the country. Reports from Minneapolis state that the flax market has moved up and that linseed oil manufacturers predict an advance in price, if the flax quotations hold firmly.

Slight increase in employment in the building trades is evident in Denver, while San Francisco reports building operations going ahead rapidly, and that men are being put to work as soon as they can be used to advantage. The recent decision in Chicago places the wage rate for bricklayers at $1.10, carpenters $1, structural iron workers $1.05, common labor, union, 72½c., and common labor, non-union, 35c. per hr. Hoisting engineers for operation of high pressure boilers and engines, railways, derricks, pile drivers, cranes and cable hoists, receive $1.10; all others 85c. per hour.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, SEPTEMBER 22, 1921 — Number 12

## Twenty-Two Times Mayor

DEPLORABLE as are political conditions in many American cities, refreshing instances of retaining efficient men in office present themselves now and then. A case of the sort has come to public attention in New Bedford, Mass., where Mayor Ashley has announced that he will not stand for office again after finishing his twenty-second term as mayor. Elsewhere we print a short appreciation of Mayor Ashley by a man who has served New Bedford faithfully and well even longer than has Mr. Ashley and who is well known to many of our readers, R. C. P. Coggeshall, superintendent of waterworks.

## Amateurs or Experts

AFTER serving eight years as a city councilman and then six years as mayor of Cumberland, Md., Thomas M. Koon believes that the city would be better governed if instead of paying five commissioners a total of $6,300 a year to act both as legislators and heads of city departments, $10,000 a year were paid to a city manager and nominal compensation to the commissioners, the latter to have legislative powers only. This is common sense. It is the basic principle of the commission-manager plan. It accords with the ideas so lucidly expressed fifty years ago by John Stuart Mill in his essay on "Representative Government." The plain commission plan gives our cities amateurs as heads of the leading city departments and pays them money enough to hire or go far towards hiring an expert chief administrator. The choice lies between city administration by amateurs or by experts.

## British Population Figures

LIKE the Borough of Manhattan, New York City, in our census of 1920, the population of what is known as the Administrative County of London shows a decrease in population, although a lighter one, for the decade just passed. The figures are those of the new British census. Greater London, as did New York City as a whole, shows an increase in population in the past decade, but a very much smaller one—Greater or Police London is not strictly comparable with New York City since the former includes many municipalities entirely independent of the Administrative County. For Great Britain (England, Scotland and Wales) the population gain for the past ten years, as was to be expected, is small and the excess of females over males has materially increased—both penalties of the war. In the Empire, Australia and New Zealand show large gains, as presumably Canada will when her 1921 population is announced. Stupendous is the word required to characterize the population of India, now 319,075,132, particularly if one reflects on what this would mean if its people consumed manufactures in the same ratio as Great Britain, Canada and the United States.

## Successor to the Alchemist

THE CHEMIST is the lineal successor of the alchemist, and to the layman is still enshrouded with some of the mystery of his predecessor. He puts two substances, quiescent when alone, together and, calling on mighty forces, produces a new substance unlike either of the others, often accompanying the transformation with spectacular evidences of high temperatures. Possibly it is to the mysterious and awe-inspiring character of some of his work—though skillful publicity methods are not neglected by the wise chemists—that the American Chemical Society's annual meeting usually gets a large amount of space in the public prints. In any event, the result is good for the chemist—and his brother, the engineer—in that there results a better understanding by the public of the functions and work of those who develop new uses of the forces of nature. Incidentally, engineers can learn something about the handling of publicity by noting how the chemists ease the newspaper man's task by assisting in translating highly technical data into every-day language.

## Rattler Tests for Road Concrete

USING spherical test pieces the Kansas Highway Commission appears to have developed a successful rattler test for concrete for pavement. Previously special apparatus, requiring too much room for laboratory use and involving time and expense which few highway departments could afford, has been considered necessary to obtain definite information on the resistance to wear of concrete paving mixtures. The Kansas test, if it bears out its present promise, puts the determination of wear into the laboratory, with apparatus already available. This is a distinct improvement. While, with the increasing use of rubber-tired vehicles, resistance to abrasive wear is not the critical factor that it was, it is still a factor which cannot be neglected in concrete road design. Tractor traffic and horse-drawn steel-tired vehicles still have a large place on paved roads particularly in the farming states of the Middle West. Abrasive strength, therefore, is not a negligible function of traffic endurance.

## Penalty of Botch Work

FROM last week's accounts of the shocking bridge accident at Chester—based on expert scrutiny of the conditions—it is difficult to conclude otherwise than that the cracked gusset-plate which tore apart under the weight of a crowd existed in its cracked condition ever since the sidewalk bracket had been "repaired" after being damaged in a boat collision. It survived during a number of years only by luck. Crowds dense enough to produce a loading of 100 lb. per square foot, conventionally taken as a maximum in design, do not occur often, but in the course of time they do happen.

The time came for this particular bracket, with a result determined by the cracked plate, which somebody's conscience had allowed him to slip back into place. The blame for the wholesale drowning does not rest on the crowd, or the age of the bridge, or the material of the plate, or the design—faulty though this was—but solely and alone on the man who botched the repairs. We may each feel content in the possession of a conscience that is proof against the temptation to do a like bit of work. But the case with its score of dead emphasizes by a tragic warning the special sin of botching at a hidden point.

## The Hudson Tunnel Deadlock

JUDGED by the events of the past few months political bickering gives promise of delaying the completion of the Hudson River vehicular tunnel considerably beyond Dec. 31, 1924, the date announced by the chief engineer in his report for 1920. There is no justification for the set-back, for the engineering staff, having brought the designs and specifications for the subaqueous work to the verge of completion, has been ready for some time to place the work under contract. The holdup seems to be chargeable to the tactics of the New Jersey commission.

That body first showed its hand in an attempt to barter approval of a shaft contract at the west end of the tunnel for a lavish program of street widening in Jersey City in which the New York commission refused to concur. Then came the summary "dismissal" by the Jersey commissioners of the board of consulting engineers, the New York commission again refusing to sanction the arbitrary and unexplained action of its confreres from across the Hudson. Now it appears that the work on the Jersey side is to continue indefinitely in the doldrums by reason of the Jersey commission's insistence on a perpetual easement for a railroad siding flanking the proposed tunnel entrance plaza. This petty squabbling has already held up the award of the Jersey shaft contract for five months (it was first publicly advertised last March) and a beginning on the real job of tunneling under the river is not yet in sight.

What the delay means can best be indicated by reference to the chief engineer's estimate of income from vehicle tolls and electric conduit rentals. In the tunnel report dated Dec. 31, 1919, it was estimated that the first year of tunnel operation would produce an income of $2,500,000. On this basis every month's delay in completing the project means a loss of more than $200,000.

But this is not the only loss. The New York district, in common with other sections, faces an unemployment problem. On the Hudson tunnel, involving an expenditure of nearly $30,000,000, a large force of both skilled and unskilled labor could find work, not merely under the river but also in the many industries which would supply the equipment and materials for the twin tubes. Ample funds for beginning construction have been provided, the engineering plans and specifications are ready, labor is seeking employment, and an impatient public is eager for the opening up of the subaqueous vehicle route which will facilitate the movement of freight, foodstuffs and passengers between the two states. In the face of these arguments for immediate action the New Jersey commission, ignoring responsibilities for public service, fails to rise above the level of political dickering.

A continuation of the tunnel deadlock should no longer be tolerated. If the New Jersey commission, as now constituted, cannot produce action, its members should be removed and replaced by others with a broader conception of their functions and with private interests affected neither directly nor indirectly by the location or the construction of the under-river tubes.

## Study of Spore Formers in Water

OF THE MANY good points in Sir Alexander Houston's article on "B. Welchii, Gastro-Enteritis and Water Supply," published elsewhere in this issue, none deserves more attention than the one on the desirability of comparative studies of spore formers in the water supplies of the United States and Canada. That he lays stress on the whole group of spore formers rather than on B. Welchii alone follows naturally from his own studies of a similar if not identical germ and is in accord with the consensus of opinion expressed in our issues of June 2 and 9 by 66 water analysts and sanitarians of the United States and Canada. Nearly the whole 66, like Sir Alexander, are skeptical as to B. Welchii being the cause of diarrhea or other waterborne intestinal disturbances but many of them, like him, are on the alert for new and convincing evidence on the subject. At the same time he and the others broaden the chances for new discoveries by holding all the spore formers open to indictment, rather than B. Welchii alone.

That Sir Alexander should think conditions for such broad exploration of the entire field of spore formers are more favorable in the United States and Canada than in Great Britain is not wholly complimentary to water-works on this side of the ocean, since the assumption rests on the belief that many of our supplies, as delivered to consumers, are inferior to the British in sanitary quality. This inferiority, it appears, he attributes largely to our use of mechanical rather than slow sand filtration, when there is any filtration, and to our reliance upon chlorination, both to make up what he considers to be deficiencies in our mechanical filter plants and, worse yet—from his and the European viewpoint generally—our use of surface supplies with no treatment safeguard except chlorination. This line of reasoning, besides being an argument for comparative studies of spore formers, should set many of our cities and towns to thinking of the dangers they run in (1) they go easy on filtration and rely too much on chlorination and if (2) they depend wholly upon such protection as is afforded by chlorination alone. In passing, it may be noted that apparently Sir Alexander, in common with many other trans-Atlantic water experts does not fully realize that when Americans speak of mechanical filtration plant they mean one that includes pre-coagulation and not merely a rapid as contrasted with a slow sand filter.

To carry out properly what we understand is his conception of comparative studies of spore formers would require co-operation between a number of water works having supplies of diverse character and treatment, preferably with state and federal co-operation. Such studies in the United States and Canada are highly desirable, but would take years.

Meanwhile, we join with an undoubtedly large majority of American and Canadian water-works men in agreeing with Sir Alexander that the B. Welchii test still stands supreme.

## Economic Limits of Flood Protection

IN THE face of the destructive floods that have been reported within the past few months it needs no prophetic gift to foretell that the near future will see much development of flood-protection work. Such happenings as the floods at Pueblo and in the southern Texas region rouse a spirit that demands that recurrence of destruction be prevented. It is known that engineering works can be provided to prevent or minimize damage by flood, and every flood-stricken community will demand that such works be constructed for its benefit. In fact, study has already been begun at Pueblo, while Phoenix has decided upon the construction of protective works even before its recent visitation. But interest in the subject is sure to engage a much wider field than merely that of the communities which have just suffered loss. The events of the current year demonstrate impressively that the flood menace is widespread, and that it affects most of all the minor streams, heretofore rarely thought dangerous.

For six or seven years, since the beginning of flood-protection planning in the Central States after the flood catastrophe of 1913, we have been marking time in the matter of giving heed to the danger to which many valley regions are exposed. Even the brilliant pioneer studies made in connection with the Miami River work have received but scattering attention. It was to be expected that this neglect of the subject would be compensated for by a re-awakening interest; all the more remarkable is it that at this time a series of floods is recorded which gives a fresh turn to thought on flood-protection. Instead of exhibiting another great regional storm like that of 1913, they show the danger residing in small-area rainfalls of phenomenal intensity. They bring back to mind the long succession of local-storm floods of earlier years, forgotten in the overshadowing influence of the 1913 flood.

There is little law or system about the occurrence of storms of intense precipitation. From present knowledge we must accept the probability that almost every brook or stream is potentially the path of devastating flood, for no natural channel—the exceptions are few—is capable of carrying the volumes of water poured out by a cloudburst storm. Though doubtless only at exceedingly long intervals, such storms may break anywhere, at any moment. It is this prospect, together with the certainty that flood-protection is worth most if built before a flood, that promises to make it one of the prime fields of public-works engineering in years to come.

Obviously the opportunities for flood-protection are great. Complete protection would require that works be built in every channel subject to flood, and this, as suggested, would mean virtually every stream throughout the country. The total cost of this work, however, would amount to a stupendous total, and every instinct tells us that so great an expenditure for the purpose is altogether disproportionate, that many of the protection projects must surely be unsound.

True progress in this field, indeed, is primarily dependent upon study of the underlying principles of the expediency of flood-protection. What are the economic limits of flood-protection?—that is the essential question. Virtually nothing has yet been done toward such study; even the data for it are lacking or buried in uncoördinated masses of statistics. Yet without it there seems little chance of sifting the good from the bad projects, and assuring the needed development of protective work without wasted expenditure.

Flood-protection is complex. It involves contingencies of wholly uncertain, perhaps speculative, character. Both the cost and the value of the protection are indefinite. It offers a variety of amazingly difficult questions, which, however, require answer, in terms of general principle at least.

The cost of flood-protection is difficult to determine not only because it is dependent on the maximum flood—a future contingency—but also because the investment accumulates at increasing rate by the piling up of interest until a return is earned by the prevention of flood loss. The calculation is closely dependent on the sequence and magnitude of floods, with prime regard, however, for the greatest flood. The value of the protection is a similarly vague quantity.

That the problem is pre-eminently one of financial, or rather economic, analysis is apparent from any one practical instance. When a city visited by flood compiles an estimate of its property losses, and reports a total of say ten millions, every citizen is strongly impressed with the importance of avoiding recurrence of such loss. At the moment, estimates of flood frequency and magnitude are arrived at in the light of the personal misfortune, and no thought is given to the application of meteorological statistics. The processes by which the matter is dealt with are emotional rather than reasoning. An investigation shows, perhaps, that protection can be had for three or four million dollars, and if a vote of the people be taken before the impression of the disaster has faded, the project is sure to receive approval. Yet the fact may be that the flood which did the damage is of less than fifty-year frequency, and then, obviously, the investment of three or four millions would accumulate to ten times that amount before it could yield a return by preventing loss in the next flood. The soundness of the improvement is challenged, and only psychological factors of loss or gain—as restoration of public confidence or improvement of realty values, could reverse the conclusion. But the extent to which these latter factors may properly be taken into account is itself open to question.

First in importance among the many elements entering into the economics of the subject is knowledge of rainfall and flood occurrence. The data available in this field are none too ample, as evidenced by the fact that the recent Texas rains gave figures so high that at first they were rejected as untrue by Weather Bureau officials at a distance—though a higher flood occurred a century ago. But even more lacking is analysis of the existing data. When this is carried to the point of supplying, for example, the definite forecast that a South Dakota valley of 300 square miles may expect flood-storms of such and such intensity at intervals of so and so many years, and when the most probable seasons of these storms are indicated, we will have a tangible working basis for planning the country's flood-protection work soundly.

What has been said might suggest that determination of the economic limits would discourage flood-protection. It would more often tend to stimulate than to discourage we believe. But whatever the effect, the study is necessary, as already indicated, if the work is to develop along sound lines. The main result to be accomplished is to outline the proper scope of flood-protection. We believe it will prove to be surprisingly large.

# Concrete Arch Bridge of Three 250-Foot Spans

## Long Spans of High-Level Bridge Over Monongahela River at Fairmont Controlled by Required Channel Clearance—Special Architectural Treatment—Three Spans Centered Simultaneously

By E. H. Harder
Assistant Engineer, Concrete-Steel Engineering Co., New York

UNTIL the present year the city of Fairmont, W. Va., had only one highway crossing over the Monongahela River, a low-level steel bridge. As the city is built high up on steep banks, even the tortuous approaches of the trolley and vehicular traffic were too steep to permit using the steel spans to maximum capacity. A new high-level concrete arch bridge completed two months ago remedies these conditions. Its three 250-ft. spans and its architectural development make it a noteworthy structure.

In developing the plans for the new river crossing the designers at first contemplated building a single huge arch across the channel—a 432-ft. span with two cored-out ribs of 95 ft. rise. This design was abandoned because of foundation conditions and cost. A better solution was found in a three-span design. The War Department required a channel clearance height of 50 ft. on a 200-ft. width, which dictated a 250-ft. arch with 52-ft. rise from a springing-line elevation 33 ft. above pool level. By using side spans of the same length all railroad and street limitations on both banks could be met. This arrangement also placed the end arch abutments against suitable rock ledges.

Equality of span lengths is an important feature of the structural design throughout, resulting in marked economy by allowing the use of forms several times and in some instances as many as six times.

*Subsoil*—The geological conditions are typical of coal-mining country. Rock was found about 15 ft. below pool elevation, covered with sand and gravel varying in depth from a few inches to a few feet. Shot-drill core borings disclosed sedimentary rocks varying from medium hard shales, limestone, etc., to very hard sandstone. Sufficient holes were drilled for each foundation—especially for the river piers—to determine the condition of the various strata, to make certain that each stratum lay in its natural bed, and that there were no breaks or caverns beneath the top layers.

The west pier was founded on solid sandstone about 11 ft. thick, the sandstone lying on top of a stratum of hard, shaly limestone. At the east pier the sandstone stratum feathered out, exposing the upper part of the limestone. In the west abutment sandstone was encountered, while the east abutment was founded on shales and limestones of varying hardness. The piers for the approaches were founded on sandstones and hard shales and, in a few instances, on hard compacted clay.

*Arch Design*—The three long spans have two ribs each 14 ft. wide, spaced 14 ft. apart in the clear (Figs 3 and 4), reinforced with 22 1¼-in. bars 8 in. on centers

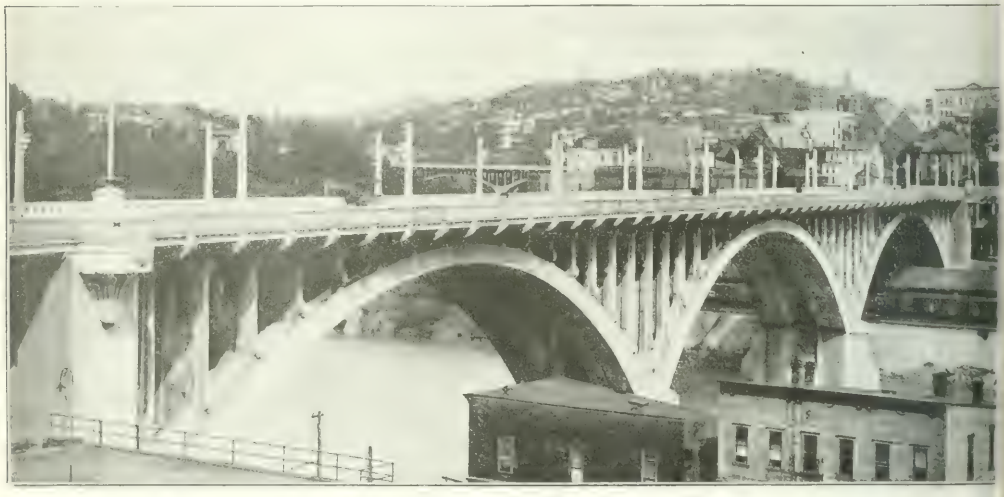


FIG. 1 THREE 250-FT. SPANS OF FAIRMONT BRIDGE, LOOKING WEST

in both top and bottom. These bars are held in place b structural-steel spacer frames, which also strengthe the rib against shearing stresses. There are also shea bars placed at intervals between the spacer frames.

The arches were designed for 150 lb. per square foo on the roadway, and 100 lb. per square foot on the side walks. The floor slab and girders under the trolle tracks were designed for 50-ton cars with 25 per cen impact, and under the remainder of the roadway fo 150 lb. per square foot or an axle-load of 24,000 lb., wit 25 per cent impact.

For slab and girder design the permissible stresse in the concrete were 650 lb. per square inch for con pression and 16,000 lb. per square inch tension in th steel; for the arches, 750 lb. per square inch for con pression in the concrete, which included temperatu stresses for a total range of 50 deg. F.

*Strain-gage Observations*—To obtain greater certainty regarding the stresses in the arch ribs, the designers carried out an extensive program of strain-gage measurements on the arch reinforcing at various points, as well as on the concrete at the crown and haunches of two of the arches. These measurements, together with extensive temperature measurements of the interior of the arch concrete, were undertaken primarily to determine the magnitude of temperature stresses. While their data are not available for publication at this time, it can be said that the strain-gage readings show higher stresses in the steel than those calculated by the usual methods of arch design.

Supporting the floor system above the arch ribs are slender transverse walls 16 ft. apart, connected at the top by girders with curved bottom line. Cantilevers cast with this girder section, overhanging 8 ft., support the sidewalks. Each cantilever is tied into both wall and girder with six 1-in. bars, because of notching for a water main and a conduit tunnel. The brackets, shaped to an ellipse from a wall capital to a point from which a curved return of short radius is made to the post unit of the parapet, give a most solid and at the same time graceful effect.

The floor slabs are continuous over three spans between expansion joints, spaced generally 48 ft. apart and located over transverse walls. The 3-in. slab forming the bottom of the conduit tunnel was cast in short sections off the job and later set in place. The 5-in. slab covering conduit tunnel and water main was cast in place in short sections, for facility of access. The sidewalk slab, 7-in. thick, was designed as simply supported in order to lessen the possibilities of cracking near or over supports; a single layer of triangle-mesh wire fabric was placed near the upper surface of the sidewalk slabs to prevent further any cracks from appearing.

Over the main abutments the roadway and sidewalks are carried by a house-like structure which rests on top of the solid concrete arch abutments. This house consists of four concrete walls with floors about 12 ft. apart. Windows, doors and stair wells are provided to make these floors useful. Access to the stair wells from the top of the bridge is by way of a circular balcony projecting from the outer wall. It is intended to build a comfort station on the top floor of the west abutment pier, while the other floors will later be utilized by the street and water departments of the city.

*Architectural Features*—The appearance of the bridge was of primary importance, but, while the architectural treatment was designed to ornament the structure, in no manner did it interfere with economy or the demands of good engineering. It was early planned to abandon the conventional style of building longitudinal face walls over the river piers to make such piers seem solid up to the roadway. Instead, a simple and uniform treatment of fascia girders and parapets in the 16-ft. spacing of transverse spandrel walls was adopted. In harmony herewith, the end faces of the transverse walls were treated in the manner shown in Fig. 2. The top of each wall is crowned with a simple capital upon which rests the sidewalk bracket. Just behind the ornamental face of the walls is a battered buttress which adds to the appearance of the wall and emphasizes its stability. The battered buttresses curve into a band of concrete 18 in. thick and of varying height, resting upon the extrados of the arch.

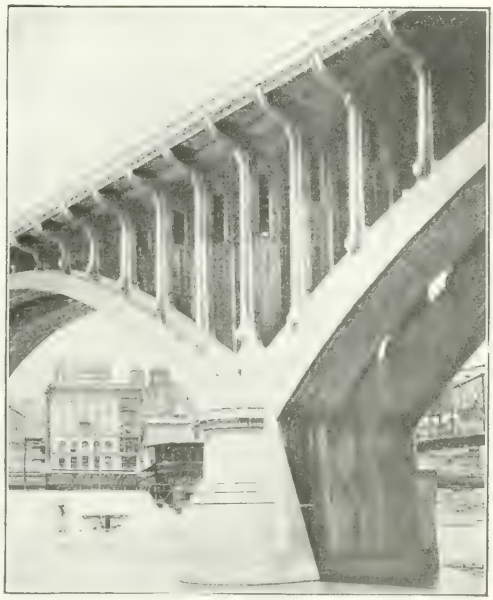


FIG. 2 ARCHITECTURAL DEVELOPMENT OF PIER AND WALLS

This band or fin has no structural significance and serves merely as an architectural device to tie in the bases of spandrel walls and give a feeling of greater stability.

Architecturally, the abutment towers are appropriately monolithic in appearance and flank the series of arches, separating in a most effective manner the long arch spans from the shorter horizontal spans of the approaches on either side. Fig. 6 shows the architectural treatment of the upper part of the abutment; a 50-ft. flag pole with bronze base crowns the kiosk covering the interior stairway. Note the delicate treatment of the vertical surface below the circular balconies. By cutting up the surface into small shallow square panels, the difficulty of obtaining a high plane surface of uniform texture and color was obviated, and at the same time the monotony of plain surfaces was avoided.

Special attention is called to the design of the combination lamp and trolley poles (Fig. 5). The arrangement of two lights one above the other is an interesting solution of the bridge lighting problem. Practically no light is wasted on the river below. Each of the two globes shown contains a 200-watt nitrogen lamp on circuits so arranged that the illumination of the roadway of the bridge may be varied from a maximum brilliance with all lights burning, to the all-night illumination with only the lower lamps on alternate poles in use.

*Construction Features*—Simultaneous construction of the three large arch spans, use of wooden forms, and cableway transport of material from bank to bridge were the defining features of the execution of the work.

Bids were received in December, 1917, but it was not until May, 1918, that the commissioners closed a contract with the John F. Casey Co., of Pittsburgh, to erect the bridge at cost plus a fixed compensation of

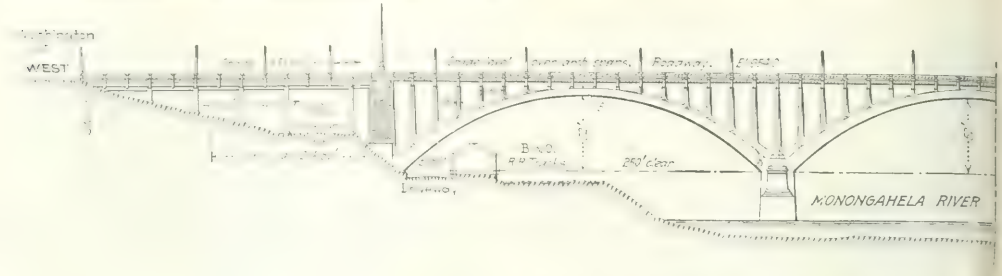



FIG. 1. PROFILE OF BRIDGE CONTROLLED BY CHANNEL

$40,000, about 9 per cent of the then estimated cost of construction. Work was not begun until the fall of that year, except in a preliminary way, as it was desired to utilize the lumber and plant then being used on the South Side bridge (described in *Engineering News-Record* Aug. 7, 1919, p. 270). Before completion of the latter the city purchased a twin cableway of 1,254 ft. span (138½-ft. steel towers), and this became the central item of the construction plant.

In the winter of 1918-19, equipment having a capacity of 500 cu.yd. of concrete per 10-hr. day was installed. On account of lack of space on the west side, all operations of the contractor were concentrated on the east side. Several schemes for plant layout and units were considered and the economics of various arrangements of machinery and of renting as against purchase by the city were studied. It was decided to rent the mixer and electric hoist and derrick which made up the machinery of the mixing plant. Saw mill and blacksmith shop equipment were bought by the city, as were also line hoppers, chutes, material derrick and all major and minor tools. Other rental units were derrick boat, centrifugal pumps, pile driver and steam hammer, concrete buckets, skips and excavation dump buckets.

*Arrangement of Plant*—At right angles to the west abutment pier and about 150 ft. from the cableways, which were erected so that the cable distributed on the centerlines of the main arch ribs (28 ft. apart), was located a 2-yd. mixer, about 20 ft. below the railroad tracks and set out far enough from the edge of the embankment to permit of a special siding serving the plant. Above the mixer was built a sand-and-gravel bin, with capacity of 200 tons of sand and 200 tons of gravel. Just to the south, storage bins of 3,000 tons capacity were built on the slope of the railroad embankment, with rough pile and board sides and floors. Dump holes under the track allowed all sand and gravel, which was delivered in bottom-dump coal cars, to flow into the bins. The mixer hoppers were served and kept full as needed from the storage piles by a 2-yd. clamshell bucket operated by derrick, which also assisted in unloading and piling sand and gravel. To the north, but directly built onto the mixer feeding platform, parallel to the siding, was constructed the cement shed, with a capacity for 4,000 barrels of cement. This arrangement allowed using cement from car to mixer in some instances, bu on long runs there was not sufficient siding capacit and so storage was necessary. Storage was a necessi also because of uncertain deliveries due to war co ditions.

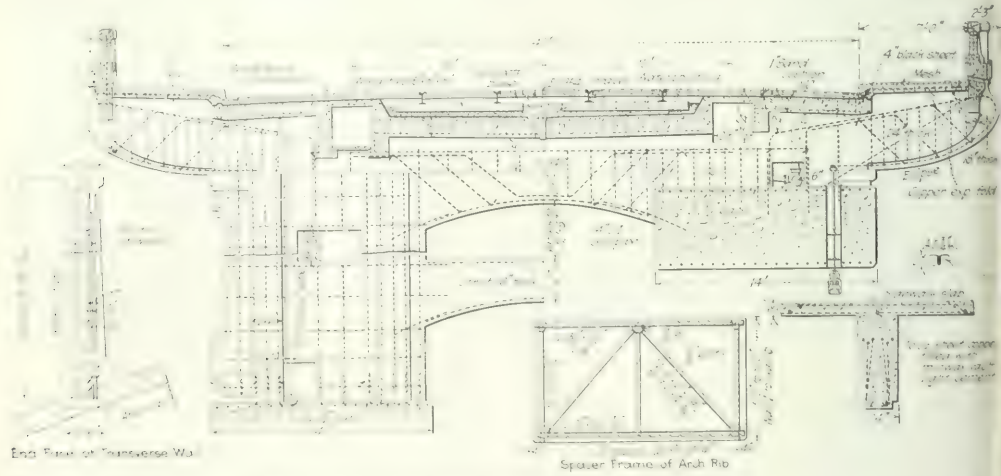
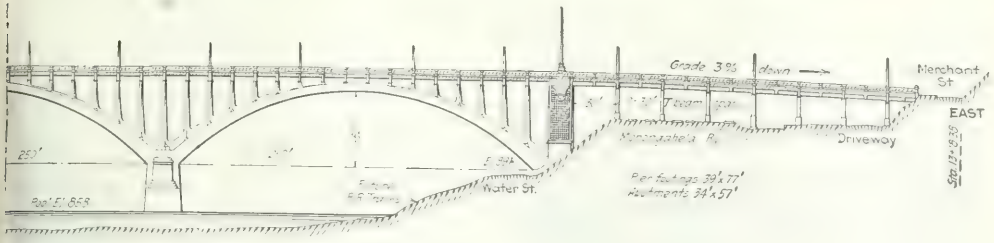



FIG. 2. WALL AND DECK CONSTRUCTION IN MAIN SPANS

From the mixer mouth to the cableways was co structed a track on a level low enough to allow 3½-y buckets on a four-wheel flat car to be pulled in und the discharge hopper of the mixer. A 25-hp. electi hoist operated this car with an endless line back a forth from the mixer to cableway. This plant mix




CLEARANCE REQUIREMENT

and distributed into place over 600 cu.yd. of concrete in one continuous run.

The cableways, which were of 7-ton capacity, transported concrete chiefly, but also handled over 1,000 M ft. of lumber. They were operated with the aid of signal men and electric bells, as most of the time the operating enginemen, located on the east end, were unable to see where their loads were to be landed or picked.

After centering construction was started, an air compressor was installed on a rental basis, to supply air for three woodboring machines, which earned their cost over and over again in the drilling of holes for the thousands of bolts used in the centering. Further use of this unit was made in the rock excavation operations, drilling concrete, etc.

River pier construction was carried out in 1919. Cofferdams of steel sheetpiling driven to get a bite into the rock, bermed up outside with clay and boulders, and thoroughly braced, were used at both piers. Abutments and approaches also were completed in that season. The arch ribs and most of the floor were constructed in 1920, running on into the spring of 1921, after which finishing, waterproofing and roadway work were done.

*Centering*—The three spans were centered simultaneously, and no center was struck until completion of the ribs of all spans. The centering of the spans differed, however, because of local conditions. That of the easterly span consisted of posts, braces, caps, joists and flooring, founded on river bottom on pile bents of 8 and nine piles, capped and braced. In the westerly span railroad tracks and freight sheds had to be spanned by structural steel posts and beams, on top of which timber centers carried the rib loads.

The middle-span centering was designed to take care of a 60-ft. channel. There being no cover to the rock bottom under this span, and flood and drift risk being present, the posts of the centering were set on individual concrete piers, 2 x 4 ft., placed in the river by a cofferdam. Eight cofferdams were constructed, each holding six pedestal piers. For each rib the timber framework from the springing line up was arranged in umbrella shape and its loads were carried through hardwood caps and wedges down three 12 x 12-in. timbers to each concrete pier.

In all the centering, long timbers were used, which permitted longer spacing and less waste. All caps were 12 x 14 in. x 60-ft. fir. These pieces were later utilized to material advantage in the erection of the superstructure.

*Concreting*—One pair of ribs contains 1,800 cu.yd. The ribs of each span were poured in four operations, each requiring 10 to 12 hr. Each rib was divided into seven sections. The crown sections of the two ribs of a span were poured first, the four skewback sections the following, and on the next two days the sections adjoining the crown and the closing sections respectively, completing the span. Work started in the easterly span and progressed in order to the west span.

Considerable effort was necessary to have sufficient material on hand for the completion of one pair of ribs, which meant four days running. The Baltimore & Ohio R. R. in several instances assigned twenty cars at a time to sand and gravel supply; Ohio River material was used, coming from Wheeling. The Monongehela Ry. brought as many as ten carloads of cement in one shipment from the mill at Wampum, Penn.

The forms for the transverse walls were assembled of shop-built sections, heavily built for repeated use. Rapid progress was made on the walls, and as soon as they were well advanced work was begun on girders

FIG. 3. DOUBLE-BRACKET CONCRETE LAMP POSTS

and brackets, following through with floor-slab and sidewalk construction.

Floor forms were built in sheets and lightly tacked on stringers supported on bents, resting on the long timbers removed from the centering and bolted to the sides of the walls. Bracket forms were also supported by these timbers, as were also parapet beams and side-

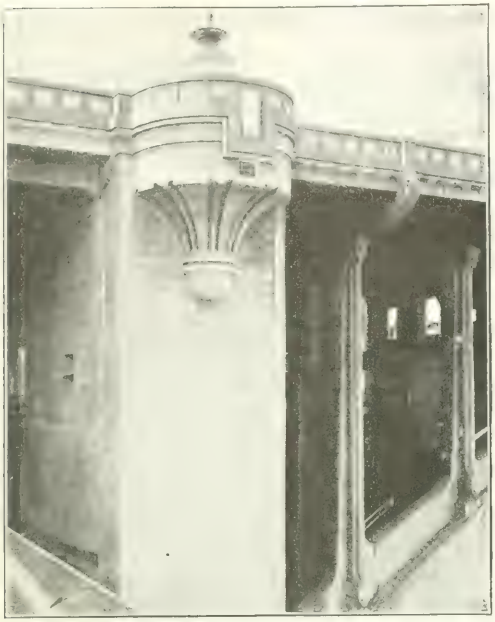


FIG. 6. CHECKERED SURFACE OF ABUTMENT FACE

walk forms. All concreting of the floor slabs was continuous between expansion joints.

The structure contains 24,880 cu.yd. of concrete, 770 tons of reinforcing steel, and 220 M brick. Arches, floor, copings, parapet and superstructure details were made of 1:2:4 concrete; the transverse spandrel walks, approach bents, approach abutments and track, 1:2½:5; piers, abutments and approach foundations, 1:3:6. Its cost, exclusive of street grading at the entrances, was very close to $860,000.

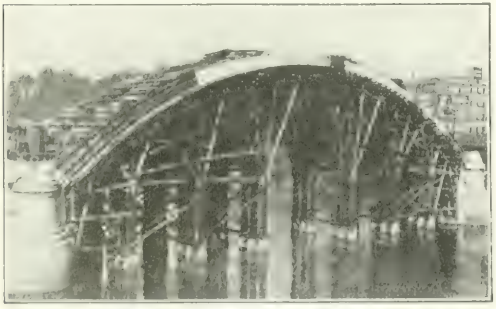
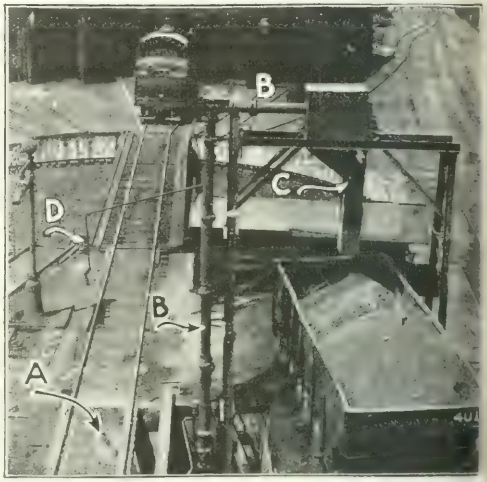


FIG. 7. CENTERING OF MIDDLE SPAN WITH 60-FT NAVIGATION OPENING

The design was made by the Concrete-Steel Engineering Co., William Mueser, chief engineer, and Charles F. Bornefeld, resident engineer. Associated with the engineers was Major Henry Hornbostel of New York as consulting architect. Samuel L. Fuller was superintendent on the work for the contractor. Shrewsbury B. Miller is city engineer of Fairmont.

## Railway Ashpit Cleaned by Steam Jets From the Locomotives

AN ASHPIT with ash-ejector system operated by steam from the locomotives is a novel feature in the engine terminal of the Akron, Canton & Youngstown Ry. at Britain, a suburb of Akron, Ohio. The ashpit is located in a track leading to the turntable and consists of a side discharge concrete hopper. In a trench along the bottom is an 8-in. pipe with a top opening or intake into which the ashes slide or are raked. One end of the pipe has an air inlet and the other end is connected to a tall riser pipe having a horizontal arm carried by a steel tower spanning a track for the ash cars. From the end of this arm a




ASH REMOVAL BY STEAM JET

A—Side discharge ashpit. B—Ash pipe. C—Chute to ash c
D—Steam blower pipe to be attached to dome of engine.

drop spout hangs over the track in a vertical positio

When an engine is spotted over the pit or hopper, an while its fire is being drawn, a steam pipe is attache to the engine dome by a quick-acting screw conne tion. As soon as the grates are cleaned, steam turned on and the ashes are blown through the pi and discharged into the car. It was intended original to have each engine blow its own ashes, but it is fou that the pit is large enough to serve three engin before it is cleaned. As the hot ashes cannot be wett in the pit, water is sprayed into the upper end of t conveyor pipe in order to quench them. With t engine in position it takes an average of ten minutes pull the fire, five minutes to blow the ashes from the p and two or three minutes to connect and disconne the steam pipe. When the operation is finished, t engine still has steam enough to move into the roun house.

This ash handling plant was built by the Convey Co., Chicago, under the direction of S. S. Senter, chi engineer of the Akron, Canton & Youngstown Ry. plant of the same type on the Denver & Rio Gran R.R., but with two ashpits served by steam from stationary boiler, was described in *Engineering Ne Record* of June 10, 1920, p. 1161.

## Dirt Roads Treated with Steam Ashes and Cold Road Oil

By Fred. H. Shepheard and E. E. Butterfield
Office of the President of the Borough of Queens, New York City

STEAM ashes and cold asphaltic oil as a form of treatment for dirt roads in the Borough of Queens, New York City, were employed for the first time during the summer of 1920. The following specifications, representing a change from those previously used, were employed:

1. Specific gravity at 25°/25°C. (77°/77°F.), 0.930 to 0.975.
2. Specific viscosity at 50°C. not more than 30.
3. Loss at 163°C. (325°F.), 5 hours, not more than 30%. Float test of residue at 50°C., not less than 50 sec.
4. Total bitumen (soluble in $CS_2$), not less than 99.5%.
5. Per cent of total bitumen insoluble in 86° B. naphtha, not less than 6.0%.

Tests shall be made in accordance with the methods of Bulletin 691, U. S. Department of Agriculture.

It was observed that the oil purchased under the foregoing specifications tended to form a bituminous mat with the surface dirt of the road after the volatile portion of the oil had evaporated. In the fall of 1919 many of the dirt roads to which this oil had been applied were covered wholly or partially with a bituminous-dirt carpet varying from a fraction of an inch up to several inches in thickness. This was extremely important from a practical point of view. There are about 700 miles of dirt roads in the Borough of Queens and it is impossible to treat all of them with a dust-laying oil each year. If it were possible to form a more or less permanent bituminous mat upon the surface the dust nuisance would be removed and the mileage of roads requiring treatment with a dust palliative would be progressively reduced.

### Heavy Oil Forms Mat

The use of light distillate, such as is usually recommended for dust palliation, offers little prospect of permanent reduction of the dust nuisance. Furthermore, the prices of such distillates put them out of reach of a community where, under the most favorable conditions and with low-priced materials, it is only possible to treat a fraction of the total mileage of dirt roads each year. It was, therefore, necessary to turn to the heavier oils which were not usually recommended as dust layers on account of their slow volatility and their tendency to leave sticky residues on the road. If the residue, however, has binding properties and will form a mat with the surface dust and dirt that property which was formerly regarded as a detriment may be turned into an advantage. The oil which was delivered in 1919 appeared to possess this valuable property and we were encouraged to go a step further.

The surface of a dirt road is usually irregular and rutted and in such cases the uniform application of oil will not insure the formation of a protective mat even if the oil has the necessary binding properties. Furthermore, the surface dirt and dust, besides its variable nature in different localities, is not a desirable or suitable material for the mineral constituent of a bituminous mat.

If the surface of the road could be evened up, covered with inert mineral matter and followed by the application of oil, the resulting mat would be more stable and insure a better exclusion of moisture and dust from the road surface. Sand, gravel, grits, chips, could not properly be used without changing designation of the type of road and are furthermore excluded on the score of present prices.

Steam ashes were selected as the cheapest available material, possessing also the advantage of porosity. This porosity should enable the ashes to absorb a considerable quantity of oil, rendering the road dustless and at the same time not unduly wet and sticky. Ashes were purchased under specifications calling for clean ashes showing loss on ignition less than 35 per cent.

Contrary to expectations it appeared that black ashes with a high percentage of combustible matter are best suited for building up a durable surface with cold road oil. Ashes containing as much as 44 per cent of combustible matter have given excellent results. Thoroughly burned gray ash, with low combustible matter, breaks up into powder and dust and does not form a stable mat.

The method of treatment was as follows: The dirt road was honed and shaped with a road machine and all foreign materials removed. Upon the road was spread from 4 to 6 in. of ashes. The spreading of the ashes was done preferably by hand although it could have been done by road machines. After the spreading, the road was opened for a few days to allow traffic to work the ashes in. During this period the ruts were raked full and the road kept to its proper shape. The oil was then applied at the rate of ¼ to ⅜ gal. per square yard. To finish the road like a sheet-asphalt pavement all that is necessary is to roll the surface with a road roller of at least 5 tons. Only one application of oil has been used this season with the ash treatment. The cost of labor and materials averages not more than 27c. per square yard.

## Great Britain Shows 4.7% Population Gain

THE population of Great Britain (England, Wales and Scotland) on June 19 was 42,767,530 according to a preliminary announcement of the census count cabled to the New York *Times*. This is an increase of 1,936,134, or 4.7 per cent in the past decade, the smallest rate of increase in the past hundred years. It is stated that the increase would have been still less had not emigration been checked by the war. The excess of females over males in Great Britain increased greatly during the past decade, the excess for 1911 having been nearly 1,200,000 against more than 1,900,000 in 1921. The ratio of females to males in 1921 was 1,095 to 1,000, the highest ever recorded.

The administrative county of London, including the cities of London and Westminster, and some twenty-five boroughs, had a population of 4,483,241 this year, a decrease of 0.9 per cent from 1911, but the metropolitan police area showed a gain of 3.1 per cent, the total population figure for 1921 being 7,476,168.

British islands adjacent to Great Britain, but not including Ireland, for which no census was taken this year, showed a population of 299,704 this year.

Populations for other parts of the British Empire outside of those named and Canada are reported as follows: Indian Empire, 319,075,132, an increase of 1.2 per cent; Union of South Africa (Europeans only), 1,521,635, or 19.2 per cent increase; Australia (excluding full-blooded aborigines), 5,426,008, an increase of 21.8 per cent; New Zealand (excluding the Maoris), 1,218,270, an increase of 20.8 per cent.

# Liberty Tunnels Driven by Full-Section Excavation

**Double-Tube Highway Tunnel at Pittsburgh Advanced 250 Feet per Month by Alternate Drilling and Mucking Shifts—Steam-Shovel Mucking—Lining Placed Inside Lagged Steel Arch-Set Timbering**

DRIVING a two-roadway street through the South Hills at Pittsburgh to bring outlying residential districts into close connection with the downtown section of the city, the contractors, Booth & Flinn, are making systematic and rapid progress by full-section face work and steam-shovel mucking. The tunnel comprises two separate tubes each about 26½ ft. wide, spaced 59 ft. apart center to center, and is to be 5715 ft. long between portals (See *Engineering News-Record*, July 8, 1920, p. 52). The nature of the rock through

FIG. 1. SHOVEL MUCKING FULL-SECTION FACE

which the tunnel penetrates controlled the construction methods both in general plan and in detail. The material, a horizontally bedded and slightly fissured shale carrying practically no water, weathers rapidly, but for a month or more after opening up is not subject to slides or falls and puts little weight on the lagging. Because of these conditions a simple arched roof timbering is used, and the excavation is made to full section right at the working face, permitting the lining to be kept close up to the heading, usually within 100 to 150 ft. The face is actually drilled and shot in two sections, the upper or arch heading and a very short bench, just long enough to give room for drilling; all the face muck is taken out by steam shovel.

A rate of progress of 10 ft. per day, or 250 to 260 ft. per month for each tube, has been reached and maintained under this system. The work has up to recently proceeded down hill from the higher (south) end only, with no trouble whatever from water; recently the north approach has been cleared also and headings started there, though this work is under the disadvantage of a three-mile haul of the muck by motor trucks over bad grades to the disposal point, as there is no opportunity for disposal along the Monongahela River bank.

*Order of Operations*—Two shifts, day and night, are used regularly, making only one round, however. The night heading-shift drills, blasts and clears the corners of the heading for setting the wall plates; simultaneously a separate gang is engaged in concreting the lining. The day shift sets the wall plates and the timbering with its lagging, puts in the rock packing back of the lagging, and muck out the heading (by hand) while the shovel working on the floor clears out both heading and bench muck. The day lining shift moves and sets the concrete forms. This arrangement divides the haulage service, the tracks being used for concrete at night and for muck hauling in the daytime.

Payment for excavation and timbering is made by a bonus system. The lining and timbering gangs are paid 11 hr. for a 9-ft. advance and 12 hr. for a 10-ft. advance, regardless of the time required. The adoption of this system, after the beginning of the work, produced a marked advance in the speed and regularity of the work.

*Face Work*—A top heading is carried the full width of the tunnel, or about 32x15 ft. Smaller drifts were used only at the entrance. The bench face is kept about 10 ft. back of the heading face. The heading muck is largely thrown over the bench in blasting, so that hand mucking is minimized.

Small one-man drills are used, six machines to the heading and four to the bench, drilling respectively 20 to 30 holes and 16 holes. In the heading, the cut holes, four on a side, 8 ft. apart, are drilled 12 ft.

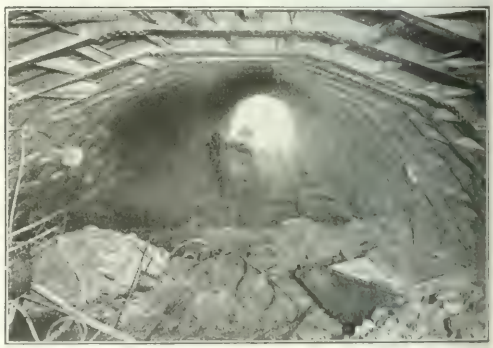


FIG. 2. SHORT BENCH BACK OF HEADING FACE

deep and the side holes 11 ft. deep, pulling 10 ft. The bench is generally drilled in two rows of 6 vertical holes 5 ft. apart, drilled 12 ft. deep, and four lifters. Drilling takes about five hours, usually. The drills being dry, the heading is quite dusty when the machines are going, but no ventilation has been found necessary except that given by the exhaust from the drills and the shovel. For blasting, a 40 per cent powder is used, 2½ to 3½ lb. per hole in the heading and 6 lb. per hole in the bench; the total consumption averages 1 lb. per cu.yd. The mucking shovel is a 1½ yd. machine operated by air. It loads into 4 yd. dump cars running on 36-in. track, and hauled in five-car trains by electric mine locomotive. Outside the tunnel the muck has

to be hauled about a mile to the dump in a public park, the track being on a 6 or 7 per cent upgrade. For this service steam locomotives are used. The total muck haulage amounts to about 200 cars per day.

*Timbering*—The arch timbering shown in the views Fig. 1 to 3 has proved very satisfactory from the standpoint of quick erection and resistance to injury by the blasting. It is also convenient in case local pressure on the roof produces distortion or in case yielding of the timbering makes it necessary to set emergency posts. Small sections of I-beam are then quickly bolted to the rings and the extra posts placed against these.

The regular ring consists of seven segments of 8-in. 32½-lb. H-beam, the segments being 6 to 6½ ft. long, terminating in a square skewback face fitted with a 15-in. foot plate. They are set generally at 4 ft. and 5 ft. alternate spacing, for a 9-ft. advance, or on straight 5 ft. spacing for 10-ft. daily advance. They are spaced by two ¾-in. tie rods and two 3x6 blocking pieces per segment, the blocking pieces being wired to the tie rods as a precaution against displacement by blasting. Yellow pine lagging 3 in. thick is laid over the rings in lengths corresponding to one ring space. Back of the lagging solid blocking is placed behind the joints between ring sections, and the remainder of the over breakage space is packed with rock. The amount of this packing is about 1.75 cu.yd. per lin.ft., or 11 per cent overbreakage. This packing is grouted, for strength and as a means of waterproofing the tunnel,

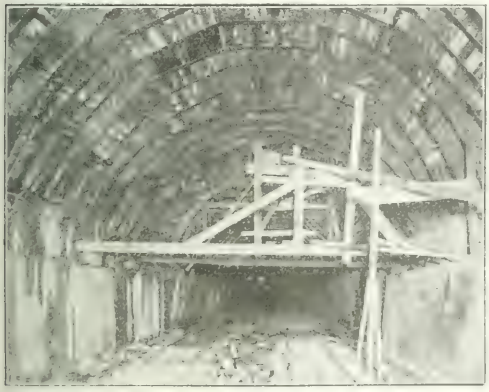


FIG. 3. SIDE WALLS AND ARCH CONCRETING

Blower 3-in. galvanized steel pipe ... on bottom flanges of beams to [illegible]

when the lining is four to six months old. For this purpose 1½-in. grout pipes are set every 15 ft., one in the crown and one in each haunch; when forms are set, the grout pipes are extended through them by pieces of 2-in. pipe slipped over them.

A 12 x 12 in. wall plate is set as a foundation for the rings, in lengths equal to the daily advance (9 or 10 ft.). The timber is notched to receive the foot plates of the rings. Where the rock is of such character as to require posting of the wall plates, the posts are set after the bench is excavated. The posts, 12x12 timbers, average about 4 ft. long, rarely extending down to the invert, and are placed at and between rings.

In placing the timbering, the material is handled into the headings by a winch attached to the side of the shovel, with ropes working on a snatch block attached to the leading ring of timbering. Ordinarily it takes from 7 to 10:30 o'clock to set, lag and pack the first ring. Some little trimming is usually necessary before the second ring can be placed, but by 2:30 this ring also is completed and packed, after which the heading men muck out, ready for the night shift to start drilling.

Originally the bench excavation was carried down only low enough to receive the roadway surface, and trenches were cut later for the sidewall footings. The cost of this trenching led the contractor's superintendent to try excavating the whole width down to footing level, the extra depth of about 2 ft. to be backfilled with tunnel muck when ready for subgrading. This plan of working proved much cheaper than the former and involved less delay in preparing for concreting, and has therefore been regularly followed since.

FIG. 4. COMPLETED LINING BEFORE GROUTING

*Concreting*—The lining operations are carried on in three stages, the footings, sidewalls and arch being concreted separately. For the footings, wooden forms are built in place, while collapsible steel forms are used for both sidewalls and arch. The arch concrete is blown into the forms by a pneumatic mixer in the tunnel, fed with premixed concrete brought in from a stationary mixing plant outside. Large yardages have been made and little delay or difficulty has developed in the concreting except during a short period when organic matter and loam in the sand interfered with proper setting. Since that time every car of aggregate is tested for organic matter and loam, and at intervals the grading is tested.

Footings are concreted to within 100 ft. of the heading (this distance being required for moving the shovel), sidewalls to a point 35 ft. farther back and the arch 50 to 75 ft. back of the sidewalls.

The sidewall form is the center of operations. It is a gantry-like structure comprising the forms for the two opposite walls and a wooden platform just above the foot of the arch, and trails back of it an inclined track about 80 ft. long, up which the concrete trains reach the platform. Under the platform is hung the pneumatic blower, which is charged directly from the cars overhead, and from which a 6-in. pipe leads back to the arch form. A tee on the end of the pipe inside this form distributes the concrete to the two sides. A pressure of 80 lb. is used for this blowing.

For the footing work, concrete is chuted from the platform deck, where it is shoveled into the chutes. The sidewall forms are filled by shoveling direct. As the concrete is mixed as dry as workable (slump, 4 to 4½ in.), it is spaded in the forms.

In preparing the arch form for concreting, the wooden spacer pieces are removed from between the steel rings, but the tie-rods are left in place and the arch reinforcement is wired to them. Holes are bored through the lagging so that in the subsequent grouting spaces between lagging and the concrete will be filled.

The sidewall form is 35 ft. long; the arch form, originally 25 ft. long, was subsequently extended by 5 ft. At the beginning of concreting, last December, when a length of about 1000 ft. of each tunnel was to be concreted as rapidly as possible before continuing the excavation, wooden forms were used to supplement the steel forms, but in the subsequent regular sequence of operations these wooden forms are not used.

Forms are stripped after 18 hr., and concreting is done every second or third day, to keep pace with the heading advance. Arch concrete is placed at the rate of six 4-car trains per hour, amounting to 16 cu.yd., which gives a rate of 160 cu.yd. per 10 hr. shift. This represents a trifle more than the volume of concrete (153 cu.yd.) in a 20-ft. length of tunnel (one tube). In an emergency period, however, over 1700 cu. yd. of arch concrete were blown in a week in a single tube.

From the actual inspection records, the full-section excavation per lineal foot of tunnel has averaged about 31½ cu. yd., against 23.7 theoretical, an excess of 34 per cent. The concrete placed has been 7.63 cu.yd., against theoretical 5.56, an excess of 37 per cent, most of the latter being in the arch.

According to J. C. Scott, resident engineer for A. D. Neeld, chief engineer in charge for Allegheny County, the productive labor cost in the work divides about 20 per cent to plant maintenance and operations, 53 per cent to excavation and disposal (29 per cent heading excavation, 7 per cent bench excavation, 17 per cent muck loading, transporting and dumping), and 27 per cent to concrete lining work.

For the contractors, the work is under the supervision of M. L. Quinn, general superintendent, R. F. Lee, field superintendent, and J. B. Sweeney, engineer.

### Italian Harbor Work Under Way

The Italian Ministry of Public Works has approved the plans for improvement of the port of Leghorn, prepared by the Leghorn Harbor Works Board in accordance with the governmental project of December, 1916. The expenditure of 70,000,000 lire ($13,510,000 at normal exchange) in construction and equipment is contemplated, of which 37,000,000 lire is for a new harbor basin, 6,000,000 lire for railway terminals, and 25,000,000 lire for mechanical equipment, warehouses, etc. The harbor facilities of Leghorn will be more than doubled by the carrying out of this plan, which is expected to take 10 years for completion. An interesting feature is the opening of an outlet on the sea for the important town of Pisa, 10 miles from Leghorn. Work has already begun on the interior waterway.

The Italian Treasury was authorized by Royal Decree of January 29, 1921, to set aside 8,000,000 lire for use of the Leghorn Harbor Works Board. The board is stated to have been able to arrange for raising the additional funds required. American firms interested in the possibility of furnishing machinery and supplies to the contractors should write to the following address: "Il Presidente, Ente Portuale di Livorno, Livorno, Italy."—Consul Lucien Memminger, Leghorn, in *Commerce Reports*.

## High Rainfall and Run-Off From Small Areas

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

A RAINFALL of unusual intensity fell on the drainage area of Honey Creek, above New Carlisle, Ohio, during the afternoon, 2 to 5 p.m. of July 29, 1918, causing flood levels in the upper sections of Honey Creek somewhat higher than during the great flood of March, 1913. Subsequent field and office investigations led to the following conclusions: (1) The maximum rainfall intensity exceeded 6 in. in three hours. (2) The depth of rainfall exceeded 2 in. in three hours over an area of 15 sq. miles. (3) The maximum rate of run-off amounted to 2,200 sec.-ft. per square mile from an area of about 6.7 sq. miles. Since recent search for data on maximum rates of rainfall and run-off from cloudbursts on small rural areas indicated that the records available were comparatively meager, the following is submitted:

The rain was unusually heavy over a narrow strip of land 5 miles long and 3 miles wide, running north and south directly over the drainage basins of the East and West forks of Honey Creek, the heavier precipitation being over the East Fork. The maximum stage on the East Fork a mile above the junction of the two streams was 28 in. higher than in March, 1913. A farmer living within ½ mile of this place measured 6 in. of rain in a paint bucket, larger at the bottom than at the top and located about 50 ft. from any obstruction. The bucket was said to have been empty when the rain began. The total precipitation at New Carlisle, the nearest rain gaging station, about 2 miles distant, amounted to only 1.74 in., the whole amount falling within a period of two hours. No other rainfall measurements were made. However, the descriptions of the residents, as well as the flood marks on the ground, indicate that the total exceeded 2 in. in three hours over an area of about 15 sq. miles. The accounts of the storm also indicate that during short periods of time the rate of rainfall was much higher than the average, as naturally would be expected. The ground was fairly wet when the rain began due to a precipitation of 0.62 in. which had fallen during the preceding evening.

The areas drained by the two forks of Honey Creek are made up of the gently rolling topography so common in the older glaciated regions. Practically all of the land is cultivated, not over 2 per cent being in timber. Ground slopes vary from 40 to 100 ft. per mile through the fields and from 20 to 40 ft. per mile along the streams. The surface soil is a glacial till containing some sand and some gravel, but it is not unusually pervious.

Careful hydrographic surveys were made immediately after the flood, before any of the high water marks became obliterated. Flooded cross sections and water surface slopes were measured at the upper, as well as the lower ends of the strip of land on which the heavy rain fell, so that estimates of the maximum rates of run-off could be made for the proper areas. Drainage areas were determined from the U. S. Geological Survey topographic quadrangles. Calculations by Kutter's formula, using values of $n$ of from 0.040 to 0.060 according to local roughness conditions, gave the following results:

| Stream | Drainage Area in Sq.Mi. | Total Discharge Sec.-Ft. | Rate of Run-off in Sec.-Ft. per Sq.Mi. | Rate of Run-off in In. per Hour |
|---|---|---|---|---|
| East Fork of Honey Creek ... | 5 1 | 350 | 70 | 0 11 |
| East Fork of Honey Creek | 11 8 | 15,200 | 1,290 | 2 00 |
| East Fork of Honey Creek. | 6 7 | 14,850 | 2,210 | 3 43 |
| West Fork of Honey Creek | 21 5 | 3,810 | 177 | 0 27 |
| West Fork of Honey Creek .. | 18 0 | 300 | 17 | 0 03 |
| West Fork of Honey Creek... | 3 5 | 3,510 | 1,000 | 1 55 |

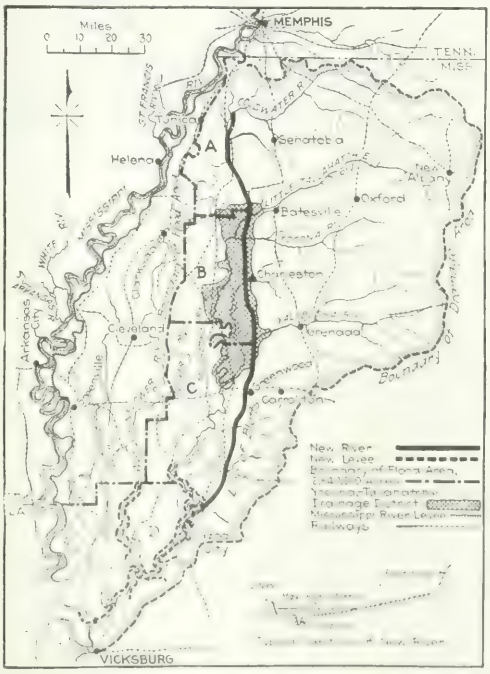
While the above data are somewhat uncertain they are not believed to be greatly in error. Cross sections and surface slopes were accurately determined, so that the only chance for error lies in the application of the Kutter formula. The calculated velocities varied from 2.5 to 7.3 ft. per sec., which do not seem unreasonably high for flood conditions in streams having such steep slopes.

# A New River Planned for Flood Protection and Drainage

## In Largest Drainage Project for 4,000 Square Miles Along Mississippi a 140-Mile Channel to Carry Off Hill Waters

A FLOODWAY channel or new river 140 miles in length is the striking feature of a project for the flood protection and land drainage of about 4,000 square miles in what is known as the Yazoo delta, in Mississippi. This is considered to be by far the largest area ever included in one drainage project.

The Yazoo delta is an oval area of about 7,000 square miles of alluvial land extending from near Memphis, Tenn., to Vicksburg, Miss., about 200 miles, and having a maximum width of about 60 miles. Its western boundary is the Mississippi River, and its eastern boundary is a line of foothills. As shown by the accompanying map, the Coldwater River enters near the north end and after about 40 miles joins the Little Tallahatchie River to form the Big Tallahatchie; the latter in turn joins the Yalobusha River about 40 miles further south, near Greenwood, to form the Yazoo River. A winding channel through the eastern part of the district and 4 to 10 miles from the foothills is formed by the Coldwater, Big Tallahatchie and Yazoo rivers, but south of Yazoo City this last river keeps more closely to the foothills until it enters the Mississippi River just above Vicksburg.




FLOOD PROTECTION AND DRAINAGE FOR YAZOO DELTA

Existing levees along the west side of the delta protect it from the Mississippi River, but as these stop about 20 miles above Vicksburg, the lower portion of the area is subject to overflow by backwater. With the river thus shut off, all the internal drainage is received by the Yazoo River, which has a drainage area of some 14,200 square miles, half of this being in the delta and half in the hill lands to the east. These hill lands, subject to frequent and heavy rainfall, have a sharp slope, giving a rapid runoff to the streams. Although the delta has numerous water courses they are inadequate to carry the combined runoff, so that both flood protection and improved drainage are needed for about 4,000 square miles in the eastern and southern portions. Much of this area is already under cultivation.

The western portion, about 3,000 square miles, is protected against floods by the Mississippi River levee and by a divide east of the Sunflower River. Adequate natural drainage for this part of the delta is provided by the Sunflower River and other streams, all of which drain eventually into the Yazoo River.

The necessity of co-operation in a project of such magnitude is illustrated by the earlier developments in the delta. In 1908, a drainage district of 2,340 square miles was organized in the northern part, but owing to opposition by some landowners the comprehensive plans were abandoned and in 1911 the district was dissolved. Since then a number of small districts have built ditches and levees and have straightened some of the hill streams, with the result of causing heavier and more frequent floods outside these local districts. In fact, it is stated that many tracts which were formerly cultivated with success are now unprofitable by reason of too frequent flooding.

Owing to this increase in floods, landowners near the confluence of the Coldwater, Little Tallahatchie and Yalobusha rivers organized the Yocona Tallahatchie district in 1917 and engaged engineers to investigate the necessary protection and drainage works. It was soon found that such works would have to extend far beyond the legal boundaries of the organized district. When the situation was explained to the landowners, they directed the engineers to consider the broader problem of flood control for the entire northern part of the delta, as far as Greenwood, Miss.

From these studies was developed the New River project for carrying off all the hill storm waters in a floodway formed for a distance of 140 miles. The north end would intercept the Coldwater River and the south end would discharge into the Yazoo about five miles above Yazoo City. From the latter point levees would be built along both sides of

the Yazoo River and its main tributaries. The Mississippi levee would also be extended south to connect with the Yazoo levee and thus protect the southern part of the district from both headwater and backwater floods. The floodway would be from ½ mile to 1½ miles wide, with a levee averaging 17 ft. in height.

Gates in the levee would be open normally to permit the runoff to pass into the natural channels through the delta and maintain the necessary supply for cultivation. At flood times, these gates would be closed, and all flood waters from the hills confined to the floodway, the internal runoff of the delta lands being carried by the water courses and ditches. A low water channel in the floodway would drain the enclosed land after flooding. Silt basins and lateral levees would be provided at the entrance of hill streams into the floodway.

About 60 per cent of the area of the delta, or 2,540,000 acres in the eastern and southern portions, is subject to overflow and subsequent delayed drainage, as noted above. This portion divides logically into the four sections indicated on the map; A, Coldwater section, 310,000 acres; B, Tallahatchie section, 480,000 acres; C, Yalobusha section, 850,000 acres; D, Brunswick section, 900,000 acres. It is expected that the work will be carried out by three or four drainage districts, organized separately, but co-operating in a general plan. The Yocona-Tallahatchie district, shown by the shaded area on the map, is already organized. This district and others partly organized include more than half of the flood area and steps are being taken to co-ordinate their work.

Investigations for this extensive project have been carried on since 1918 by the Elliott-Harman Engineering Co., Peoria, Ill. The expense of flood protection is estimated at about $15 per acre, this estimate being based on studies made for the area of about 1,000,000 acres north of Greenwood, Miss.

### Lumber Value Not Affected by Turpentining

Contrary to usually accepted theory the operation of turpentining pine trees does not lower the strength or resin content of the wood, according to information obtained by the Forest Products Laboratory, Madison, Wis. The crude turpentine, or oleoresin, is not drained from a store in the tree, but is manufactured under the stimulus of the wound by living cells in the sapwood immediately adjacent to the cut on the trunk. The major part of the tree is not appreciably affected, and the loss due to death of trees or to a reduction or degrading of lumber is very small when the proper method of turpentining is followed. This loss is more than offset by the additional revenue obtained through turpentining. The greater part of the wood that is chipped away would not have become finished lumber, but would have gone into slabs and edgings at the sawmill.

## Small Station Layout Illustrated in New Structures

### Illinois Central R.R. Depot and Freighthouse Good Examples of Building and Trackwork at Smaller Cities

A RECENT example of improvements to railway station layouts in cities of the smaller class is afforded by the entire reconstruction and rearrangement of the passenger and local freight facilities of the Illinois Central R.R. at Centralia, Ill., this work having become desirable in order to accommodate the increasing business and being hastened by the destruction of the old passenger station by fire. Instead of simply erecting a new station building, the opportunity was taken to revise the whole layout at a cost of about $400,000 for a new station, freighthouse, tracks and approaches. The buildings are shown in Fig. 1, and the general plan in Fig. 2.

FIG. 1. STATION (ABOVE) AND FREIGHTHOUSE (BELOW) AT CENTRALIA, ILLINOIS CENTRAL R.R.

This town of about 13,000 population is the terminal of three divisions and has a large engine terminal and a freight yard with gravity switching, but as no division headquarters are located here it was only necessary to provide offices for the station staff. There is a passenger service of about 35 trains daily. When the Illinois Central R.R. was built through Centralia in 1853, a three-story brick station and hotel was built, the hotel serving both the public and the railway employees. This building was burned in February, 1918, together with adjacent two-story frame buildings for baggage and express. In removing the old freighthouse, built at about the same time as the station, it was found that it had white oak posts and framing, yellow poplar flooring, joists and rafters, white pine siding and yellow poplar sheeting 12 to 18 in. wide. All the framing was mortised and draw-pinned.

To increase the passenger facilities, the double track main line has been developed to give four tracks through the station, with two brick platforms 16 x 1,000 ft. and one 12 x 400 ft. The lighting is by elec-

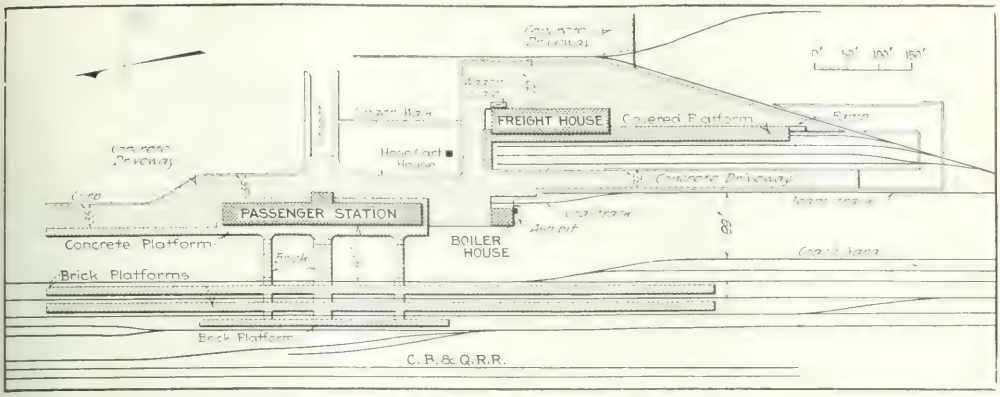



FIG. 2. LAYOUT OF NEW STATION AT CENTRALIA

tric lamps on tall poles, no platform shelters being built. A two-track coach yard for passenger cars that lay over at night is provided with water and steam heat connections. For the local freight service there are three stub tracks at the freighthouse, team tracks, industry tracks and a branch to the boiler house of the station. Concrete driveways serve the passenger station and freighthouse and the surroundings will be made attractive by grass plots and shrubbery.

In the design of the passenger station, 314 x 37 ft., a feature of interest is its division into three parts separated by 23-ft. arcades but all under one roof, as shown in Fig. 3. The two-story central portion has the principal station facilities; ticket office, waiting and toilet rooms in the middle, with the baggage and express rooms at opposite ends. On the upper floor are

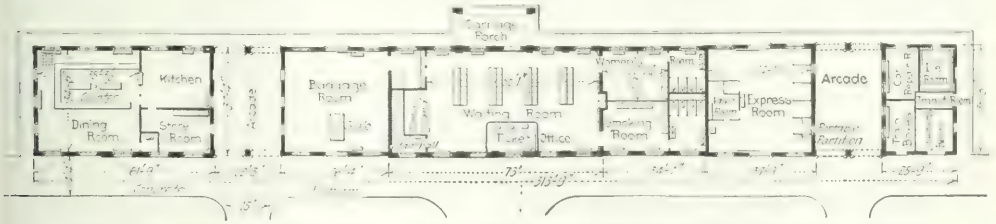



FIG. 3. PLAN OF PASSENGER STATION, SHOWING ARCADES SEPARATING IT INTO THREE PARTS

the telegraph office, a conference room and offices for the assistant yardmaster, track supervisor, conductors, switchmen and special agent. The dining room and kitchen occupy one of the separate one-story end portions of the building, the other having an ice room and rooms for the linemen and car repairers. The freighthouse, 182 x 40½ ft., has for half its length an upper floor for offices and file room. Beyond the building is a covered platform 24 x 274 ft.

Between the two main buildings is a boiler house for the heating plant, coal for which is dumped into a combined track hopper and storage bin, the floor of which is level with the boiler room floor. Ashes are stored in an underground bin which is fitted with a vertical bucket conveyor discharging through an inclined spout either into a car or a wagon. A pipe tunnel in the station gives ready access to the steam and water pipes and electric conduits. For fire protection there are four outside hydrants and the freighthouse has water connections with hose attached.

A rough dark red brick is used for the exterior, with trimmings of Bedford limestone for the station and of precast concrete for the freighthouse. Timber trusses and trussed rafters carry slate roofing, except that the boiler house has a concrete roof. Buff pressed brick forms the interior of the waiting room, but otherwise the finish is mainly of wood in both buildings. Iron plate protection for the lower part of the exterior wall on the driveway side of the freighthouse is an unusual provision, the plating being ⅜ in. thick and 29 in. high. Large sliding doors are placed in both sides of the freighthouse.

The general building contract was let to Joseph E. Nelson & Sons, Chicago. Tracklaying and installation of electric equipment were done by railway forces. The buildings were designed by D. F. McLaughlin, architect for the railway, and the work was in charge of F. R. Judd, engineer of buildings. Both design and construction were under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.

## How Residences Follow Street Car Lines

In the four cities clustered together on the east side of San Francisco Bay, 3,353 residential building permits were issued during the 18 months ending June 30, 1921, and of these 85 per cent were within three blocks of street car lines. The estimated cost of this 85 per cent was $15,030,412 as against $1,433,355 for those not within three blocks of a car line.

# B. Welchii, Gastro-Enteritis and Water Supply

## Short Cuts to Purity—B. Enteritidis Sporogenes Test Abandoned in London—Case Against B. Welchii and Other Spores Not Proven—More Studies Suggested—B. Coli Test Remains Supreme

By Sir Alexander Houston, K.B.E., C.V.O., M.B. D.Sc.,
[illegible], Metropolitan Water Board, London, England

*A continuation and to some extent a critical review of the discussion of the same general subject by 66 water experts in "Engineering News-Record," June 2 and 9, 1921. The frequent references in those articles to Dr. Houston as an exponent of British practice and opinion led "Engineering News-Record" to secure this contribution from him.*

*Dr. Houston worked for the British Local Government Board on lead poisoning from moorland water and on other public health studies, 1893 to 1905; for the London County Council on sewage treatment experiments, 1898-1900; was bacteriologist to the Royal Commission on Sewage Disposal, 1899-1905; bacteriologist to the City of Lincoln, England, during the typhoid epidemic of 1905, and has filled his present position, noted above, since 1905. During the Lincoln epidemic Dr. Houston introduced chlorination of the water supply, which was continued until a new supply came into use in 1911. Besides various papers and reports, including a notable series of research reports on the contents and treatment of London water, he has published: "Studies in Water Supply" (1913); "Rivers as Sources of Water Supply" (1917); and "Rural Water Supplies and Their Purification" (1918).*—Editor.

I PROPOSE to make a few comparisons between "slow" and "rapid" filters, touch on the views of "chlorinators" and "anti-chlorinators"; point out the divergent claims made as regards the identity of B. Welchii. etc.; deal with the evidence implicating the spores of anaerobes generally; suggest that comparative bacteriological and epidemiological investigations should be carried out in the United States and Canada; consider the evidence of American sanitarians on this thorny subject; and to reiterate the views I expressed in 1912 as regards the supremacy of the B. Coli test.

In England slow sand filtration has been practised for a great many years, and the advocates of this form of purification have weapons in their armory which render their position almost unassailable. First of all, they have the evidence that initially impure waters have, after slow filtration, been supplied with apparent safety to consumers over a long term of years, and they claim, with good reason, that this honorable history is better than the opinions of all the scientists in the world. Secondly, they have the knowledge that slow sand filtration removes bacteria *of all sorts* from water to an extent unattainable by rapid or mechanical filtration without, and perhaps even with, the use of coagulants in *economical* amount. So true is this claim that users of mechanical filters almost invariably are driven to employ supplementary processes of purification—for example, coagulants or chlorine, or both these agencies. Lastly, they plead that the almost perfect way a slow sand filter removes all the living matters from water renders the process beyond the reach of criticism, and in this connection they justly point out that our knowledge of the causes of at all events some water-borne diseases is either speculative or not absolutely proved; hence, the all but complete removal of living "particulate" matter from a water removes the possibility of disease being caused by it, whatever may be the precise nature of the infective agent. In other words, they contend that whether A, B, C or X, Y, Z are the responsible agents, by removing the whole alphabet all the known or unknown causes of disease are eliminated.

On the other hand, the advocates of mechanical filters justly point out that slow sand filters are not well adapted to certain climates and to particular kinds of water. Most of them indeed go much further than this and claim that with the aid of coagulants and chlorine, as good or better results can in all cases be achieved with mechanical as with slow sand filters, and at equal or less cost.

The use of mechanical filters, coagulants and chlorine is extending very slowly in England, but in the United States and Canada it is the almost universal custom to rely upon these agencies separately, or in conjunction, for the purification of water. Within recent years there have arisen out of this some elements of controversy which require delicate handling.

There is no doubt that chlorination has led, perhaps not unreasonably in view of its apparent effectiveness, to what may be termed "short cuts to purity." It is to be seen in its most transparent guise when impure water is sterilized, in lieu of any filtration process, directly by means of chlorine. In less transparent form it crops up in connection with rapid filtration processes and is usually to be regarded not so much as an additional safeguard as an admission that the filtration system adopted is only relatively satisfactory.

The advocates of sterilization say that the crux of the position lies in the destruction of B. Coli, and certainly this microbe is the most amazing indicator of a potential danger that could possibly be conceived, in view of the fact that one gramme (about 15 grains) of human faeces harbors at least one million, and that in pure waters it is absent from one hundred or more times this amount.

Nevertheless, there are epidemiologists, bacteriologists and others who, with no ulterior object to serve, are opposed to chlorination. They plead, among other things, that chlorination is often the cloak to cover imperfections, and that frequently the dose is governed less by questions of safety than by those of taste. This question of taste is truly one of paramount importance. Those who seek to evade its embarrassing features by reducing the dose of chlorine are often unconsciously flirting with danger.

In addition a school has arisen whose pupils directly challenge the supremacy of the B. Coli test. In effect the position is strained, but the writer is not one of those who imagines that controversy on this subject is gov-

erned by other than purely altruistic considerations. The writer has sought to place himself in sympathetic touch with current opinions, but he is faced with the circumstance that many of the views expressed on the subject are, owing to our imperfect knowledge, so indefinite as to verge on the nebulous.

### Some Doubt Whether B. Welchii is a Spore Former

There seems, for example, some element of doubt whether B. Welchii is a sporing or non-sporing microbe. In England it is regarded as a spore-bearing organism and many consider it as identical with B. Aerogenes Capsulatus, if not with B. Enteritidis Sporogenes (Klein).

D. D. Jackson, Columbia University, New York City, considers that B. Sporogenes and B. Welchii are absolutely distinct (see *Engineering News-Record*, June 9, 1921, and particularly the table on p. 1002).

However, if for the sake of argument it is convenient for the moment to suppose that B. Welchii is a non-sporing and even pathogenic microbe, where does this view lead us? Not very far, the "chlorinators" will say, because chlorination presumably would destroy it equally with B. Coli. Certainly it is a fact in the writer's experience that when a river water is being chlorinated successfully the number of bacteria growing in agar at 37 deg. C. is practically identical in (a) unheated cultures and (b) in cultures previously heated to 80 deg. C. for ten minutes to kill all but sporing organisms. (Curiously enough the "heated" cultures tend to yield slightly higher results than those which are not "heated.") The obvious inference is that if there are any pathogenic non-sporing microbes in water they will be destroyed by the chlorination process.

The foregoing remarks refer to aerobic cultures (heated and unheated) but the writer thinks that anaerobic cultures would yield comparable results. He, of course, admits that even among the non-sporing bacteria there are degrees of resistance to chlorination treatment, and that where the dose is unduly reduced some may survive, although the majority have perished. Nevertheless, his experience has been that if the treatment is pushed to the extent of destroying B. Coli, practically all the other non-sporing microbes also suffer extinction. When we come to consider sporing germs the case is widely different, for even the "chlorinators" will readily admit that it is impracticable to kill the spores of bacteria.

### Can Any Spores Cause Gastro-Enteritis?

The writer proposes to disregard the identity of B. Aerogenes Capsulatus, B. Welchii, B. Enteritidis Sporogenes, etc., and ask himself the simple question, is there any convincing evidence that the spores of any microbe are capable through water supply of causing gastro-intestinal disturbances?

Gastro-intestinal disorders are not uncommon; they are frequently associated, rightly or wrongly, with errors in diet, tainted food, impure shellfish, contaminated milk, high temperature, sudden chills, insanitary conditions, influenzal epidemics, etc. Communities enjoying the use of water supplies from virgin gathering grounds suffer from them, and it has still to be proved satisfactorily that populations less favorably situated in this respect and consuming chlorinated waters are affected to an abnormal extent.

Our milk supplies, from the udder of the cow to the mouth of the consumer, sweat with opportunities for spore infection. The writer would hesitate to accept any evidence implicating a water supply as a causative factor in the production of gastro-intestinal disorders *through the medium of spores*, until he was satisfied that the milk supply, at all events, was fully exonerated. Nevertheless, it must not be concluded from this that the writer considers that milk is *necessarily a potent* factor in creating the symptoms which characterize obscure intestinal affections.

Many of us believe that infections are largely caused by some accidental circumstance which sets free a great army of hostile invaders (e.g., the discharges of a "carrier") or, alternatively, and less convincingly, by bacilli possessed of such intense morbific power that even singly they can overcome the natural resistance of the individual.

When we consider the distribution of spores in nature as compared with bacilli and consider that they are non-multiplying factors in connection with water supply, the writer feels that their numbers are in most cases insufficient to cause water-borne disease, unless one or a very few spores are sufficient to create infection.

### B. Enteritidis Sporogenes Test, London

In London the B. Enteritidis Sporogenes test was carried out from 1905 on to the end of 1909 as regards the filtered waters, when it was abandoned as the results were always practically negative, but it was continued until March 31, 1916, in connection with the examination of the raw waters. Taking the year ended March 31, 1909, as an example the results were as follows:

B. ENTERITIDIS SPOROGENES IN LONDON WATER
In percentages of total samples examined

| | 100 c.c. | 100 to 10 c.c. | 10 to 1 c.c. | 1 to 0.1 c.c. | 0.1 to 0.01 c.c. |
|---|---|---|---|---|---|
| | Per Cent | Per Cent | Per Cent | Per Cent | Per Cent |
| River Thames | 40 3 | 57 6 | 2 1 | 0 0 | 0 0 |
| River Lea | 17 3 | 52 6 | 44 1 | 6 0 | 0 0 |
| New River | 57 6 | 40 3 | 2 1 | 0 0 | 0 0 |
| Filtered Waters | 96 9 | 3 0 | none | none | none |

It is obvious that the test as applied to the filtered waters yielded practically negative results, and, unlike the B. Coli test, it gave no useful indication throughout the year of important fluctuations in the quality of the supply to the Metropolis. Even with the raw waters, positive results were largely confined to relatively large amounts of water, and when the writer compared the results with those yielded by other tests he decided, rightly or wrongly, to concentrate the work in other, and in his view more important directions.

### An Indicator of Stormy Fermentation Only

It is of importance to note that the test was employed as an indication of "stormy fermentation" and not as affording proof of the presence of any particular spore to the exclusion of the spores of other anaerobes. The following quotation from p. 157 of the writer's "Studies in Water Supply" will make this point clear:

> The milk tubes are examined and those showing the B. Enteritidis Sporogenes phenomenon (gas formation, separation of the whey from the casein with precipitation of the latter) are registered as positive results. It may be objected that a variety of microbes may produce these changes, and the writer has always frankly admitted that he regards the test primarily as a test, and not necessarily as proving the presence of a particular microbe, and that microbe alone.

The above changes in milk culture were described by

Klein as characteristically typical of the growth of B. Enteritidis Sporogenes, and so it is both complimentary and convenient to retain the name, although the word *test* should be added as signifying that, in recording a positive result, one is not necessarily committed to the view that the characteristic changes are produced solely by one microbe, and that the one described by Klein. The practically important point is that sewages commonly yield a positive result with 0.001 c.c. and pure water a negative result with 10 c.c. or even more.

Apparently Dr. G. E. McLaughlin, Jersey City, adopts very similar views, for he says (*Engineering News-Record*, June 2, 1921, p. 929):

It may be objected that a variety of microbes may produce these changes, but I frankly admit that I regard this procedure primarily as a test, and not necessarily as proving the presence of any particular microbe, and that microbe alone.

In England the subject of the possible relation of spores to gastro-intestinal disorders does not lend itself readily to experimental investigations. Nearly all, if not all, of our large supplies are either derived from sources which are almost, if not quite, unimpeachable in character, or else they are subjected to very thorough processes of water purification.

In the United States and Canada the writer believes that the conditions are more favorable for comparative observations. That is to say, that there are many places where filtration is either not practised at all, or is admittedly imperfect, and where chlorination is relied upon to correct all the imperfections of an otherwise potentially "unsafe" water, and also a great many cities where the conditions of water supply approach the ideal.

A comparison between the two, bacteriologically (quantitative and qualitative spore tests) and epidemiologically (occurrence of gastro-intestinal disorders) would be of far-reaching importance, but it would necessarily have to be a condition of the investigation that in the former case the chlorination treatment was *really* effective in destroying B. Coli and allied non-sporing germs.

The writer conjectures that food (including milk) conveys to our alimentary tracts as many, or more, spores, than a water supply, although this is no convincing argument against the importance of reducing the risks (if there *are* risks) of infection to a minimum by purifying water to the highest standard possible.

### Spore Theory on Insecure Foundations

The evidence that spores are, *through water supply*, instrumental in causing gastro-intestinal disorders rests, for the moment, on insecure foundations, and the writer cannot help feeling that in the presence of a chlorination process which really (and not merely nominally) destroys B. Coli in water, the danger of disease occurring has been unduly exaggerated. In cases where B. Coli is not killed, and therefore where other non-sporing bacteria of pathogenic sort escape destruction, the results may be different, but this, if it occurs, arises out of the imperfection of the chlorination process and is not, as the writer thinks, due to the presence of spores.

In the *Engineering News-Record*, June 2 and 9, 1921, pp. 929 and 998, there is an interesting summary of answers from 66 distinguished sanitarians to the question of the relation of B. Welchii to water-borne intestinal troubles. There are only two answers decidedly in the affirmative; one considers it doubtful, and all the rest either give no answer (presumably equivalent to "no conclusion reached"), or express views summarized as doubtful, not proven, no data, no proof, no, possibly, uncertain, and no more than B. Coli. This is not, to say the least of it, a concensus of opinion in favour of B. Welchii, or allied germs, being related to gastro-intestinal disorders.

J. H. O'Neill, New Orleans, says:

In the Summer of 1919, by request, the city bacteriologist of Shreveport tested for B. Welchii and found it in the Red River and Bayou water after rapid filtration and liquid chlorination. B. Coli is seldom found in the treated supply, but a large number of samples examined ferment lactose on the presumptive test. I believe there is some relation between these lactose fermenting organisms (probably in many cases B. Welchii) and the incidence of enteric diseases other than typhoid, *but I have no definite data.*" [The italics are mine.—A. C. H.]

Prof. D. D. Jackson, New York City, says:

They [B. Welchii and B. Enteritidis Sporogenes] are indicative of contamination in water, are both pathogenic to guinea-pigs and have often been found by the author and others in cases of intestinal disturbance, particularly among small children where the resistance is low.

### B. Welchii Spores Not Proved Dangerous

The writer does not think that the presence of B. Welchii in diarrhea stools is evidence of its causative connection, especially in view of the fact that B. Welchii, B. Enteritidis Sporogenes, etc., are found in the discharges of healthy normal individuals. Nor is pathogenicity to guinea-pigs any proof necessarily of real harmfulness to the human species.

Further on Prof. Jackson says:

The occasional presence of organisms [B. Welchii and allied forms] of this character is becoming more apparent since the removal from water and sewage of a large proportion of the numerous other species by chlorine treatment, and much more attention should be paid to the determination of the presence of members of this group than has been the case in the past. It is evident that where such organisms are found in drinking water efficient filtration as well as chlorination should be applied.

The remaining affirmative answer comes from H. B. Larner, health officer, Montclair, N. J., but the writer has not been able to trace in the documents in his possession the exact reasons on which Mr. Larner bases his contentions. It appears, however, that in 1918 there was an outbreak of 1,625 cases of diarrhea in Montclair (population about 30,000) ascribed to the water supply, and so large a proportion of cases must, the writer thinks, have been caused either by milk or water. Again in 1921 a telephone canvass of physicians disclosed 187 cases of diarrhea.

In the earlier epidemic the water consumption was temporarily increased very greatly owing to the cold weather and war emergencies, and it also appears that the filters were by-passed so that unfiltered but chlorinated water was supplied to the inhabitants. The writer would greatly like to know whether during this period (1) the *uniform* destruction of B. Coli was definitely established, and (2) whether all possible causes, other than water supply, were eliminated satisfactorily.

[As to (1), in the account of the 1917-18, outbreak *Engineering News-Record*, Feb. 28, 1918, p. 432, it is stated that analyses made every three days up to about Jan. 15 and every day after that showed nothing unusual. which in the case of the Montclair supply means water of

a very high grade, so far as disclosed by analysis. Regarding (2): Detailed investigations by both the local and state health authorities convinced them that the water supply was the only possible common source of infection—EDITOR.]

The second epidemic (?) would have been more impressive if a canvass had simultaneously been made of some other towns, the water supply of which had not fallen under suspicion. If we are forced to accept both of these outbreaks of diarrhea as water-borne, the position is serious, as in 1921 the water was filtered as well as chlorinated.

### SOME UNKNOWN FACTOR IN MONTCLAIR OUTBREAKS?

Having regard to the fact that a great many of the towns in the United States and Canada are supplied, so the writer is informed, with water, not only initially more impure, but apparently less perfectly treated than as seemingly been the case at Montclair, it is remarkable, to say the least of it, that similar and worse manifestations have not occurred wholesale. Have we been blind to comparable outbreaks at other places, or is there some factor in the Montclair situation, which, if known, would at once relieve our minds of all further anxiety?

The writer is in agreement with those who consider that the microbes causing "stormy fermentation" should be more thoroughly studied and classified, but this will take a long time, and meanwhile he thinks there is much common sense in the remarks of W. F. Wells, Albany, N Y.:

> Until more definite methods for classifying the B. Welchii group of organisms are developed it seems better for the partial water-works operator to make a broad classification and not attempt to go into finer distinctions. Until one particular member of the group is discovered to have pathogenic effect when taken in small numbers in drinking water it is only logical to assume that the wide distribution of the general group, and its common occurrence in drinking waters without any distinct result having been observed, makes its presence no cause for alarm.

Many other quotations might be made with advantage, and in selecting the opinion of N. J. Howard, Toronto, Ont., for special reference, the writer does so because it reflects so accurately the views of a large body of practical sanitarians:

### EFFICACY OF CHLORINE IN CONTENTION

> If it can be clearly shown that B. Welchii is the direct cause of intestinal disturbance a very difficult controversy will arise, involving a radical change in present ideas of the efficacy of chlorine in eliminating water-borne epidemics. The results of *effective* [italics mine—A. C. H.] chlorination have been so conclusive that one hesitates to accept any such new theories, because, if the contention were a sound one, epidemics would be of frequent occurrence in almost all American cities.

> It needs to be remembered that the controversy alluded to by Howard involves even slow sand filtration plants, although, doubtless not to the same extent, because they are relatively, and not absolutely perfect in the matter of elimination of spores. Indeed there is no water purification process in existence which is not involved in greater or lesser degree in the criticisms of the "stormy fermenters."

The writer's long and varied experience of matters relating to water supply has taught him the importance, for the interests of truth, of paying the utmost deference to the views of others. At the same time, he cannot help feeling that, in the present state of our knowledge, the importance of the "stormy fermenters" in relation to gastro-intestinal disorders and in connection with water supply has been unduly magnified.

### B. COLI TEST STILL REMAINS SUPREME

As regards any doubts thrown on the supremacy of the B. Coli test the writer desires, in conclusion, to reiterate the observations he made nine years ago (*British Medical Journal*, Sept. 21, 1912) because he thinks that they remain equally true today:

> Typical B. Coli (lactose +, indol +) is present in enormous numbers in excremental matters, and is absent from, or present only in small numbers in, substances free from undesirable pollution.
>
> Typical B. Coli is a decadent microbe when divorced from the animal body; hence its presence in a water in any number probably points to fairly recent pollution.
>
> Pure waters, general speaking, contain no typical B. Coli in 100 c.c. in a majority of representative samples; and incidentally it may be stated that impure waters can be so purified as to yield similar results at a not unreasonable cost.
>
> Even so lenient a standard as "no typical B Coli in 1 c.c." of water in a majority of representative samples implies that the supply is not habitually contaminated with 1 gal. of sewage or its bacteriological equivalent, even in 100,000 gal. of water. The 10 c.c. and 100 c.c. standards (that is, no B. Coli in these amounts) obviously connote the absence of 0.1 and 0.01 gal. of sewage respectively from a like volume of water.
>
> With the establishment of too severe standards there is danger of condemning reasonably safe supplies, and with too lax standards there is the possibility of passing waters which ought properly to be condemned. Always to steer safely between the Scylla of the one and the Charybdis of the other may be difficult or impossible without the aid of a pilot familiar with all the local conditions.
>
> The B. Coli test ought primarily to be regarded as a quantitative decimal enumeration of "lactose +, indol +" microbes, but the subsequent grouping, according to certain attributes of the organisms thus obtained, into fairly stable or apparent varieties, may be of real practicable or diagnostic importance.

### A SUMMATION OF VERDICTS

Standards are worse than useless if they are not interpreted with discretion and in relation to local and other conditions. Instances could be quoted where even similar B. Coli results ought properly to lead to dissimilar conclusions as regards quality and safety.

The B. Coli test even alone is of the greatest value, but a water supply should be finally judged on a summation of verdicts (geological topographical, physical, bacteriological and chemical).

The B. Coli test is by far the most reliable and speediest method of judging the degree of efficiency of the particular water purification process under investigation, and when a sterilization treatment is in operation, the certified destruction of B. Coli should afford absolute proof, practically speaking, of the divitalization of all the microbes of epidemic water-borne disease.

The B. Coli test having now survived the various vicissitudes of an earlier time, stands today as the most practical and delicate and rapid test for excremental filth, and may surely be taken as the most reliable indicator in its positive aspects of possible danger, and in its negative aspects of the almost certain absence of microbes associated with epidemic water-borne disease, and, generally speaking, as the one test which, above all others, it is least excusable for a water analyst to omit.

All the counts in the indictment charged against the B. Coli test when fully marshalled amount to no more than this: The test is only, or mostly, of relative, not absolute, value, and therefore the results should be interpreted with discretion.

# New Laboratory Abrasion Test for Concrete

## With Spherical Test Pieces the Standard Brick Rattler Gives Definite Results in 900 Revolutions

By C. H. Scholer
Director of Tests, Kansas State Agricultural College, Manhattan, Kan.

*For about two years the engineering experiment station of the Kansas State Agricultural College, in conjunction with the Kansas Highway Commission, has been studying the possibilities of a laboratory abrasion test, with standard apparatus, which would give definite results in comparing concrete mixtures for pavements. The nature of this study, which is now considered successful, is described in the following article.*—EDITOR.

A NEW abrasion test for concrete is being developed by the Engineering Experiment Station of the Kansas State Agricultural College. The test consists of casting 9-in. spheres of the concrete to be tested and after proper aging and curing, submitting them to abrasion in a standard brick rattler using a standard abrasive charge. It has been found that the full hour's run of 1,800 revolutions is not necessary, 900 revolutions giving sufficient loss on even the toughest specimens to indicate the relative resistance to abrasion, offered by the material.

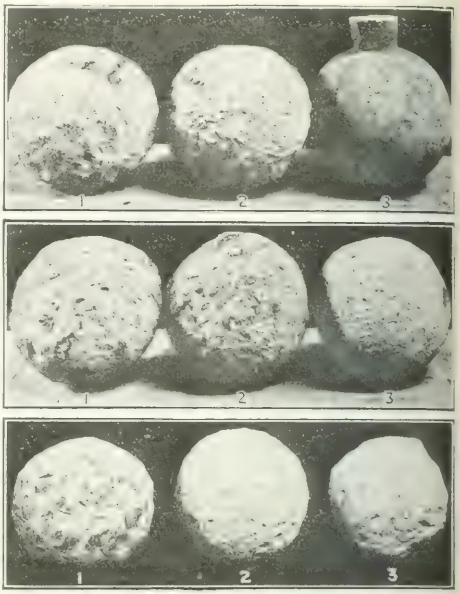
CAST-IRON MOLD FOR SPHERES

Spherical specimens were adopted after a trial of rectangular and cylindrical specimens because of the peculiar advantages offered by the spherical surface.

An examination of rectangular specimens after they are tested shows that a considerable portion of the loss is due to the exposed edges and that this loss is not a measure of the resistance to abrasion offered by the surface. The 9-in. spherical surface affords a very good approximation of the plane surface of a pavement especially as it relates to its resistance to abrasion.

The use of spherical specimens eliminates the necessity of a special type of rattler, as they can be tested in the standard brick rattler with the standard abrasive charge.

The first spheres were made in concrete molds cast over a wooden pattern. In one-half of the mold a 2-in. gate was left, through which the concrete was poured. These molds were thoroughly paraffined and oiled on the inside and little difficulty was found in removing the forms after the specimens were cast. After it was found that the test was practical, a number of cast iron molds were prepared and are now used exclusively in casting the spheres. Considerable care had to be exercised in placing the concrete forms together so that the two hemispheres were concentric and there was also difficulty in puddling and ramming the concrete, lest the alignment of the forms be disturbed. The cast-iron forms can be jolted and rolled to eliminate air voids and further to compact the concrete.




(ABOVE) WISCONSIN GRANITE 1 : 2 : 3½ CONCRETE
(1) 10.2 per cent loss; (2) 11.1 per cent loss; (3) before testing, 28 days old.

(MIDDLE) GRAVEL AND CHATTS CONCRETE COMPARED
(1) Arkansas River gravel 1 : 2 : 3½ concrete 28 days old, loss 22.8 per cent; (2) same as No. 1, 21 per cent loss; (3) Joplin Chatts 1 : 3 concrete 28 days old, loss 35.5 per cent.

(BELOW) GRAVEL CONCRETE COMPARED
(1) Silverdale gravel 60 days, loss 11 per cent; (2) Arkansas River gravel 60 days, loss 17 per cent; (3) Arkansas River gravel 28 days, loss 29 per cent.

No difficulty is found in getting satisfactory specimens free from air pockets using concrete of proper consistency, with a slump of less than 1 in. Specimens are cast with a neck, which is left on until ready for testing when it is broken off with a hammer.

The storage and treatment of test specimens can be as seems desirable. In the laboratory, storage has been two days in the forms, nineteen days in water, and re of the time in the ordinary dry atmosphere of the laboratory.

Because of the limited funds available for research work, no systematic studies have been made. The different tests to date have been on different aggregate using various brands of cement, so that results are not always comparable, and do not warrant the drawing of definite conclusions.

Series Nos. 3 and 12 were made using the same sand and cement with the exception of No. 5, as noted. The results are shown in Table I. This was the first series of tests made. Nos. 1 and 2 were tested at 7 days

TABLE I—VALUE OF FRENCH COEFFICIENT OF WEAR ON ABRASIVE RESISTANCE

| No. of Test | Coarse Aggregate | French Coefficient | Proportion of Mix | Age 28 Days Loss in Per Cent | Average | Maximum Variation from Average | Age 90 Days Loss in Per Cent | Average | Maximum Variation from Average |
|---|---|---|---|---|---|---|---|---|---|
| 3 | Limestone | 6 5 | 1 2 4 | 22 7<br>24 1<br>22 6 | 23 1 | +1 0 | 9 3<br>10 1<br>10 6 | 10 0 | 0 7 |
| 4 | Limestone | 4 0 | 1 2 4 | 33 3<br>39 9<br>33 7 | 35 6 | +4 3 | 25 8<br>29 0<br>24 2 | 26 3 | +2 7 |
| 5 | Limestone | 4 5 | 1 2 4 | 18 6<br>18 8<br>18 5 | 18 6 | +0 2 | 13 0<br>12 2<br>10 7 | 12 0 | +1 0 |
| 6 | Quartzite | 13 5 | 1 2 4 | 12 2<br>12 6<br>13 8 | 12 8 | +1 0 | 10 3<br>7 6<br>5 4 | 7 7 | +2 7 |
| 7 | Granite | 18 0 | 1 2 4 | 7 8<br>8 3<br>8 0 | 8 1 | +0 3 | | No data | |
| 8 | Limestone | 4 9 | 1 2 4 | 38 2<br>39 7<br>31 9 | 36 6 | —4 7 | | No data | |
| 9 | Limestone | 6 6 | 1 2 4 | 16 1<br>20 3<br>17 2 | 17 8 | +2 5 | 14 1<br>20 8<br>22 2 | 19 0 | 4 9 |
| 10a | Mine run chatts | | 1 3 | 21 2 | | | 23 5 | | |
| 10 | Mine run chatts | | 1 3 | 40 5<br>35 5<br>10 5 | 38 0 | +2 5 | 20 4<br>20 5<br>8 6 | 20 4 | |
| 11 | Pit run gravel<br>40% on ¼ in. screen | | 1 4 | 15 5<br>21 6<br>22 8 | 15 9 | +5 7 | 12 5<br>13 8 | 10 6 | 3 2 |
| 12 | Sand only | | 1 3 | 27 1<br>31 1 | 27 0 | +4 2 | | | |

Notes: No. 5. A different brand of cement from others used in this test. No. 6. Coarse aggregate, too coarse for best results. No. 9. This specimen much denser than others, may indicate an error in proportions of mix. No. 10a. A well graded chatt. No. 10. Not so well graded as 10a, also a slow setting chatt.

and 14 days, with the result that the specimens were ost, the mortar not having sufficient strength to withtand the wear. This table shows the degree of uniormity given by each series and also the effect of ge and the value of the French coefficient of wear on he abrasive resistance of the concrete.

ABLE II—MORTAR ABRASION TESTS ON CEMENT OF DIFFERENT BRANDS

| | Age 28 Days, Per Cent Loss | Age 75 Days, Per Cent Loss |
|---|---|---|
| and A 1:3 | 37 3 | 25 6 |
| and B 1:3 | 26 1 | 10 7 |
| and C 1:3 | 52 0 | 34 3 |
| and D 1:3 | 52 8 | 42 3 |
| and E 1:3 | 31 8 | 20 8 |
| and F 1:3 | 54 5 | 35 6 |
| and G 1:3 | 22 4 | 15 4 |

Table II is a series of tests on mortar made with ifferent brands of cement. This mortar was of rather n inferior quality. This shows that there is a marked ifference in the wearing properties at early ages, of ne mortar made from different cements, and from data n standard tests of the cement the resistance to abraon was in practical agreement with the strength. In eneral, the properties which give strength might be aken as indicative of the resistance to wear.

TABLE III—RESULTS FROM SAME LOT OF CEMENT BUT DIFFERENT AGGREGATES

| Aggregate | French Coefficient of Wear Value | Proportions of Mix | Loss in Per Cent 28 Days | Loss in Per Cent 60 Days | Crushing Strength 28 Days Lb. |
|---|---|---|---|---|---|
| Limestone, Granite | 18 | 1 2 3½ | 11 1 | 9 8 | |
| | | 1 2 3½ | 11 2 | 8 0 | 3.010 |
| | | 1 2 3½ | 10 2 | 6 9 | |
| Limestone gravel | 18 | 1 1½ 2½ | 8 2 | 5 8 | 4,930 |
| Limestone gravel | 18 | 1 1½ 3½ | 9 8 | 7 9 | |
| Coral, Blue R. gravel | | 1 : 3 | 33 1 | 24 6 | 2,320 |
| Blue R. gravel, sand | 18 | 1 1 3½ | 14 8 | 13 1 | 2,660 |
| Blue R. gravel, sand | 18 | 1 2 3 | 22 8 | 19 | 1,975 |
| Blue R. gravel, screenings, gravel, sand | 13½ | 1 2 3½ | 21 0 | 16 7 | 2,890 |
| Limestone chatts and pea gravel | 12 to 18 | 1 3 1½ | 14 9 | | 3,230 |
| Limestone chatts, pea gravel | 12 to 18 | 1 2 2 | 13 9 | 13 4 | 2,810 |
| Limestone chatts, Blue R. gravel | 12 to 18 | 1 3 1½ | 29 4 | 22 8 | 2,490 |
| Limestone chatts, Blue R. sand | 12 to 18 | 1 2 2 | 15 1 | 13 8 | 2,160 |
| Limestone chatts | 12 to 18 | 1 3 | 35 6 | 19 8 | 3,660 |
| Limestone gravel, Blue River sand | 12 | 1 1½ 2½ | 9 9 | 7 6 | 4,045 |
| Limestone screened yellow flint-sand | 12 | 1 : 1½ : 2½ | 10 7 | | 4,550 |

*Definitions of proportions. Measurements of aggregates in cu.

Table III shows a set of results which are more comparable, as all were made with the same lot of cement. They were, however, made at different times and represent a wide range of aggregates.

The results of the tests indicate that the method of testing is entirely practicable and possessed of several advantages over other tests so far developed.

A visual inspection of tested samples indicates the desirability of a coarse aggregate of smaller size than is commonly required for one course concrete work.

It is believed that the improved wearing value shown by the richer mixes used for the wearing course of a pavement is largely due to the finer coarse aggregate used in such mixtures.

The mortar bond on gravel or stone breaking with a glassy fracture is not strong enough to permit the use of this test at ages earlier than 60 days, as at earlier ages aggregate breaks out of its bedding.

It is not believed that smaller sized spheres would be practicable. Some 6-in. spheres were cast and tried out with unsatisfactory results.

## To Reduce Time of Air Seasoning Wood

Although air seasoning of wood is an old practice, no systematic attempt has ever been made to work out exact conditions under which drying time and drying costs can be reduced to a minimum. In co-operation with the saw mills and wood utilization plants throughout the country, the Forest Products Laboratory, Madison, Wis., is organizing an extensive field study to determine piling practice which will result in the fastest drying rates consistent with the least depreciation of stock, the least amount of required yard space and the least handling costs. A comparison is to be made of the effects of such variables as sticker heights, spacing of boards in layers, heights of pile foundations and the direction of piling with relation to prevailing winds and yard alleyways. The study should settle the question of whether, from a business standpoint at least, lumber should be dried partly at the mill and partly at the plant of utilization or whether it should be completely dried at the mill, also whether air seasoning or kiln drying is the more profitable.

# Safety Factors in Airplane Design

## Reasons for Adoption of Low Factors Based on Abnormal Conditions—Successful Use of Long Columns

By Alfred S. Niles

Assistant Structural Engineer, Aircraft Service, Brooklyn Navy Yard

THE chief difference between the structural design of an airplane and that of a bridge is that instead of a safety factor of 4 or 5 a factor of about 1.75 or 2 is used. This statement may be startling to structural engineers in view of the fact that one of the chief structural materials used in airplane construction is wood; but further consideration of their problem will show that the airplane engineers are not as foolhardy as would appear at first sight.

In ordinary structures the load is applied at nearly all points on the structure and the supporting forces concentrated at a few points. In airplane work the reverse is the case most of the load being carried in the forward part of the body, the supporting forces being widely distributed over the wings and control surfaces. As a matter of common practice the supporting forces on the wings, etc., are usually spoken of as loads and the true loads, i.e., the weight of the airplane and its equipment, as supporting forces. In this sense the loads on an airplane may be divided into three classes: (1) Loads on the structure in normal flight; (2) loads during maneuvers due to the flight being in a curved path; and (3) loads resulting from impact in landing. Those in the first class are determined largely by wind-tunnel tests of small models, and to a much less extent by full-size tests in flight. Loads of the second and third classes are found by theoretical considerations checked by tests in the field. Once the loads acting on the airplane have been determined the structure can be resolved into its component beams and trusses and designed in the usual manner.

### Pulling Out of a Dive

The loads in normal flight are comparatively small. The weight of the airplane plus its useful load must be balanced by the supporting air forces on the wings. When traveling in a curved path the airplane has an acceleration toward the center of curvature of the path, depending on its linear velocity and the degree of curvature of the path. In order to cause this acceleration there must be forces applied equal to the mass times the acceleration. As one pound of force is that force which will give a mass of one pound, an acceleration of 32.2 ft. per sec. per sec., the total force acting on the airplane will be $F = Wa/32.2$, where $F$ is the force, $W$ the weight of the airplane and $a$ the acceleration in feet per second per second. The most severe maneuver for an airplane is pulling sharply out of a steep dive, in which case, it has been calculated, $F$ may under exceptional conditions be as great as $15W$. Flight tests with an accelerometer made in England showed a maximum value actually obtained under service conditions for $F$ of $4.2W$. Due largely to these tests and the fact that such airplanes have proved satisfactory, pursuit airplanes are designed to carry $8.5W$. This gives a true factor of safety of a little more than two, based on the flight tests.

As is indicated above, the abnormal loads on the structure are a certain number of times the normal ones in uniform level flight. The relative distribution of load is the same. For this reason airplanes are designed for a given "load factor." We would say that the pursuit plane was designed for a load factor of 8.5. Very often the load factor is incorrectly called the safety factor, but the practice is decreasing as it gives a false impression of the safety of the structure. For large airplanes which are not going to be maneuvered in the manner of pursuit planes, such as bombers or large commercial machines, the load factor used is less than 8.5 but is still chosen to give a true safety factor of about 2.

In landing, the body of the airplane is subjected to considerable impact. Comparatively little has been done to find out how great this effect will be. In fact it is impossible to put a maximum possible value to it. The only thing possible is to determine what it is likely to be when the landing is made by an ordinary skillful pilot under service conditions. For convenience this load also is expressed by a load factor, and the body is designed to carry from 4 to 7 times the weight of the airplane applied at the wheels and tail skid. The load factor in any given case is determined by what has proved satisfactory in airplanes of similar types. Large slow airplanes are designed for lower factor than fast pursuit or training ships.

It can be seen from what has just been said that while the airplane has a low factor of safety in the abnormal conditions of maneuvering, the safety factor for normal flight is much higher.

### Accidents Not Due to Structural Design

Several justifications can be advanced for the use of the low safety factor.

*First,* airplane design has proven generally successful. Very few accidents have happened recently due to faulty structural design. The chief causes of trouble are engine failure, fire, and reckless pilots. Where structural failure has occurred it has generally been due not to the use of a low safety factor but a faulty design in which the assumed safety factor was not attained.

*Second,* the maximum loads are temporary. It has been found that wood can be stressed far beyond the elastic limit, almost to the modulus of rupture, and if the excess load is removed in a few seconds the wood is not harmed. In the case of steel, the elastic limit is more than 50% of the modulus of rupture, so that the steel members will not be stressed beyond the elastic limit.

*Third,* the ultimate strength of struts is taken as the yield point in compression. In this respect airplane work varies considerably from ordinary structural work. In ordinary column formulas the maximum compressive stress on a column is taken as 16,000 lb. per sq.in., reduced for column action. This gives a factor of 4 when compared to an ultimate strength of 64,000 lb. per sq.in. But the yield point in compression is the true limit of the strength of a compression member, and as this is only about 40,000 lb. per sq.in. the true factor of safety for columns in ordinary structural work is only about 2.5.

*Fourth,* most of the struts used are very slender and can be computed by the Euler formula, which gives much more accurate results for long slender columns than any formula yet devised gives for the short columns. Slenderness ratios of from 150 to 200 are very common in airplane work. In this connection

reference may be made to a recent editorial in *Engineering News-Record* in which some doubt was cast upon the reliability of long slender struts. It has been found in airplane practice that such struts are perfectly reliable. The four D.H. airplanes which made the New York to Nome and return flight have as main structural members four pin-ended struts with a maximum slenderness ratio of 170 and four with a slenderness ratio of 220. As all four machines made this 10,000-mile flight without mishap the reliability of these struts (spruce) cannot be doubted.

*Fifth,* great care is taken to compute secondary stresses, so that part of the "factor of ignorance" can be eliminated.

*Sixth,* greater care is taken in inspection of material and workmanship than in structural work. Due to the care with which materials are selected a rectangular beam of spruce can be assumed to have a modulus of rupture in bending of 10,300 lb. per sq.in. instead of the 4,000 lb. per sq.in. which is used in structural work for ordinary spruce. Airplane designers make no allowance for knots, checks, etc., because such defects are cause for rejection of the material.

*Seventh,* most new designs are checked by a static test in which a full-sized airplane is loaded with sand or lead shot until destruction. In this way any weaknesses of fittings, etc., or errors in design are found out before similar airplanes are flown. This is always done where there is any doubt with regard to the strength of the design. In France the static tests largely take the place of theoretical analyses. In England the reverse is the case, reliance being placed chiefly on theoretical analyses. The U. S. Army steers a middle course, making a theoretical analysis and usually checking by static test.

If these considerations are taken into account, it will be seen that the design of airplanes with a factor of safety of 2 or slightly less is not the reckless practice that it would appear on first sight, but is a procedure necessitated by the requirements that not one useless pound of weight shall be found in the structure, and it is undoubtedly justified by the results which have been obtained.

## Concrete Proportioning Tests Made at Washington University

In a thesis presented for the Degree of Bachelor of Science in Civil Engineering of Washington University, O. E. Salveter and E. J. Schewe investigated some of the current methods of proportioning concrete and arrived at the following conclusions. The colorimetric test for organic impurities in sand does not furnish an accurate basis for determining whether or not a sand is unfit for use in concrete. The slump test apparatus is very unreliable, especially in leaner concrete mixtures. There is need for investigations to disclose whether the consistency of concrete is dependent upon the surface area of the aggregate or upon some function of the fineness or grading of the particles. The water content in concrete is the most important single factor influencing strength, though the effect is more pronounced in early ages. The water-cement ratio has proved the most satisfactory of any of the methods for considering the water content of the concrete mix.

# Tidal Bore Studies on River Dee and Its Estuary

### Made in Connection with Investigations of Effect of Birkenhead Water-Supply Scheme on Navigation to Chester

By William Gore
of Gore, Nasmith & Storrie, Consulting Engineers, Toronto, Ont.

IT SOMETIMES happens that work in one branch of engineering leads to studies belonging to another branch. The following is an example in point where the promotion of a water-works project led to an investigation of a tidal bore.

When promoting a bill for new water-works from North Wales to take water from a tributary of the River Dee, the County Borough of Birkenhead, England, was opposed by the River Dee Conservancy Board, representing the Port Authorities of the ancient city of Chester. The basis of this opposition was that the

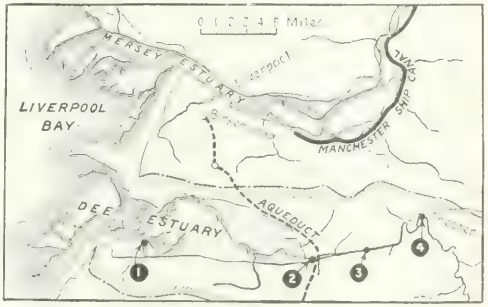



FIG. 1 ESTUARY OF THE RIVER DEE

diversion of the upland waters of the River Dee would deprive that river of some of the natural scour required as an aid in maintaining a navigation channel through the estuary of the river. It was alleged that the situation was a very unfavorable one owing to a tidal bore, 3 ft. high, which stirred up the sand in the estuary and in the bed and sides of the river and made the ship channel difficult to maintain.

It became necessary on the part of the borough to investigate the tidal phenomena in the estuary and river and the writer had charge of this work under the direction of the late Dr. George F. Deacon, consulting engineer to the borough.

A tidal bore is the beginning of a flood tide, marked with suddenness and distinction. Many tidal rivers or estuaries are subject to this phenomenon and probably the best example is that of the Bay of Fundy.

The bore of the Welsh River Dee was described a hundred years ago in De Quincey's "The Confessions of an English Opium Eater," as "a high, charging block of water filling the whole channel of the river and coming down upon us at the rate of forty miles an hour." He also used other terms and expressions of a more or less awe-inspiring nature. He at first supposed the long foretold event of Euripides, "the return of the fountains of the deep to their ancient sources," was about to take place. By reason of the terror that inspired De Quincey or for other reasons, his estimate of the velocity of the bore was probably several times too

FIG. 2. TIDAL DIAGRAMS OF RIVER DEE AT SANDYCROFT AT EQUINOCTIAL SPRING TIDE, MARCH 31, 1907

Observations at Sta. 3, Fig. 1. The maximum tidal current up-stream was 8 ft. per second. The tidal bore traveled upstream at the rate of 12 ft. per second, and the crest of the tidal wave at the rate of 20 ft. per second.

great, and in other respects his observations were unreliable.

It will be seen (Fig. 1) that the River Dee discharges into Liverpool Bay by an estuary fifteen miles in length and five miles wide at its mouth. At low tide the estuary is mostly sand banks which are ever shifting and changing so that the low water channel as shown is only approximate.

The highest tides travel up stream several miles above Chester, but the bore goes no further owing to a half-tide weir constructed for power purposes on the site of an earlier example of the 13th century. The four observation stations are shown by the encircled figures. The river channel between Stations 2 and 4 is mostly artificial and like a canal with embankments on either side which prevent the tides from covering considerable areas of low-lying lands. The low-water channel along this length is about 300 ft. wide, with a depth of water of from 3 to 5 ft. or more, depending upon the amount of upland water. It is along this channel that the bore reaches its maximum height and Station 3 was selected as the point of reputed maximum height of the bore for the more detailed examination of the tides and the bore. Stations 1, 2 and 4 were used only when tidal profiles were required. At Station 3 two cross sections were selected, 200 ft. apart, and the velocities of the bore and of the tidal currents were measured by the intervals taken to travel between the two cross sections. The tidal currents were measured by vertical rod floats 2 ft. long standing 3 in. out of the water and surmounted with small red or white flags. The floats were thrown into the center of the stream some distance above the nearer cross section and picked up beyond the further one.

The profile of the bore was determined by rods graduated in colors, driven into the bed of the river, and by strings of corks, which were photographed at and before the passage of the bore.

The observations took place over a series of daylight tides preceding and including a vernal equinoctial spring tide and one day following it. This period was selected so as to cover the highest tides. At this time the sun and moon are most nearly in a straight line with the earth and in consequence the resultant of the tide generating forces is a maximum.

The [illegible] tides only. That is, at spring tides and a few tides on either side thereof. At the spring tides the bore commences about half way between Stations 1 and 2, reaches a maximum along the straight reach at Station 3 and gradually recedes until Station 4 is reached, when it suffers extinction at the Causeway Weir. At this point there is some evidence of a slight reflection back down stream.

Fig. 2 shows the tidal levels and velocities at Station 3 for the highest tide experienced. The sudden rise of level of 2 ft. at the passage of the bore is followed by an almost uniform rate of rise up to the highest point 1 hr. 40 min. later, followed by a nearly uniform rate of fall for 3 hr., which then gradually reduces until low water is reached. The velocity curve shows a sudden change from 1.4 ft. per second down stream to 3.5 ft. per second up stream at the passage of the bore, followed by a gradually decreasing rate of increase until a maximum of 8 ft. per second is reached 24 min. later. The tidal current then falls to zero in a further one hundred minutes. These are typical of the whole series of observations at Station 3, and differ very much from the almost simple sine-shaped generating tide

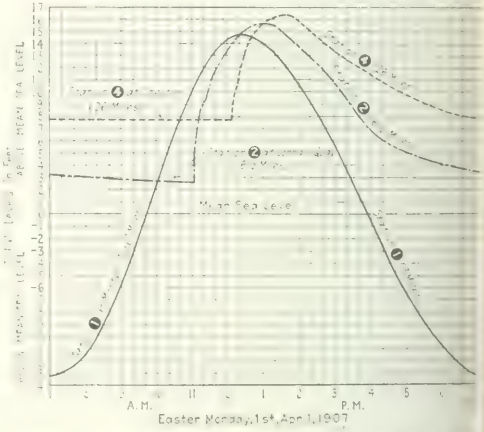



FIG. 3. SIMULTANEOUS TIDAL LEVELS OF RIVER DEE AND ESTUARY, APRIL 1, 1907

Observations at Stations 1, 2 and 4 [illegible] vernal equinoctial spring tide [illegible] Liverpool Bay.

curve at points near Liverpool Bay, as shown by observations at Station 1, Fig. 3.

In Fig. 3 are shown simultaneous tidal diagrams of a high tide 24 hr. following the vernal equinoctial spring tide. The range at Station 1 was 28 ft., that at Station 2, 13 ft. and at 4, 7.5 ft. The height of the crest of the tidal wave or the high-water mark, as it is called, rises with the distance up stream. The flood portions of the same tide is shown in profile on Fig. 4 to an exaggerated vertical scale for half-hourly intervals. Two kinds of bores or wave fronts were observed. These are also shown in Fig. 4 to a natural scale with the same vertical scale as the tidal profiles.

The photographs, Figs. 5 and 6, show the appearance of the bore. The greatest height measured was just under 2 ft. and the maximum velocity 12 ft. per second.

It will be seen that the bore is partly a smooth wave and partly a breaking one. Sometimes it is wholly smooth, at others wholly breaking and the change from one condition to another are exceedingly rapid

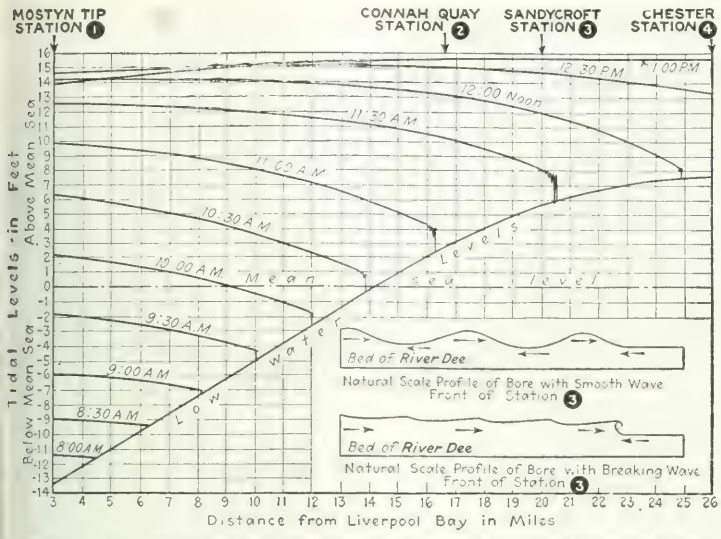



FIG. 4. TIDAL PROFILES OF RIVER DEE AND ESTUARY TAKEN AT HALF-HOUR INTERVALS, APRIL 1, 1907.

ccompanied by much noise and turmoil. At the edges he water is turbid, showing erosion of the sides of the hannel, which are more or less protected by stone itching; but the turbidity spreads into the main body f the water at some distance behind the wave front.

Attempts by means of floats were made to determine ie movements of the water in the bore but not very iccessfully. The ebb current immediately in front of ie bore was about 1.5 ft. per second. In the case of

FIG. 5. VIEW OF TIDAL BORE ON RIVER DEE AT SANDYCROFT, MARCH 31, 1907.

Taken at Station 3 (see map Fig. 1) at the beginning of an ximetrial Spring Tide, which is the highest scheduled of a six- nth period. The top of the rod in the center of the river, just front of the bore, is 2 ft. 2 in. above low water. Just back of s rod at 5-ft. intervals, are two others. At the time of the ssage of the bore a strong wind was blowing from the right ward quarter.

e breaking wave the direction was reversed almost in- antly but the wave moved forward much faster than e water. Thus, while the wave moved at 12 ft. per cond, the water, until some distance back, did not ach half this rate. In the case of the smooth waves, ere was a steady slowing up and a reversal before the est of the first wave was reached, which was again versed at the trough following. The same thing oc- rred with the succeeding wave, after which the float moved up stream at a faster and faster rate until a maximum of about 8 ft. per second was reached at a point more than a mile behind the bore.

The immediate cause of the bore is the rapid change in the direction and velocity of the water in the tidal channel. This is brought about by the main portion of the tidal wave traveling forward at a more rapid rate than the forefront. Thus, the crest of the tidal wave in this case was observed to travel up stream at the rate of 20 ft. per second while the bore moved at only 12 ft. per second. These velocities must be distinguished from the tidal currents, which in no case exceeded 8 ft. per second. Thus, during the flood tide, the rear portions of the tidal wave crowd upon the front portions more and more, producing a steeper and steeper forefront until instability is reached and the true bore is formed. The difference in the rate of travel of the various portions of the tidal wave is due primarily to the difference in the depth of the water. The wave velocities observed appear to follow very closely the formula $v^2 = 2\ g\ h$, where $v$ is the velocity of tidal propagation in feet per second along the water and $h$ is the depth from the surface to the mass center of the section of the channel.

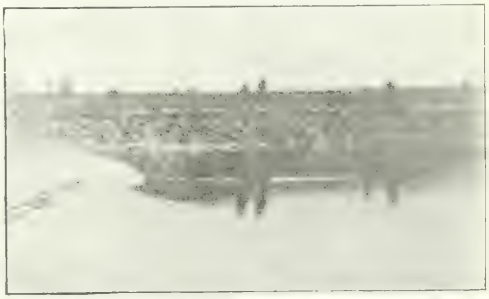


FIG. 6. TIDAL BORE IN RIVER DEE, MARCH 29, 1907.

The white streak in front of the bore is a string of corks put in the river to form a profile. The nearer portions of the bore are in the form of smooth waves while the distant parts are broken. Interest in the phenomenon is added by its continually changing character.

Similar observations to the above made by the writer on the Manchester Ship Canal, indicated on Fig. 1, which at that time was partly tidal, did not disclose a bore, although subjected to the same generating tide in Liverpool Bay; but, as the water in the canal was 28 ft. deep instead of, say 4 ft., the forefront of the tidal wave propagated at the much greater rate of 30 ft. a second and was reflected back and forth over a reach of 12 miles in length until it faded away. In this case the formulæ for $v$ also applied.

From the spectacular point of view it is to be re-

gretted that the magnitude of the Dee bore, as disclosed by the present series of measurements, was much less than that given by repute. This experience, however, does suggest that this class of phenomena is often magnified above its proper value by casual observers. At the same time it is well to state that the general appearance of the bore is very striking and somewhat startling to an observer at the edge of the river. Some of the more experienced local boatmen will ride the bore, but others scuttle to the shore when it approaches.

The outcome of the opposition was that Birkenhead agreed to pay the port authorities of Chester a small annual sum to cover the alleged increased cost of maintaining the ship channel, but as the borough discharges down stream at the head works continuously one-third of the whole yield of the reservoirs plus all overflows, the injury to the navigation interests must, if any, be very little indeed. From observations by the writer of several different tidal rivers he has come to the definite conclusion that a tidal bore is evidence of a defective channel from a navigation point of view, and is not the cause of the channel being defective.

# San Antonio Flood Damage Estimated at Ten Millions

## Rainfall of Phenomenal Intensity Brought by Storm Traveling North from Mexico—Much Pavement and Numerous Bridges Destroyed—Plan to Build Detention Basin

SUPPLEMENTING the brief telegraphic reports of the San Antonio flood of Sept. 10 printed in our news columns last week (p. 462), we give below further reports and data on the effects of the flood and the rainfall that caused it. The estimate of total loss given by the city engineer reaches the high figure of $10,000,000. Of special importance is his statement that a detention-reservoir project will probably be voted on shortly. The rainfall figures reported by the Weather Bureau confirm the early advices and tend to establish the southern Texas storm as among the most remarkable rainfalls of which definite record has been obtained in this country.

### The Flood and Its Effects

By D. D. Harrigan
City Engineer of San Antonio

The most extensive and destructive flood in the history of the ancient city of San Antonio occurred in the late hours of Sept. 9 and the early morning hours of Sept. 10, 1921. Preceded by 24 hr. of almost continuous rain in and around the city, a heavy storm broke in the evening of Sept. 9, accompanied by heavy rain from 7 to 9 p.m. The total rainfall in the center of the city during the twenty-four hours preceding the flood was approximately 8 in. A few hours previous to the heaviest of this rain the records show that there had fallen in the valley of the Olmos Creek, which empties into the San Antonio River at the city line, approximately 13½ in. of rain in a very short time. About midnight this raging torrent of water, augmented by the heavy local rain, swept upon the center of the city. By 2 a.m. of Sept. 10 a section of the city six miles long and from one-third to one mile wide was under water. Practically the entire business district was covered with from 3 to 10 ft. of water. In addition about two square miles of residence section were inundated.

From the approximate data obtainable at this time, it appears that about 20,000 sec.-ft. of water crossed the center of the city. The total property loss will probably reach $10,000,000, of which the city will probably lose about $800,000.

*Paving.*—Of the paving loss of $350,000, the principal item was more than 100,000 sq.yd. of wood block paving, the loss of this material being approximately two-thirds of the total yardage of this class of paving in the city. This experience will bar forever the use of wood block paving in San Antonio, except for patching on streets where the damage is not sufficient to justify replacing.

*Bridges.*—The loss to bridges was approximately $150,000, the largest item being a three-girder bridge on South Alamo St., over the San Antonio River. This bridge, which will require about $25,000 to replace, was built some ten years ago. Its destruction is due to the fact that the footings of the piers rested on gravel only 4 ft. beneath the bed of the stream. Due to the accumulation of wreckage against the bridge, a siphon was formed underneath the bridge which cut two channels between the piers, undermining the foundations and causing a total loss. There were sixteen smaller bridges completely wrecked, and thirteen badly damaged.

*Other Public Property.*—The loss to public buildings and parks will approximate $200,000. Fire equipment and miscellaneous damage and cost of salvaging will reach $100,000.

Within sixty days, weather permitting, all paving can be replaced, and within 120 to 140 days, weather permitting, all bridges can be replaced.

*Protection.*—The city at the present time has practically no protection against cloudbursts such as this one, but it is proposed to vote a bond issue to construct a detention reservoir above the city to regulate the flow of flood waters so that they may be confined to the channel, and the excess be allowed to run off in subsequent hours or days. This dam will probably cost in the neighborhood of $2,000,000.

The total loss of life will probably not exceed seventy-five.

### Effect on Public Utilities

By Robert J. Harding
Vice-President and General Manager, San Antonio Water Supply Co.

Metcalf & Eddy, in their report of the city a year ago, indicated a possibility of a flood such as has occurred. The high-water level reached a point 6 ft. higher than has occurred in the last 35 or 40 years.

*Lighting and Power.*—The San Antonio Public Service Co., which operates the gas, electric and street car companies, suffered no damage to the gas works or to the gas distribution system.

One of the two power stations was considerably dam-

aged by the water filling the basements and covering the main floor, so that the service from a large part of this station has been out. This station also furnished the direct current in the city and operated the street cars, so that the street cars were immediately placed out of service. By Sept. 13 they were in operation again, however. The underground electrical system has been considerably damaged.

*Water.*—The San Antonio Water Supply Co., which operates two pumping stations in a direct system of water distribution, had both stations out of service on account of the water. The main station, however, was restored within 39 hours.

No material damage was done to the water works system. The hydrostatic level of the artesian wells was sufficiently high to maintain water service for one-half of the population, including the business district, and was sufficient for fire protection with the assistance of fire engines in this area.

## Extraordinary Rainfall Due to Mexican Storm

By C. C. Clark

Acting Chief of Weather Bureau, Washington, D. C.

Complete reports of the Texas rainfall preceding the recent flood will not be available for two or three weeks, but below is given such a summary as we have been able to compile from the brief telegraphic reports received.

AMOUNT OF RAINFALL, INCHES

| Station | Sept. 8 | Sept. 9 | Sept. 10 | Sept. 11 | Total |
|---|---|---|---|---|---|
| San Antonio | 0 55 | 3 49 | 3 36 | .... | 7 40 |
| Boerne | 0 22 | 6 44 | . . | .... | 6 66 |
| New Braunfels | . . | 9 38 | . . . | .... | 9 38 |
| San Marcos | . | 8 00 | 1 50 | . . . | 9 50 |
| Austin | 0 20 | 0 78 | 18 24 | . . | 19 22 |
| Marble Falls | 0 56 | 5 50 | 11 00 | .... | 17 06 |
| Cameron | 0 76 | 12 46 | 0 84 | | 14 06 |
| Temple | . | 0 34 | 9 00 | 2 54 | 11 88 |
| Taylor | . . | 0 34 | 21 50 | 2 13 | 23 97 |
| Georgetown | . | 1 40 | 11 30 | 1 42 | 14 12 |

The separate values on Sept. 9 and 10 for Boerne, New Braunfels, San Marcos and Cameron are not strictly comparable with those given for the remaining stations, owing to a difference in the hour of observation, but the combined totals for Sept. 9 and 10 are comparable. Again, the rainfall given on Sept. 11 for Temple, Taylor and Georgetown really belongs to Sept. 10, as the rain evidently ceased during the early afternoon of the latter date. Observations are taken at 7 a.m. local time, and any rain after that hour would be recorded on the following date.

*High Intensities*—No details for periods less than 24 hr. have been received, except from Taylor, where it appears that the heavy rain began at 3:30 a.m., Sept. 9, and ended at 1 p.m., Sept. 10, a period of 33½ hr., during which time 23.63 in. fell. From 6:45 p.m., Sept. 9, until 7 a.m., Sept. 10, a period of 12¼ hr., 19.49 in. of rain fell, of which 3.61 in. fell between 8 and 9 p.m., Sept. 9.

The 24-hr. rainfall at Taylor, ending 11:41 a.m., Sept. 10, was 23.10 in. This exceeds all previous records for the state of Texas. The previous heaviest fall was 20.60 in. on June 28-29, 1913, at Montell, Uvalde Co., near the headwaters of the Nueces River. The one-hour fall of 3.61 in. has been exceeded quite often, and in various sections of the country.

*Cause.*—As to the direct cause of the excessive rains: In our opinion they were due to a storm that moved inland south of Tampico, Mex., on Sept. 7. At 7 a.m., Sept. 8, at Laredo, Webb Co., Tex., on the Rio Grande, a 24-hr. rainfall of 6 in. was reported; at Encinal, La Salle Co., Tex., about 40 mi. north of Laredo, 4.05 in. at 7 a.m., Sept. 9; and at Hondo, Medina Co., Tex., about 85 mi. north of Encinal, 5.70 in. at 7 a.m., Sept. 10, indicating a slow, yet steady, northward movement of the heavy-rain conditions. Apparently the excessive rainfall did not extend very far north of Temple.

## A Long and Enviable Mayoralty Record

AFTER having been twenty-two times elected and four times defeated as candidate for mayor of New Bedford, prior to which he served as common councilman and before that for four years as postmaster of the city named, Charles S. Ashley has announced that he will not stand for re-election as mayor after the completion of his present or twenty-second term. He says that while he has enjoyed political life, he considers some thirty-five years of it sufficient—but puts in the saving clause "for the present."

On entering upon his twentieth term as mayor some eighty merchants and manufacturers of New Bedford presented him with a purse of $12,000 by way of appreciation of what he had done for the city in the past and encouragement for the future. At that time *Engineering News-Record* wrote to R. C. P. Coggeshall, known to many of its readers as superintendent of the New Bedford water-works for decades, asking for a few sentences of explanation and appreciation of Mayor Ashley's long and successful career as mayor. Mr. Coggeshall's reply has heretofore remained unpublished. It seems opportune to print it now in view of Mayor Ashley's recent announcement:

Charles Sumner Ashley is sixty years old [February, 1919]. He is a professional politician of high grade. In addition he has been a student of civic affairs, and for many years has been recognized as an expert in such matters, aside from their political aspects.

He is well equipped to become the general manager of any municipality, has a most vivid imagination, and forecasts the needs of this community several years in advance of its requirements. He views such problems broadly, leaving the details to be worked out by others under his direction. He is a great dreamer and his dreams are apt to come true.

Owing to the rapid growth of New Bedford for the past twenty years Mayor Ashley has had the good luck to see his visions mature in such a way that practical men of affairs rise up and call him blessed. The impetus due to his activities affect every city department.

He has replaced narrow ways in the business section of the city with wide avenues, reconstructed the fire department, enlarged the water-works, constructed new parks, new cemeteries, new and extensive sewers, and been instrumental in having other improvements made. Just now, in his private capacity, he is organizing a bank of which he is to be the president.

New Bedford has never been a follower of national party lines. For many years the issue has been Ashley or otherwise. The division comes upon some local problem. In national and state politics, Mr. Ashley is a Democrat. He was postmaster during Cleveland's administration and was first elected mayor in 1890. His term of office has not been continuous.

No man can live so long in the public eye without creating bitter opposition, and Mayor Ashley is no exception to this rule, but he has steadily made more friends than opponents, largely due to his winning personality. While he is a great politician, he never interferes or tries to influence the votes of the employees of the various departments. In all the long years we have been together he and I have never conversed upon the subject.

# Problems and Progress in the Water-Works Field

## Abstracts of Papers and Discussions Before the Annual Convention of the New England Water Works Association by Allen Hazen, George C. Whipple, Harrison P. Eddy and Others

### Sanitary Protection of Water Supplies

By Allen Hazen
Consulting Engineer, New York City

I AM going to speak to you today about the relations between water supply and disease, and about what is done and may reasonably be done to keep public water supplies from carrying disease, and from ever being in a position where those who take the water may have well grounded anxieties as to the safety of the supply. I propose to discuss this matter in very general terms, and with particular reference to the developments of the last few years, that have put at our dipsosal new and most useful methods of control.

The question now presented is not so much how to keep our water supplies free from disease-producing qualities, for that question has been answered; but rather to see what precautions may best be taken to secure safety without duplicating to an unreasonable extent parallel lines of defense when this involves added cost and an unreasonable burden on the people who pay the bills.

#### Six Lines of Defense

[Mr. Hazen then reviewed the following six lines of defense: (1) Ownership and (2) sanitary supervision of catchment areas; (3) treatment of sewage from towns on catchment areas; (4) water purification by natural agencies—storage; (5) filtration, including pre-sedimentation and coagulation; (6) disinfection.—Editor.]

We need to know how to select those lines of defense that will give us the desired security with the least cost and with the least disturbance to existing desirable conditions. Often the answer will be found in the application of several lines of defense. For instance, taking the first one enumerated above—it will be worth while to buy and control, as completely as ownership gives control, certain parts of the catchment area. These parts will naturally be the areas along the streams and near the intakes and about the reservoirs. They may also extend to areas which, because of topography and other conditions, are more than unusually favorable for future occupation and pollution. The cost of the land must be considered. It will be worth while to buy large areas of cheap wild land. It will not be worth while to buy highly developed property that has been arranged to prevent pollution. Much protection may be secured by ownership, even though only a fraction of the whole catchment area is acquired.

Storage in large reservoirs often or usually helps in maintaining the safety of the supply, but it is not to be depended upon at all times. It fails to be reliable when heavy rains follow droughts that have depleted the reservoir. It has been one of the great elements in maintaining the sanitary quality of some of our supplies even though it is not efficient at all times. It is efficient most of the time, and the existence of storage on some of our larger water supplies has been a potent influence in reducing any disease-producing qualities which the water might otherwise carry.

The progress that has been made in the last decades in filtration and disinfection has been so great that the idea has sometimes been expressed that with such treatments it is no longer necessary to keep up other lines of defense. It has been thought by some that it was unnecessary to purchase lands on catchment areas for protective purposes, and that it would even be possible with the filtration of the water to sell great areas of such lands previously purchased. It has been suggested by others that sanitary supervision of the population on catchment areas could be reduced or eliminated when the water was filtered. Such ideas can hardly be accepted as representing sound judgment. The protection afforded by filtration and disinfection may be made very complete; but new discoveries are constantly being made, and new points of view are reached as more is known. The importance of each new advance is apt to be exaggerated at the time. Subsequent experience often shows unexpected drawbacks. We do not even know about all of the disease-producing qualities in water well enough to be sure that all of them are eliminated with the bacteria that we count, and on which present judgments of the efficiency of the processes are mainly based.

#### Chlorination, Filtration, Supervision

As chlorine kills nearly all the bacteria, we may logically let up on the rigidity of our filter requirements; but how much? Can we put the filter back to the point where it is only a rough strainer? Or is it not wiser to keep, even at added cost, the major part of the splendid efficiency that was obtained by the best filters before chlorine was used? And with these processes of filtration and disinfection in use is it not wise to retain to the full ordinary limit the sanitary supervision of rural populations developed before disinfection began? This is usually an inexpensive part of the protection and it certainly produces results in the safety of the furnished water supply.

Then there are the supplies, not very numerous to be sure, but there are very important examples, where the sanitary quality reached by the lines of defense already in use has been so high that it has not been thought necessary to use chlorine. Some of us may think, even in these cases, that the use of chlorine as insurance against remote contingencies would be worth while, but we must admit that results actually obtained without it leave little ground for criticism.

The standards of quality of public water supplies have increased and will no doubt increase still further. When water that caused only a few deaths replaced water that caused a great many deaths, the improvement was so great that it seemed at first to be wholly satisfactory. As years go by, and our students and laboratory men study the cases minutely and find out what is happening, they sometimes find that conditions might be still better. Standards are again raised and still better water is demanded. The art of water purification has advanced in the last decades to meet these demands. How far it has yet to go and how the best informed sanitarians of the future will regard the qualities of water now supplied can only be disclosed by the future. It is certain that polluted waters of years ago produced more disease and more deaths than can be accounted for by present theories of water carried disease. When we have stopped the bacteria that are counted in the laboratory, have we stopped all the disease-producing qualities of the water? That is what we do not yet fully know, and until that question is answered more conclusively than it can be answered today, and more conclusively than there seems to be, an immediate prospect of its being answered, we shall do well, within reason, to stick to all the approved lines of defense that are in use, and that can be economically maintained without going to unreasonable extremes.

In the meantime there is much to be done. Information is ahead of practice. There are opportunities in New England and throughout the country to secure added safety by the better application of well known methods; and it is for us to see that no promising opportunity is lost.

*Discussion*—Frank W. Green, Little Falls, N. J., suggested three minor lines of defense not mentioned by Mr Hazen: (1) Typhoid inoculation of residents on river banks and in catchment areas; (2) education of doctors and nurses in care of typhoid patients; (3) provision of swimming pools to keep city populations from bathing in waters used for public supply. A. W. Folwell, New York City called attention to dangers from the automobile camping places now becoming common. H. P. Eddy remarked on the necessity for vigilance, regardless of the number of lines of defense, as witness the recent typhoid epidemic at Salem, Ohio.

# The Qualities of the Water Supplies of Massachusetts

By George C. Whipple
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass

IT IS a long time since a critical review of the water supplies of Massachusetts with reference to quality has been published. [The author then outlines the subject in general and presents and discusses analytical results in detail, with special relation to color, odor and other qualities coming under the general head attractiveness. Parenthetically he gives the average typhoid rate for the State of Massachusetts in 1920 as 2.5 per 100,000; the highest typhoid rate for any city as 10.7; and states that only five Massuchusetts cities had rates above 5 per 100,000. He presents a list of 24 Massuchusetts cities and towns having same kind of water filtration in use on Jan. 1, 1921, mostly small places. Only the concluding portion of the paper is given here.—Editor.]

The question, "Why are there not more filters in Massachusetts?", is one that is asked outside more than within the state. As a matter of fact, the water supplies of Massachusetts taken as a whole are well safeguarded and reasonably satisfactory to the consumers. The very low typhoid fever death-rate of the state has already been referred to. Yet, looking at the data for color, turbidity, sediment, and odor, it will be seen that very few of the surface waters are attractive at all seasons of the year. Even the water supplied to the Boston Metropolitan District is no exception, as microscopic organisms appear in large numbers in Wachusett Reservoir and the other reservoirs every few years. Lake Cochituate water in recent years has been notably unsatisfactory. These occasional unpleasant conditions cause only passing comment by the people, but the fact cannot be ignored that standards of quality are rising. With the supplies of most of the large cities of the country made brilliant by filtration, the supply of Greater Boston will before many years suffer by comparison. For many years, before the days of filtration, the water supplies of New England were of much better quality than those of the South and Middle West, but with the very rapid application of filtration to these naturally muddy waters the tables are being turned and the New England supplies, because of their color, sediment, turbidity, and occasional growths of odor-producing organisms, are coming to be of lower standard of attractiveness than the others.

## Risks from Unfiltered Supplies

It must not be forgotten also that while the surface water supplies of Massachusetts are well safeguarded against constant pollution, any unfiltered supply is subject to accidental contamination. Heavy rains may suddenly wash polluting substances into the streams. The "turn over" of a reservoir, because of the disturbance of thermal stratification, may carry deposits from the bottom to the supply pipes of the city. There may be accidental infection resulting from the practices of boating, fishing, and ice-cutting. Storage in large reservoirs gives a high average factor of safety but may be subject to such irregularity that the chance of danger is one which should not be ignored. Almost every year, especially in the early spring, some city of the state suffers from the sudden occurrences of a mild type of dysentery, which is so general in its distribution that the public water supply would seem to be the only possible cause. These mild outbreaks seldom result in deaths, and the cases are not even reported. They come to the attention of the health officers informally, often through the press. They are usually of such short duration that by the time the epidemiologist and the sanitary engineer take up the study the bad conditions have passed. Outbreaks of this character have been reported during recent years in Wellesley, Norton, Medfield, Lancaster, Lynn, Northampton, Longmeadow, Cambridge, and elsewhere. Whether these dysentery outbreaks have been caused by water and, if so, whether they have been due to such an organism as B. Welchii, whether to a recent infection, or to the accumulated sediment on reservoir bottoms, is not known, but, if due to water, filtration will protect a community from infections such as these, provided the filtered water is not stored in an open reservoir.

In my opinion, the time is not far distant when the people will demand the filtration of all surface water supplies, and New England water-works superintendents will do well to keep this possibility in mind.

If filtration is to become general, the type of filter is a matter of importance and one which should already be receiving attention. Unfortunately, the removal of color from soft water is one of the most difficult problems of water purification. The exact nature of the reaction between alum and coloring matter is not yet known. Sanitary chemists used to say that all of the aluminum sulphate was changed to hydrate and that none of it went through the filter. Hiram F. Mills stoutly denied that this was so—although he could give no reason for it—and we are now coming to believe that he was right. The use of alum with short periods of coagulation and mechanical filtration of the ordinary type is, in my opinion, inappropriate to our soft colored Massachusetts surface waters. We must find some modification of the process which will be better, and I think this can be found. The corrosion problem in our state is serious already and must not be made more so by inappropriate chemical treatment. This is no place to enter upon a discussion of this problem, but it is one for the State Department of Public Health and for this association to study in all seriousness.

## Should Give More Attention to Analyses

The water-works superintendents of New England should give greater attention to the analyses of the water supplies under their charge. Analyses are useless unless used. The state sanitary engineers and chemists use them constantly in the course of their supervision, but even this tends to become a perfunctory proceeding unless the superintendents show a co-operative interest. In 1917 the Health Commissioner of Massachusetts sent out a questionnaire relating to water analyses. In reply, 32 superintendents said they made no use of the analyses sent out by the State Department of Health; 19 said that they kept them on file; 18 said that they published them in their annual reports; 23 said that they occasionally show them to inquiring consumers; 28 said that they used them to compare present with past conditions; and only four said that they regarded them as having any important use.

All of the consultinging engineers who replied to the questionnaire were emphatic in their appreciation of the analytical work being done.

The results of this canvass must be regarded as a serious reflection on the interest which the superintendents of the small water supplies of Massachustets take in the quality of the water which they supply, and shows an over-confidence in state supervision. Since the active work of Mills, Stearns, Drown, and Sedgwick, a new generation of superintendents has come forward, and it is because the men of the present day need to have their interest aroused that the writer has brought together various facts and ideas which, for the most part, are not new and which are already well known to many of the members of this association.

*Discussion*—H. P. Eddy remarked that perhaps the reason why superintendents make so little use of the analyses sent to them is because a mere table of analytical data means little to them. M. N. Baker suggested that the water analyses should be correlated with the vital statistics of the city in question and urged that with the virtual elimination of typhoid as a water-borne disease the health authorities should bring forward a new measurement for the relation of water supply to health. Robert J. Thomas said that the old-time water-works superintendents are disappearing in Massachusetts and being replaced by mere formen, who cannot be expected to value and interpret water analyses. This change he attributed to the placing of the water service under departments of public works.

## The Significance of Hydrogen-Ion Concentration

By Harrison P. Eddy
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE term *Hydrogen-ion concentration* (also written "H-ions" and "$P_H$") may be paraphrased as *concentration of acidity or of alkalinity*, as the case may be. Pure water is neutral, and its hydrogen-ion concentration is taken at 7. Acidity is designated by numbers below, and alkalinity by those above 7. The acidity or alkalinity of a liquid has thus far generally been reported in terms of total quantity of acid or alkali present. The new hydrogen-ion method shows the intensity, or true acidity, rather than the total quantity of acid.

It has generally been supposed that the precipitation of the sulphate of alumina is dependent primarily upon the presence in the water of sufficient alkali and that any excess of alkali likely to be present in waters generally used as sources of water supply is not disadvantageous. However, certain experiments indicate that there is an optimum point at which apparently all of the aluminum is thrown out of solution, but that above that point on the side of alkalinity or below it on the side of acidity precipitation is not complete. This offers a plausible explanation of the presence in the water being treated of aluminum both in insoluble and soluble form at the same time and of the frequent occurrence of dissolved aluminum in filtered waters. It certainly indicates that it may be highly important, if practicable, to carry out the coagulation process at the optimum point of alkalinity—the isoelectric point. Without this determination, or its equivalent, it is impossible to know whether the water has the proper $P_H$. It may be too low or too high for complete precipitation and it will probably only occasionally be just at the optimum point.

### Alkalinity and Hydrogen-Ions

Alum can be converted completely into insoluble aluminum hydrate only within a narrow range of hydrogen-ion concentration, which is not indicated by the methods commonly used for determining alkalinity, and either above or below this zone the aluminum or a portion of it, may be present in solution. It follows, therefore, that it is as important to reduce an alkalinity which is too high as to increase an alkalinity which is too low.

For ascertaining the isoelectric point the determination of the hydrogen-ions affords a convenient and practical means. This may be accomplished in a manner similar to that long used for the determination of the total quantity of acid or alkali present * * * * * or by means of electrical apparatus which indicates the relative conductivity of the water under examination.

In order to take advantage of the hydrogen-ion concentration in the operation of a water purification plant it will be necessary to control the chemical treatment according to several steps, such as: (1) Determine the quantity of alum required for successful treatment under conditions prevalent at the time. (2) Determine the $P_H$ of the water to be treated. (3) Determine the quantities and kinds of chemicals to be introduced, in order to bring the water to the isoelectric point for coagulation of the aluminum.

The quality of most raw waters varies from time to time, often materially within very short periods. This variation may be in bacterial content, organic matter, numbers of micro-organisms, turbidity, temperature, or in all of these. It is obvious, therefore, that the quantity of alum must be varied to meet the conditions at the time. It is highly probable, also, that the $P_H$ varies greatly and that the kinds and quantities of chemicals used to produce the isoelectric point must be varied accordingly. Even if the $P_H$ of the raw water remained constant, the necessary changes in the quantity of alum introduced would make it necessary to vary the chemicals required for producing the isoelectric point, as this condition must be fixed with reference to the quantity of alum used, or in other words, if coagulation is to be complete the water must be at the isoelectric point after the suplhate of alumina has been added

It has been suggested that the $P_H$ of the water may be determined and the application of the conditioning chemicals regulated automatically by electrical apparatus. Such equipment would greatly simplify the control of the process.

Among the advantages which may possibly result from $P_H$ control of water purification plants, may be mentioned the following:

(1) Prevention of passage of alum through filters and after-precipitation in mains. (2) Prevention of corrosive action. (3) Control of small plant and animal life. (4) Possible reduction in size of filter plant. (5) Possible increase in efficiency of operation. [Each of these five points was given a paragraph in the original paper.—Editor.] While these and perhaps a number of other advanages of the $P_H$ control may be possible from a theoretical point of view, or may be obtained in the laboratory, it is important to prove to what extent, if any, they can be secured in the practical operation of water purification plants.

### Thorough Investigation Warranted

There is little doubt that the determination of the hydrogen-ion concentration will permit of a more intelligent study of the water and the reactions taking place during its treatment. This fact alone is sufficient to warrant making a thorough investigation of the subject and determining the $P_H$ value in many cases. It is possible that the methods of control now in use, based in part upon the older conceptions of the chemistry involved and in part upon practical operating experience, permit of as close operation of purification plants as it is possible to obtain, even with the assistance of the more delicate and refined hydrogen-ion determinations.

It often happens that empirical methods lead to practical results which are as satisfactory and effective as those based upon more accurate knowledge. This fact, however, does not justify disregard of progress in science and of new theories. It cannot be gainsaid that the older practitioners in any profession, or in the arts, are inclined to adhere to the older methods and processes as a result of their familiarity and experience with them and a natural reluctance to adopt new ideas. The older members of the profession should constantly guard against this tendency, in order that valuable improvements may not be ignored, simply because they involve new discoveries and new theories.

While it is wise to give proper weight to the reasonable doubt of success in order not to be misled by theoretical considerations, it is certain that the subjects of coagulation and filtration should be very thoroughly studied in the light of the more modern chemical theories. Such investigations will lead to a better understanding of the chemistry of coagulation than that which has governed this important subject in the past. With improved conception of the process, advantages of more or less importance are likely to follow. The true value of the hydrogen-ion determination can only be learned through investigations covering a great variety of conditions encountered at a large number of plants. Such investigations may well lead to a restudy of the whole subject of chemical treatment of water and improvements may result in lines entirely apart from the hydrogen-ion determination, which furnished the initial incentive for such further study.

## Other Papers and Discussions

*Bridgeport Water-Works*—The plant of the Bridgeport Hydraulic Co. was described at the opening session by S. B. Senior, president. The supply is by gravity from impounding reservoirs. The company has built five concrete dams with its own organization, including an engineering staff, and has made preparations for building a sixth dam, 150 ft. high. It has engaged extensively in reforestation of its watersheds since 1906 and has two nurseries for the purpose. Owing to disease troubles of white pine, red pine has been planted for the last six or seven years. A jobbing department cuts and fells wood from existing forested areas. The company also uses available water power to run a jobbing grist mill.

Water for all public purposes is supplied without charge

except that some $5,000 a year is collected for water delivered to schools and other public buildings, the rate for this service being 3c. per 100 cu.ft. and the total revenue from this source being only $5,000. No charge is made for water supplied to factories for private fire protection. Meter rates for industrial purposes are 4.4c. per cubic foot. Most of the domestic service is on a flat-rate basis.

*Can High-Value Watershed Land Be Put to Profitable Use?*—This question was presented by Mr. Senior, the problem being "to get adequate returns from rich farming land and at the same time protect the water supply." Some of the land bought by the company cost from $1,000 to $2,000 an acre. Mr. Senior said that the company could not get a return on the value of this land by planting it to conifers and that if it were left idle it would soon grow white birches, etc., and fall to a value of $35 an acre. Cropping with potatoes has shown a loss. Some of the land is now being put into grass. The company is experimenting with orchards, having planted 100 acres in apples, with peaches between in a portion of the area.

*Discussion*—Considerable discussion by various members showed no unanimity of opinion as to the possibilities of profitable utilization of such lands. Allen Hazen stated that the Spring Valley Water Co., San Francisco, owns about 100,000 acres of land some of which is of high value. It has an agricultural department which leases land for short terms—under restrictions, including one against plowing. This department has been profitable, but the Railroad Commission of California finds difficulty in auditing the accounts of the department [from the viewpoint of public policy evidently—EDITOR]. The company now talks of organizing an agricultural company to take the lands off its hands. Others who discussed this question told of the utilization of watershed areas for sheep grazing and for orchards, but on the whole the opinion seemed to be that for most water-works owning lands reforesting would be the best policy.

*Control of Waste by House-to-House Inspection*—Gordon Z. Smith, chief inspector, Bridgeport Hydraulic Co., described the company's system of house-to-house inspection to control waste. He said this is an integral part of the company's method of keeping control of its flat or schedule rate business, which appertains to nearly all the domestic supply. The inspection is made twice a year. Where leaks or other wastes are found and not rectified after due notice, the company sets meters on domestic services. Estimates indicate that any saving in domestic consumption effected by the universal meter system would be more than offset by capital and operating charges for the meters. Water from the various sources of supply is measured by Venturi meters. The percentage of unaccounted water is comparatively small.

*Discussion*—Opinions expressed by several in brief but spirited discussions were for the most part in favor of complete metering as fair and in the long run economical. M. N. Baker suggested that in the company's estimates of the cost of metering all domestic consumers, credit should be given for the postponement of the need for additional water supply to the saving in consumption effected by meters.

*Monel Metal*—This material and its suitability for water-works uses was the subject of a paper by H. S. Arnold, International Nickel Co., New York. The larger part of the paper was devoted to a discussion of this "natural alloy," obtained from nickel-copper ore. The advantages of the use of monel metal for valve stems, seats, etc., in chemical works, steam power plants, and water-works were outlined as well as of the use of the material for water screens and for use in filter and chlorination plants.

*Discussion*—J. M. Diven, secretary, American Water-Works Association, said water-works men would gladly pay double price for valve stems that would not break. Samuel C. Killam, Boston Metropolitan Water-Works, said that he had substituted a monel metal valve stem for a broken item in a 36-in. hydraulic valve. The cost was some 75 per cent extra.

*Leadite for Joints*—An impromptu discussion on substitutes for lead joints brought out the fact that one of the winter meetings of the association will be devoted to this subject. Favorable testimony as to leadite was given by several speakers, including Lincoln Van Gilder, of Atlantic City, in which place leadite has now been used for nearly twenty years and almost wholly for the past fifteen years.

*Disappearance of Coating from Cast-Iron Pipe Stored in the Yard*—Mr. Killam told how pipe stored on his works had shown disintegration of coating, inside and out, after five to ten years. The outside trouble was located 2½ ft. from each end of the pipe, which led him to think that it was due to the rolling of pipe on skids at the works soon after it was coated.

*Discussion*—There was considerable discussion as to changes in character of coating since the manufacture of water gas has become almost universal. Allen Hazen said that he had recently been informed by the chemist of the Barrett Co. that while there is less old-style gas tar than formerly, yet it can be obtained. The Spring Valley Water Co., San Francisco, has a dipping tank in its yard for giving an additional coating to defective pipe. The discussion also brought out that such a tank is used at Springfield, Mass. F. A. Barbour, Boston, stated that the Association's Committee on Cast-Iron Pipe Specifications had decided to send a letter to the pipe manufacturers asking their co-operation in studies for better coatings.

*Reinforced-Concrete Pipe*—A paper on reinforced-concrete pipe for water-works purposes was read by W. G. Chase, of the Lock-Joint Pipe Co., New York City. It was illustrated by both lantern slides and moving pictures. The author stated that where the time used in the manufacture of the pipe is short a colloidal materal can be used for giving tightness and added that Abrams says that clay, which is cheaper than lime, can be used for this purpose up to 10 per cent of the amount of cement with a decrease in the strength of the pipe of 1 per cent for each 1 per cent of clay.

*Chlorination of New England Water Supplies*—A short paper on this subject by W. J. Orchard, of Wallace & Tiernan Co., Newark, N. J., brought out some facts as to the relatively small use of chlorination in the New England States. For the whole country, there are 1996 water supplies having municipal liquid chlorination plants for water and sewage, but only 128 of these, 12 of which treat sewage, are in New England, and of the number stated nearly half are in Connecticut. In Massachusetts only nine plants are using liquid chlorine. The Boston Metropolitan Water District is the only water-works of its size that does not chlorinate the water. The principal reason for the small use of chlorination in Massachusetts seems to be an objection to having water treated by any chemical. Notwithstanding all this, a considerable amount of the work on which the extensive use of chlorination elsewhere in the country is based was done in New England, including the experiments by Sedgwick and Phelps at Boston.

*(Further abstracts will appear in subsequent issues)*

## Water-Works Laboratories Compared

In the report of Fuller & McClintock on the water supply of Kansas City, is a table shown below giving the water-works laboratory personnel and scope for several representative cities:

| City | Pop. 1910 Thous. | Daily Consump. m.g. | Chief Chemist | Asst. Chemist | Asst. Bacter. | Lab. Helpers | Kind of Work |
|---|---|---|---|---|---|---|---|
| Indianapolis, Ind. | 224 | 24 3 | 1 | 2 | | 2 | ABCDEG |
| Louisville, Ky. | 224 | 20 0 | 1 | 1 | 1 | | ABCEG |
| New Orleans, La. | 339 | 30 0 | 1 | 2 | 1 | | ABCEG |
| Grand Rapids, Mich. | 113 | 12 4 | 1 | 3 | | | ABCEG |
| Minneapolis, Minn. | 301 | 30 0 | 1 | | 1 | 1 | ABCDG |
| St. Louis, Mo. | 687 | 98 0 | 1 | 2 | 2 | 4 | ABCDEG |
| Albany, New York | 100 | 20 0 | 1 | 2 | | 1 | ABCEG |
| Cleveland, Ohio | 560 | 96 0 | 1 | | 1 | 2 | ABCEG |
| Youngstown, Ohio | 168 | 20 0 | 1 | 3 | | | ABCEG |
| Cincinnati, Ohio | 363 | 50 0 | 1 | 1 | | | ABCEG |
| Kansas City, Mo. | 248 | 50 0 | 1 | | 1 | | ABG |

A—Bacteriological
B—Examination of Water, Other Than Bacteriological
C—Sanitary Chemical
D—Mineral
E—Organic
F—Microscopical
G—Control of Material

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Time Units in Flow Duration Curves

Sir—I have noted with interest the letter published in *Engineering News-Record*, Aug. 11, p. 250, entitled: "Time Units in Flow Duration Curves" by Mr. Stackpole of the Maine Water Power Commission. Engineers interested in this subject might desire to know of the matter published in this respect in the Ninth Annual Report of the New York Conservation Commission, p. 477, which I prepared in anticipation of inquiries similar to that of Mr. Stackpole. There are given in that report duration curves for five typical streams of New York State, using both daily and monthly flow values. This annual report is available for general distribution.

EDW. H. SARGENT,
Senior Assistant Engineer,
Bureau of Water Power,
Department of State Engineer.

Albany, N. Y.,
Aug. 15.

## "Normal" Construction Activity

Sir—*Engineering News-Record* of July 28 carries editorial comment with reference to certain figures showing the shipments of cement, stone, and sand and gravel for 1921 as compared with 1920. The following statement is made:

"How is it then, if the construction industry is suffering so badly through inactivity, that the production and shipments of construction materials are so near to normal?"

The question naturally arises as to what is meant by that much-abused term "normal" as applied to the construction industry.

The year 1913, being the year previous to the starting of the World War, is frequently referred to as a normal year in the barometer of business activities. However, 1913 certainly cannot be considered as normal for the construction industry for purposes of comparison, for there was accumulated during the intervening eight years a vast amount of construction work, including the demand for housing, railway improvements, public buildings, and farm and factory structures, due to the fact that building activities were seriously curtailed during the war period.

Moreover, with the advent of federal aid in 1916, highway construction received its greatest impetus. Figures prepared by the Bureau of Public Roads show that the number of miles of state and state-aid roads built during 1920 was 98 per cent more than in 1914 and this figure, no doubt, can be applied to 1913 with equal verity. This percentage figure does not include repair work, nor does it take into account that the amount of highway construction and mantenance was seriously reduced during the war period.

Still further, 1920 cannot be considered a normal construction year, for during the last half of that year shipments of sand and gravel, stone, and cement were cut at least 50 per cent due to priority orders granted by the Interstate Commerce Commission in favor of the movement of coal and grain.

It is estimated that there is at least $1,000,000,000 now available for highway construction; that there is a demand for over 1,000,000 homes; that the railroads, in order to bring their maintenance of way work up to the required standard and make necessary extensions and improvements, will need to spend approximately $1,000,000,000. No estimates are available showing the amount that should be expended in public structures, nor for farm and factory buildings, but, no doubt, the needed expenditures for this sort of work would represent an enormous sum.

With this accumulation of deferred building work, can it be said that activity in the construction industry, as indicated by production figures of building materials, is anything like what it should be? In other words, neglecting the fact that there exists a general business depression, is there a normal amount of construction being done for 1921?

E. GUY SUTTON,
Executive Secretary,
National Association of Sand and Gravel Producers.

Washington,
Aug. 12.

## Barbed Wire Fences Form Spur Dikes

Sir—A form of river bank protection that has been very successful along the line of the Fort Worth and Denver City Ry., in Texas, is composed of spurs of piling driven out from the bank pointing downstream. The piles are driven on 7 ft. centers, with the tops projecting above the high-water mark. On this piling is strung barbed wire on 4-in. centers from the river bed to the high-water mark.

SPUR DIKE MADE OF BARBED WIRE ON PILES

This wire effects a slowing down of the current that flows through it, causing it to deposit the sand or silt held in suspension, and building up a sand bar for some distance both above and below the spur. The spurs are more effective during flood time when more sand is carried by the water. The resultant sand bars start forming as soon as the water flows through the wires. The more sand the river carries in suspension, the more effective is the spur.

M. A. STAINER,
Engineer, Maintenance of Way,
Fort Worth and Denver City Ry. Co.

Fort Worth, Texas, Aug. 24.

## Stresses in Horizontal Pipes on Rigid Saddles

Sir—There appear to be several typographical errors in my article on pipe stresses published in the Aug. 25 issue, p. 306, which I would like to point out for those who may want to use the article.

In Table I the column headings should read: $\phi$, $T/\gamma r^2$, $M/\gamma r^2$, $\lambda$, $(\gamma r^5/EI)$.

In Tables II and III, with the exception of the first column, the headings should be values of $\theta$, not $\phi$. In Table II the coefficients are to be multiplied by $Sr/\pi$. In Table IV the algebraic signs defining the character of moments and deflections are not shown. There are several errors in the tabular figures, three of which, in column 4 of Table I and columns 4 and 10 of Table II, are considerable.

Under "Shell Stresses for Case II," in the final expression for $W$ the limits of integration for the last two terms are $\theta$ and $\pi$, not zero and $\pi$. In equations (7a), (8a), (7b) and (8b), the first term inside the bracket should read $(\pi - \theta) \sin \theta \cos \phi$.

Under "Deflections for Case I," the second term in the first equation should be multiplied by 2, i.e. the 2 in the denominator should be omitted.

Tables II and III show values of equations (7) and (10) not (7) and (12). On p. 308, the ninth line from bottom of second column should read, "points $Z_1$ and $Z'_1$."

T. B. PARKER,
Captain 7th Engineers.

Camp Jackson, S. C.,
Aug. 30.

# NEWS OF THE WEEK

New York, September 22, 1921

## To Make Special Examination of Philadelphia Bridges

Thorough examination of all bridges in Philadelphia has been ordered by the Mayor, because of the bridge collapse at Chester, reported in last week's issue. No doubt is entertained as to the safety of any of the Philadelphia bridges, with the possible exception of the South St. bridge, which is old and in bad condition, and whose rebuilding is about to be contracted for. A special examination, however, is thought desirable to give complete assurance to the public concerning the condition of the city's structures.

## War Department Reports Against Deeper Hudson Project

A report against undertaking the project to deepen the Hudson River from its mouth northward 116 miles to Hudson, N. Y., was sent to Congress by the Secretary of War Sept. 6. The report gives the estimated cost as $2,332,000 and points out that the improvement is desired chiefly in connection with the development of lumber traffic from the Pacific Coast via the Panama Canal, to the city of Hudson, where a large lumber terminal has been proposed. The report states that the project is not now justified and points out that it might be in the interest of economy to locate such a terminal farther down the river to avoid the expense of dredging a channel for the long distance proposed.

## Bids Desired on Big Steel Pipe for Catskill Siphons

The Board of Water Supply of The City of New York is about to advertise for bids for the construction of mortar-lined and concrete-covered steel-pipe siphons along the Catskill aqueduct. The diameters of the steel shells range from 11 ft. 6 in. to 11 ft. 3 in., the inside mortar lining being 2 in. thick. The type of construction will be similar to that in the siphons previously built. (See *Engineering News*, Nov. 2, 1911, p. 526.) There are 14 siphons, at each of which two pipes are to be put in. The work will be divided into three contracts, one covering the territory from the Ashokan reservoir to the Hudson River, and two east of the Hudson.

The entire undertaking involves, among other items, about 500,000 cu.yd. of excavation, 100,000 cu.yd. of concrete, 20,000 tons of steel, 200,000 bbl. of cement and 2,000,000 sq.ft. of mortar lining inside the pipes.

Preliminary information may be obtained at the office of the chief engineer of the Board of Water Supply, Municipal Building, New York City.

## Road Builders To Meet Jan. 17-20

The American Road Builders' Association will hold its next annual convention and exhibit of road building machinery and materials at the Coliseum, Chicago, Jan. 17-20, according to an announcement made this week by the board of directors.

## Penstock Bursts During Tryout of High Head Plant

The Big Creek No. 8 hydroelectric plant which has just been completed in southern California was temporarily put out of commission during the tryout period due to the bursting of a penstock section near the power house. The plant has a capacity of 22,500 kw. and operates under a head of 680 ft. At the point where the break in the line occurred the penstock has an inside diameter of 6 ft., a thickness of 1 in. and is under a 580 ft. head. The damaged section of pipe was replaced and the plant was started again after a few days delay.

## 1,000-Mile Transmission Range Indicated by Million-Volt Tests

Tests were conducted at the high-voltage laboratory of the General Electric Co.'s Pittsfield (Mass.) works last week using voltages above 1,000,000 to determine whether the corona and spark-over characteristics at these enormous voltages follow the laws which have been established for voltages below 250 kv. As a result of the tests, which were made at 60 cycles, engineers of the company have concluded that it will be feasible to adopt considerably higher voltages for transmission than are now commercially employed. With the transmitting range permitted by 1,000,000 volts—namely, about 1,000 miles—it should be practicable to supply vast districts with power from the original source of energy such as waterfall, coal mine or oil well.

## California Highway Bonds To Be Offered Oct. 27

A block of $5,000,000 worth of California highway bonds bearing interest at the rate of 5½ per cent will be offered for sale on Oct. 27, according to press reports from Sacramento, Cal. This is the second lot of road bonds to be offered recently by the state at this rate of interest. Reference to the earlier offering appeared in *Engineering News-Record*, July 28, p. 167. The present issue is expected to bring a premium of $30,000, as compared to the $19,550 premium on the previous issue, due to the improvement of the bond market.

## Power and Irrigation Report on Deschutes River

### Engineer Board Headed by D. C. Henny Submits Findings to Federal Power Commission

Utilization of the Deschutes River and its principal tributaries is discussed in a report just submitted to the Federal Power Commission by engineers comprising the Deschutes River Board and composed of D. C. Henny, consulting engineer of the Reclamation Service (chairman); Col. J. B. Cavanaugh, Corps of Engineers, U. S. Army, division engineer for the Northwest District, and Fred Henshaw, the Geological Survey's district engineer for the Northwest. The recommendations of the board are as follows:

That rights to storage in Upper Deschutes River be held withdrawn and be dedicated to irrigation and domestic use, with incidental use for power and industries involving a minimum flow of 200 sec.-ft. past Bend, and 50 sec.-ft. past the lowest irrigation diversion.

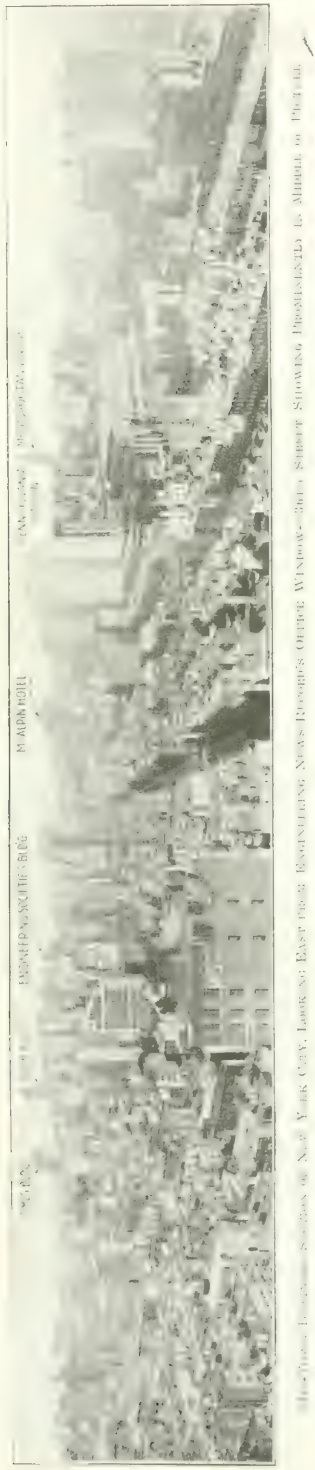
That rights to storage in upper Crooked River be held withdrawn for such use as may seem best in future, it being the present opinion that use for power with incidental use for irrigation in Crooked River Valley will prove most beneficial.

That Upper Deschutes storage do not exceed 525,000 acre-ft.; that possibility of heavy reservoir seepage losses be recognized in plans for storage development and disposal and that aggregate storage to be had with reasonable safety be assumed at not to exceed 350,000 acre-ft. at Benham Falls, and 80,000 acre-ft. at Crane Prairie until higher areas are flooded and greater storage is shown to be practicable.

That any storage development plan take into consideration the probable demands of old water right lands including the 50,000 acre-ft. storage space allowed by the State to the Tumale State Project.

That if storage rights at Benham Falls or Crane Prairie should be granted to interests other than the United States, these rights be limited to irrigation use subject to the maintenance of a minimum flow of 200 sec.-ft. past Bend and 50 sec.-ft. past lowest irrigation diversion for power and industries and to such other conditions as may be necessary to prevent undue monopoly.

That in view of the absence of any large market for Deschutes power and the doubt whether any of the large powers on Lower Deschutes can be developed profitably within the time contemplated by law after application for preliminary permit, all applications



LOOKING NORTHWEST ACROSS THE HUDSON RIVER FROM ENGINEERING NEWS-RECORD OFFICES

## From the Editors' Window

Some time ago a Pacific Coast engineer called on us and brought his wife along. Both of them were much interested in the views of New York City, the Hudson and the Jersey shore from the windows of the editorial office. Believing that the same interest may be shared by others not familiar with New York we print in adjoining columns two views from our office windows. The one looking eastward shows the great pile of buildings which has grown up in the Mid-town office section of New York. The development shown extends along Fifth, Sixth and Seventh Avenues, and Broadway from about 23d St. to 59th.

The other looks northwest across the Hudson toward the Jersey shore.—*The Editors.*

## To Construct New Buildings for Rose Polytechnic Institute

Construction work on the new Rose Polytechnic Institute buildings at Terre Haute, Ind., east of the city, will start within the next 60 days and the school will be transferred to the new location before June 1 of next year, according to an announcement by President Philip A. Woodworth.

The institute management has sufficient funds on hand to proceed with the work and bids on the work will be asked within a few days.

(*Continued from preceding page*)

for power at this time be considered as covering necessary investigations only and be handled by the Federal Power Commission so that ultimate development may not be hindered when conditions render such development economically practicable.

That no license be issued for development of water power on either Upper or Lower Deschutes which is not in harmony with the maximum development of irrigation.

That no license be issued for any project on Lower Deschutes which is not in harmony with the general scheme for the development of water power outlined in Water Supply Paper 344 of the Geological Survey until conclusive showing of an improvement upon this general scheme is made.

## Port Authorities' Convention To Be Held in Seattle

The convention of the American Association of Port Authorities is to be held in Seattle Oct. 11-14. The program includes inspections of Seattle's port facilities, of the logging industry, the Bremerton Navy Yard, and the inland lakes of Seattle.

## Pontoon Bridge Proposed to Relieve Seattle Ferries

Two Seattle engineers, R. R. Montell and J. H. Dirkes, have made an offer to the county engineers of King County (Seattle) to build two pontoon ridges across Lake Washington in place of ferries. They propose to use fifteen of the wooden vessels of the Shipping Board now moored in Lake Union, and estimate the total cost at $235,000 if the vessels are furnished without cost. The superstructure, built of wood, is to have 18-ft. roadways and 4-ft. sidewalks. The 3,000-ft. crossing from Seward Park to Mercer Island would consist of trestle approaches and ten spans on nine pontoons, while the crossing from the east shore to Mercer Island, 1,000 ft. long, would require three vessels. Draws would be provided in both bridges. In support of the plan it is stated that the present ferries are operating at a loss and that traffic would be facilitated.

## Orders Rehearing of Cleveland Union Station Case

A rehearing in the Cleveland passenger terminal case has been ordered by the Interstate Commerce Comission. The proceeding has been assigned for Sept. 20. It will take place in the Federal Building at Cleveland before Commissioner J. B. Campbell and Examiner R. W. Clarke.

In the meantime Peter Witt, former transit commissioner of Cleveland, who opposed the Public Square project in hearings before the commission, has filed a brief with that body petitioning that it compel the building of a union station on the Mall site to be used by the New York Central, the Big Four, the Nickel Plate, the Baltimore & Ohio, the Pennsylvania, the Wheeling & Lake Erie, and the Erie Railroads.

## Columbus Flood-Protection Work Near Completion

Scioto River channel improvement for flood protection of Columbus, Ohio, will be completed by the end of 1921 if the contractors are favored with fairly mild weather, according to R. H. Simpson, city engineer. The river channel has been widened from its confluence with the Olentangy River to a point south of the city. With the exception of some earth to be removed at the Broad, Town and Mound St. bridges all of the excavation has been completed. Approximately 1,000 ft. of levee must yet be constructed on the east bank and a small portion on the west bank. Nearly one-half of the concrete revetment is completed. The entire work cost about $3,500,000.

## Louisiana to Legislate on Roads and Motor Vehicles

Bills dealing with the highway situation are expected to be a prominent feature of the special session of the Louisiana legislature which convened this month. A spirited fight is looked for on the tax on gasoline provided for by the recent constitutional convention where a maximum tax of 2 cents per gallon was specified. Advocates of lower taxation want the legislature to impose a levy of not more than 1 cent per gallon.

Another contest is expected on whether the State Highway Department shall be under the control of one commissioner or a commission of three members.

## Submits Freight Belt-Line Plan for Flint, Mich.

According to recent announcement of officials of the Pere Marquette Ry., a plan for the construction of an 8-mile subsidiary line, to serve as a belt line for the diversion of freight traffic, has been submitted to the railroad company by the city of Flint, Mich. The Interstate Commerce Commission has already authorized the railroad to acquire control of the Flint Belt Railroad Co. It is the purpose of the plan to provide better yard facilities and to assist in the plan of civic development. The officials of the railroad hope to complete construction of the 8-mile line by the end of 1922.

## Morgan Executive Chairman, A. A. A.

At a special meeting of the executive board of the American Automobile Association, held in New York City, Sept. 12, D. L. Morgan, of New Haven, Conn., was elected executive chairman to succeed the late A. G. Batchelder. Mr. Morgan, who has long been active in the good roads activities of the Pennsylvania Motor Federation and New Haven Automobile Club, has been at the Washington headquarters of the A.A.A. since July 1, as acting executive chairman.

## Engineer Employment Status Shown by A. A. E. Statistics

During August a few more engineers applied to the American Association of Engineers for positions than in July, but there were more vacancies available. The following table shows the trend:

| | Aug., 1921 | July, 1921 | Aug. 1920 |
|---|---|---|---|
| Applicants for employment | 2,320 | 2,215 | 1,303 |
| Positions received | 360 | 321 | 738 |
| Men referred | 2,250 | 2,567 | 3,502 |
| Men placed | 204 | 212 | 306 |

The most active fields are highway and municipal engineering and teaching. The average monthly salary of positions filled in August was $181, while for the same month last year it was $209. The highest paid position was for a city manager at $7,500 per year and the lowest a rodman at $125 per month.

## Simplon Excavation Completed

Excavation of the second Simplon tunnel was completed Sept. 13, according to cable dispatches. The tunnel was being built by enlargement of the ventilation heading driven parallel to the first tunnel at the time the latter was constructed. The work was greatly retarded by conditions during and subsequent to the war. It is reported that traffic may be turned through the second tunnel by the end of the year.

## To Promote Entente Cordiale Among World's Engineers

Several hundred American engineers will gather with representatives of the principal engineering societies of Great Britain and France at a dinner to be given at the Engineers Club, New York City, on the evening of Oct. 10. While formally celebrating the homecoming of the mission of American engineers who went abroad to confer the John Fritz medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. The event is planned to mark the launching of a world movement of engineers to promote unity among the English-speaking peoples and among peoples who aided in the war against Germany.

Invitations have been extended to many men prominent in public life, including Herbert Hoover, Secretary of Commerce, Viscount Bryce and Charles E. Hughes, Secretary of State. Others who will attend are the governing boards of the four national engineering societies, the trustees of the United Engineering Society and the officers of the Federated American Engineering Societies. British organizations whose representatives will be guests are the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Mining and Metallurgy, Iron and Steel Institute, Institution of Electrical Engineers, and the Royal Society of London. France will be represented by La Société des Ingenieurs Civils de France.

## Clifford Richardson, Asphalt Specialist, Retires

### Was Prominent Figure in Development of Paving Practice in American Cities and Europe

Clifford Richardson, well known in this country and Europe as a specialist in asphaltic materials and paving methods, has announced his intention to retire from active practice Oct. 1. He will leave New York City, where for many years he has served as consulting engineer to the Barber Asphalt Paving Co., and will establish a residence in Santa Barbara, Cal. He was one of the pioneers in the investigation of bituminous materials for paving purposes, a field in which his early training as a chemist was a fundamental asset.

Mr. Richardson's first work, after he had graduated from Harvard in 1877, and taken post-graduate work at the University of Bonn, in Germany, gave little indication of the field in which he was eventually to become prominent, for he started as a chemist in the U. S. Department of Agriculture at Washington and was engaged principally in making studies of the adulteration of foods and the composition of American cereals. In these and similar investigations he was engaged for ten years.

#### Becomes Asphalt Inspector

One day in the year 1887, while at the Metropolitan Club in Washington, Mr. Richardson was accosted by Col. William Ludlow, then engineer-commissioner of the District of Columbia. On this same day E. A. DeSmett had resigned as inspector of asphalt and cement, under Col. Ludlow's direction, and the latter, knowing of Richardson's ability as a chemist and laboratory investigator, immediately offered him the position. Mr. Richardson accepted and began a campaign to place the selection of asphaltic materials for paving work on a rational basis. At that time practically all of the asphalt used in this country came from Trinidad, with a small amount also from Cuba, but the oil asphalts had not yet been developed. Asphalt paving specifications were exceedingly loose and ambiguous and there was practically no control over the material going into the work. Mr. Richardson set about fixing the proper proportions to use in sheet asphalt work and acted also as advisor on construction methods.

In those early days it was the practice to lay the asphalt to a thickness of 2½ in., with no binder course, the foundation often being of natural cement. Mr. Richardson's studies led him to conclude that the foundation of natural

cement was sufficiently porous to allow water from the subgrade to come in contact with the asphalt surfacing causing disintegration. With the introduction of portland cement concrete foundations, this trouble was largely eliminated.

### Close Binder Developed

One of the first important developments in asphalt paving practice during Mr. Richardson's service with the government was the introduction of a binder course. As first constructed of broken stone and liquid asphalt, forming what was known as an "open" binder course, it proved fairly satisfactory until rapidly moving rubber-tired motor vehicle traffic became great. It was then found that pavement laid on an open binder course was shoved into waves by traffic, as the material in the binder course, together with the comparatively soft surfacing then used, was not sufficiently stable to resist the thrust from motor-driven wheels. This condition of affairs led to the development, largely through Mr. Richardson's efforts, of the "close" binder in common use today, in which the voids in the coarse aggregates are filled with asphaltic mortar. Mr. Richardson considers the introduction of the close binder as one of the important developments in asphalt paving and in its early endorsement he was joined by Capt. Symons of the Corps of Engineers.

When a change in the engineer-commissionership of the District of Columbia occurred about 1894, Mr. Richardson found his work less agreeable than under the old regime. Meeting A. L. Barber of the Barber Asphalt Paving Co., in Washington two or three months later, he told him of his dissatisfaction under the new conditions, and Mr. Barber promptly engaged Mr. Richardson to take charge of the field and laboratory work of that company's paving operations. He continued in Washington on this work and later (1906) went to New York in charge of the Barber laboratory in Long Island City. He has served that organization in a consulting capacity ever since, and his work has taken him into every state of the Union and to Europe.

### Work on Thames Embankment

One of Mr. Richardson's notable engagements was on the paving of the Victoria Embankment in London. Heavy motor-vehicle traffic had made necessary a yearly resurfacing of the old macadam pavement, and on behalf of the London authorities W. C. Copperthwaite sent out a general invitation for a solution to the problem. Mr. Richardson went to Europe and proposed the surfacing of a section of the famous roadway with Trinidad Lake asphalt. He explained his project in detail and then asked what specifications it would be necessary to meet.

"There are none," he was told, "The job is yours. Do with it what you wish."

Under this broad authority Mr. Richardson laid about 800 sq.yd. of asphalt top surface on a base of asphalt binder near the east end of the embankment. The price, including two years' maintenance, was $2.17 per square yard. Other sections of the Thames embankment were paved in a variety of ways by other interests, but the asphalt paving was the only surfacing which remained after two years of service. These results led to an extension of the use of lake asphalt on the roadway and at the end of 1912 this type of surfacing constituted the entire area of the Victoria embankment from Black Friars Bridge to Westminster.

### Thick Binder—Thin Top

Returning to the United States after the work in London had been completed, Mr. Richardson continued his service with the Barber company. Present-day traffic needs, he believes, make desirable a thicker binder course and a thinner wearing surface than were formerly employed. The surfacing, he points out, is only a protection for the binder course and might well be reduced to a thickness of 1 in., provided 2½ in. of close binder are laid to carry the heaviest kind of traffic. Today's traffic demands also call for an asphalt surfacing considerably harder than that used a decade ago, due, among other things, to the shoving effect of the wheels of automobiles and the softening of the pavement surface by oil droppings from motor cars. Mr. Richardson gave much study to determining the proper portioning of materials in the more recent top surfaces of asphalt pavement.

Mr. Richardson has been a prolific writer on subjects in his special field, among his principal books being "The Modern Asphalt Pavement." During recent years he has devoted much study to the colloidal state of matter in relation to the asphalt paving industry. His investigations have also related to the manufacture and constitution of portland cement and to the petroleum industry.

## Fourteen States Tax Gasoline

In fourteen states taxes on gasoline are now operative, according to a recent statement by Harry Meixell, Jr., secretary of the Motor Vehicle Conference Committee, New York City. The tax is 1c. per gallon in all of the following states except New Mexico, where a 2c. levy is imposed: Colorado, Kentucky, New Mexico, Oregon, Arizona, Arkansas, Connecticut, Florida, Georgia, Montana, North Carolina, Pennsylvania, South Dakota and Washington.

Bills aiming to impose gasoline taxes were also considered this year by the legislatures of nine other states, namely, California, Illinois, Indiana, Maine, Michigan, Nevada, Ohio, Tennessee and Texas, but the measures failed to gain sufficient support to become laws.

It is estimated that $6,000,000 per year is now being collected from the gasoline taxes, which are in addition to the usual vehicle registration fees.

## Convention of the New England Water Works Association

The registration at the fortieth annual convention of the New England Water Works Association at Bridgeport, Conn., Sept. 13-16, was 404. The program announced in *Engineering News-Record*, Sept. 8, p. 421, was carried out in full. The relatively few papers scheduled for each session gave full opportunity for discussion and avoided the confusion, haste, and postponement of papers to other sessions common with overcrowded programs.

The Dexter Brackett medal for the best paper printed in the *Journal* of the association during the past year was awarded to Robert Spurr Weston, consulting engineer, Boston, Mass., for his paper on lead poisoning from water supplies. The committee report on Water-Works Accounting presented at the 1920 convention and published in the *Journal* for March, 1921, was adopted after very little discussion, with about 35 to 40 members present. The committee report on standard specifications for water meters, printed in the *Journal* for June, was also adopted. This report covers disc meters only, although the committee expects to cover other types later on. The discussion on this report brought out the hearty approval of the manufacturers.

The Bridgeport Hydraulic Co., through its president, S. P. Senior, and other officials contributed largely to the success of the convention by the way of papers, discussion on the floor of the convention, and the provision of automobiles and escorts for trips to the various impounding reservoirs and chlorination plants of the company, and to the city sewage works, where there are installed two 20,000,000-gal. Reinsch-Wurl screens, each 26 ft. in diameter, and pumps with a total capacity of 48,000,000 gal., the entire installation of screens and pumps being electrically driven. Among other entertainment features provided by the Water-Works Manufacturers' Association was a picnic and short dinner after the close of the Friday morning session of the convention. There was also a visit to the Crane Co. valve works.

Attendance at the technical sessions of the convention was good the first two days, but dwindled rapidly on the third and fourth days.

Abstracts of a considerable number of the convention papers and discussions appear elsewhere in this issue or will be published later.

## A. G. C. 1922 Annual Meeting to Be Held in Cleveland

At the mid-year meeting of the executive board of the Associated General Contractors of America, held recently at White Sulphur Springs, W. Va., Cleveland was selected as the city in which the 1922 annual meeting of the association will be held. St. Louis, Washington and San Antonio were other cities considered. The date of the convention has not yet been fixed.

### Report I. C. C. Plan for Railroad Group Consolidations

Reports on a plan for the consolidation of railroad companies into large systems, as provided in the Transportation Act, purporting to be that suggested in a report made to the Interstate Commerce Commission by W. V. Ripley, professor of economics, Harvard University, have been published in the daily press. At this writing the commission has refused to confirm or deny the report, although it has been widely published. Under the Transportation Act the commission must render an official report outlining its recommendations for the consolidation of carriers into large systems, but it has no power to enforce the project.

The plan now reported proposes twenty systems, some of which are "alternative." Six systems would be formed in the northwest part of the country, exclusive of New England. Under one plan the New England lines would be included with the Lackawanna and other roads as the New England-Great Lakes System. From carriers in the southeastern section, five systems would be formed and five big Western systems would be built around the Union Pacific, the Burlington, the Milwaukee, the Santa Fe and the Southern Pacific. Two systems in the Southwest, known as the Frisco-Katy-Cotton Belt and Chicago-Missouri Pacific Systems, are suggested.

### End One-Way Traffic on Broadway

As the result of a conference between representatives of business organizations in the Times Square district, New York City, and Dr. John A. Harriss, special deputy police commissioner, it is announced that beginning Sept. 15 one-way traffic on Broadway is to be discontinued for a period of thirty days. A change in traffic regulations, put into effect some months ago, restricted the use of Broadway between 38th and 57th Sts. to northbound traffic between the hours of 7 p.m. and midnight. The institution of these regulations, the business men claimed, was responsible for a considerable reduction in their income.

Plans are under consideration for the use of traffic signal towers, such as those employed on Fifth Ave., at Seventh Ave. and 42nd St., Broadway and 42nd St., Broadway and 49th St., and Broadway and 53rd St.

### California Road Probe Refused By Governor

Governor Stephens of California, on Sept. 9, refused the request of the California State Automobile Association for an investigation into that organization's charges of waste and bad judgment in the construction of the state highway system. He maintained that "all reasonable demands" for such an inquiry had been met by the comprehensive investigation by the U. S. Bureau of Public Roads, which submitted its report Feb. 18.

### Mississippi Valley Associations Forms Eleven Districts

The Mississippi Valley Association has formed committees representing various waterway districts to aid and promote waterway development. The eleven waterway districts represented by committees will be as follows: Intercostal Canal, Illinois River, Lower Mississippi River, Missouri River, Ohio River, Upper Mississippi River, Warrior River and the Great Lakes district. Committees representing the tributaries of the Ohio River and of the Mississippi have also been formed.

## Engineering Societies

### Calendar

**Annual Meetings**

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

**The Western Society of Engineers** was addressed, Sept. 12, by A. R. Hirst, state highway engineer of Wisconsin, on "Developing a System of Highway Transportation to Serve the People of a State." On Sept. 19 Arthur E. Morgan, until recently chief engineer of the Miami Conservancy District, spoke on "Dayton Flood Control." Sept. 26 will be chief engineers' night and the society will learn of the experiences of C. A. Morse, chief engineer, Chicago, Rock Island & Pacific Ry.; A. S. Baldwin, vice-president and formerly chief engineer, Illinois Central R.R.; H. R. Safford, assistant to president, Chicago, Burlington & Quincy R.R.,and formerly chief engineer, Grand Trunk System; C. F. Loweth, chief engineer, Chicago, Milwaukee & St. Paul Ry., and E. H. Lee, Chicago & Western Indiana R.R.

**The Allied Engineering Association,** Charleston, S.C., has announced for the season a series of papers among which are: Oct. 17, "The Auto Truck—Its Use in Construction Work" by Lt.-Col. Eugene Kelly; Dec. 19, "Rebuilding Filter Plant, Charleston Water Department," Francis B. McDowell, Jr.; Jan. 16, "The Engineer and the Financier," E. H. Pringle, Jr.; Feb. 20, "Concrete Roads," James W. Martin; March 20, "Construction of Bridge Piers for the New Santee River Bridge," J. Bryce LaBruce; April 17, "Railroad Problems" J. P. Walker; May 15, "Paving of City Streets," J. H. Dingle. The officers are: President, J. E. Gibson; vice-president, W. L. Whitescarver; secretary and treasurer, T. A. Burbridge.

## Personal Notes

ROBERT L. E. WARD, representative of the Weiland Engineering Co., Canon City, Col., has been appointed city engineer of Canon City.

WILLIAM CORMAN, formerly with the Gabriel Steel Co., is now chief engineer of the McRae Steel Co., Detroit, Mich.

PROF. L. S. SMITH, head of the highway engineering and city planning courses of the University of Wisconsin, has been appointed engineer of the Appleton, Wis., City Plan Commission.

R. M. CONNER, formerly project manager, Fort Peck project, U. S. Reclamation Service, with headquarters at Poplar, Mont., has been transferred to the Riverton project as construction engineer on diversion dam and canals to irrigate 100,000 acres in Fremont County. His headquarters are at Pilot, Wyo.

D. WALLACE BROWN has resigned as professor of engineering in the Royal Military College, Kingston, Ont., to become professor of mechanical engineering in the Nova Scotia Technical College, Halifax.

LIEUT.-COL. S. W. FLEMING, JR., of the firm of Gannett, Seelye & Fleming, Inc., has been appointed by Governor Sproul of Pennsylvania a member of the commission to investigate the battle fields of France and Belgium to mark the places where Pennsylvania units fought.

SAMUEL D. FOSTER, consulting highway engineer, has been appointed consulting engineer for the Allegheny County, Pa., Planning Commission.

GEORGE A. ARMES, president and general manager of the Moore Shipbuilding Co. of San Francisco, has resigned. Directors of the company, in announcing the resignation of Mr. Armes, who was an engineer, paid a high tribute to his skill. He is credited with having made a world's record in ship launching when six vessels were sent down the ways within an hour's time, as well as with several shipbuilding records including the recent completion of the oil tanker "Vacuum" in 115 working days winning the race for a world's record against the Sparrow's Point Shipbuilding Co. at Sparrow's Point, Md., where a vessel of similar dimensions was under construction. Mr. Armes was "loaned" to the Shipping Board by the Bethlehem Shipbuilding Corporation to handle their construction work and resigned this position to become the head of the Moore Shipbuilding Co.

CHARLES N. ROBERTS, consulting municipal engineer and surveyor, Chicago, has taken his son, Keith Roberts into partnership. Mr. Roberts, senior, has been engaged in the design, operation and construction of waterworks, sewers and paving, particularly of the North Shore suburbs, since 1889.

Keith Roberts is a mining engineer and until recently has been employed by Robert W. Hunt & Co. on examination of properties. During the World War he was an ensign in the Navy.

HUGH MILLER, since 1918 instructor in the Army Engineer School at Camp Humphreys, Va., has been appointed professor of civil engineering at George Washington University, Washington, D. C. He was graduated from Princeton in 1901 with the degree of C. E. and was an instructor in civil engineering at Princeton and later at the Harvard engineering camp. From 1900 to 1915 he was professor of civil engineering at Clarkson School of Technology, Potsdam, N. Y., and from 1915 until he entered the government service, he was lecturer in engineering at the Rice Institute in Texas.

## OBITUARY

WILLIAM J. RODGERS, president of the Rodgers Granite Corp., New York, died in New York Aug. 31. He was 49 years old. For many years he was associated with his father John C. Rodgers in the contracting business under the firm name of J. C. Rodgers & Son. Among the large contracts he executed in this connection were two sections of the old rapid transit subway system New York, the Madison Ave. and Willis Ave. bridges over the Harlem River, the New York speedway and Riverside Drive. The Rodgers Granite Corp., of which he was president for the past few years, is operating one of the largest quarries in Maine, located at Stonington.

L. T. GOBLE, district engineer in the construction department of the Lakewood Engineering Co., Philadelphia, Pa., died Sept. 5. He had formerly been engaged in construction work in the West and was connected with the Allied Machinery Co., New York. His first assignment with the Lakewood company was at its Detroit office and, later, at the Philadelphia office.

## EQUIPMENT AND MATERIALS

### New Asphalt Block Press

In the National asphalt block press all stages in the making and discharging of blocks are automatically handled by the machine itself. After the hot mixture is fed to the hopper it is not again touched until the blocks are discharged from the water trough connected to the machine, at which time they are sufficiently cooled to be ready for storage or shipment.

The basic principle of the machine is hydraulic, but the hydraulic pressure is intensified by means of a system of levers. The maximum pressure obtainable is 400 tons. After the block is molded and compressed it is delivered to a belt conveyor which carries it through a trough of running water, in which the block is cooled and delivered to a platform ready for removal.

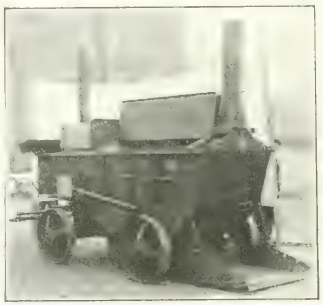
The press is designed so that it is readily adjusted to make the three standard sizes of asphalt block, 5 x 12 x 2 in. for light traffic, 5 x 12 x 2½ in. for medium traffic, and 5 x 12 x 3 in. for heavy traffic.

There is also a National press for making asphalt tile for walks and other light uses, and also a type which will make either paving block or tile.

The machine is made by the National Molding Press Corporation, 262 Fulton St., Brooklyn, N. Y.

### Compact Road Repair Outfit

A compact road-repair outfit, sold by H. P. Andresen & Co., 1261 N. Clark St., Chicago, Ill., combines in a single device carrying capacity for materials



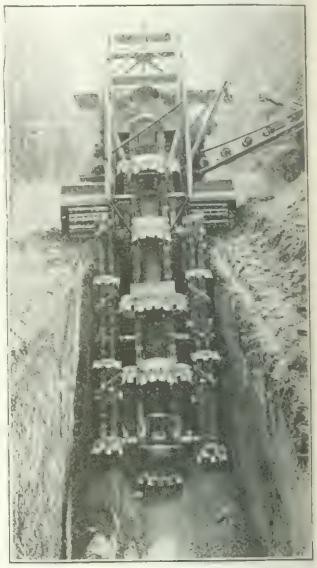
for repairing all types of roads. It carries a 125-gal. heating or melting kettle; two bins, each of 1-yd. capacity, for heating sand and stone; a combination mixing pan and tool carrier, a heater for tampers and smoothers; a coal-burning furnace; a coal bin of 350-lb. capacity; a cement box holding six sacks of cement; space on top of the bins for carrying materials and tools, and a hot shelf for keeping pouring pots warm.

The shipping weight of the outfit, mounted on 30-in. steel wheels, with 10-in. treads, is 5,500 lb.

### Device Extends Width Limits of Trench Excavators

An attachment to a trench excavator which increases the width of trench that can be dug beyond the ordinary limit, which is the width of the throat through which the buckets pass, has been successfully developed by the Austin Machinery Corporation, of Chicago. This attachment can easily be made to any box-boom Austin excavator. In actual tests on a No. 0 machine, which normally digs trench a maximum of 42 in. wide, a trench 76 in. wide has been dug. The tests indicated that this width could be increased and further experiments will be made to determine the maximum.

The new attachment consists of endless chains, two on each side of the boom, to which are attached steel castings, to which are bolted teeth and side-cutters. These teeth merely rip up the dirt beyond the point where the regular buckets and bucket extensions dig. The scrapers, set diagonally between the castings, throw the dirt into the buckets that cut the core of



the ditch. These cutters and plows can be extended or made narrower.

In a ditch of 11 ft. depth, three shafts are necessary. These are inserted through holes in the box-girder boom and are reinforced with cast-steel hubs on each side of the boom. One shaft carries the upper sprockets, which are the driving ones, and another carries the lower idlers. The third or central shaft carries idlers to keep the chains from pushing over toward the center of the machine when hard material or obstructions are met.

### Steam Shovel Mounted on Rubber-Tired Wheels

The Osgood Co., of Marion, Ohio, is now prepared to equip its Model 18, ¾-yd. traction revolving steam shovel with solid rubber tires. The purpose is to make a unit which can be moved over city pavements at considerable speed in going from job to job. The gears for self-propulsion can be disengaged so that the unit can be towed rapidly.

The tires are 40 in. in diameter and 14 in. wide, with ribbed treads. They are mounted on steel rims which are pressed on the regular 35 in.-diameter by 16 in.-face cast-steel wheels. This arrangement permits removal of the tires when desired. Cleats can then be attached to the rear wheels.

The tires are furnished by the Firestone Tire & Rubber Co.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Reductions Made in Wholesale Prices of Cement

Cement manufacturers have announced a general reduction of cement ranging from 15 to 30 cents per barrel, which is already effective. The New York price alongside dock, to dealers, is now $2.10, as compared to $2.40, a price which has been in effect for several months. New York dealers, who for some time have been operating on practically no margin, have reduced their price to contractors 10 cents, making the present quotation $2.50 per barrel, net.

The price f.o.b. Chicago is now $1.97, which is a decrease of 20 cents. The decrease at Pittsburgh and Duluth plants is 15 cents. The Minneapolis price is now $2.26, as against $2.41, not delivered on the job. The new San Francisco price is $2.89, a decline of 20 cents.

Present prices in nine important centers are given in the regular weekly tabulation of basic materials quotations, on the following page.

## Ohio Road Work Active

About 60 per cent more miles of highways have been built in Ohio up to Aug. 31 than were constructed in any previous year, according to a recent report of Leon C. Herrick, state highway commissioner. During the present year the department has completed 572.4 miles of highways; the highest previous mileage was in 1916 when 367 miles were completed. Mr. Herrick predicts that during 1921 at least 800 miles and possibly 1,000 miles of highways will be completed.

About 40 improvement projects are being delayed in anticipation of reductions in prices of materials.

## Highway Work in Washington

Bids for eleven road contracts received by the Washington State Highway Commission and opened Aug. 30 constitute probably the last of the new road work to be authorized during 1921. Seven of the new projects are located in eastern Washington, and all will call for starting work this year, and finishing it in 1922. The state is now improving 187.29 miles of highway at a cost of $4,056,739.69. Thirty-five grading jobs and sixteen paving contracts are under way.

## Maryland Road Contract Awards Completed for This Year

The State Roads Commission of Maryland has completed the award of contracts for this year. Since the beginning of the construction season contracts for about 160 miles of road had been let, involving an expenditure of roughly $3,500,000.

## Activity on Road Work in California

Early in September there were 2,500 men employed on state highway construction work in California, according to estimates by A. B. Fletcher, chief engineer, state highway commission. Of this number, 1,500 were employed on contract work. Since Jan. 1, 1921, sixty-three contracts have been let, totaling in value $7,916,000.

## Crane Business Improving

There has been a noticeable improvement in the derrick and crane business in the New York district recently, according to A. R. Ulbrich, general sales manager of the Terry Manufacturing Co. That company, within the past few weeks, has closed several orders for derricks and cranes, among them one for a tractor crane in Hoboken.

## Ohio Plans Relief for Unemployed

Secretary of Commerce Herbert Hoover has received from Governor Davis, of Ohio, a telegram outlining that state's policy of relieving unemployment. The message was sent in response to Mr. Hoover's plea for the letting of road contracts during the winter. Governor Davis says, in part:

"Extensive roadbuilding contracts have been let. I am urging letting of additional contracts for new highways and hope to continue grading and other highway operations throughout the winter to relieve the situation.

"Additional appropriations are available soon for a large building program at state institutions. Ohio operates seven free employment offices in the larger cities through which it hopes to provide machinery for the placement of the unemployed. Ohio cities, as such, have not made appropriations for relief."

## Recommend Unemployment Bureau for New York City

Acting upon the recommendation of the Mayor's Committee, headed by Bird S. Coler, commissioner of public welfare, the New York Board of Estimate and Apportionment on Sept. 7 made an initial appropriation of $25,000 for the establishment of an industrial aid bureau to deal with the problem of unemployment. The committee also recommended "that federal, state, and city governments be urged to commence at once and extend as far as possible all contemplated public works in and around New York City for which appropriations have been made." An appeal also was made to private employers to initiate work or proceed as rapidly as possible with work for which contracts have been let.

## Brick Outlook Improves

Reports from 110 manufacturers of common brick in the United States on Aug. 1 indicate an improved condition in construction. Although stocks on hand are far in excess of orders, the increase in orders in relation to the increase in stock is in about the ratio of 3 to 1. This is the first month since the beginning of the year that the figures have revealed an actual upward trend in brick demand.

The number of plants closed is 35, the percentage being reduced from last month. Out of 110 plants reporting, 35 are closed, while a month ago the same number were closed out of a total of 92. These 110 manufacturers produce about 40 per cent of the common brick made in the United States. Stocks of burned brick on hand have increased from 198,169,000 on July 1 to 231,460,000 on Aug. 1, showing an increase in production for July. This is accounted for by the placing of orders amounting to 130,613,000 as compared with 73,562,000 on the books July 1.

## Southern Pine Orders Show Notable Increase

Orders on hand for Southern pine were higher for the week ended Sept. 2 than at any time during the last three and a half years, with but two exceptions. Reports received by the Southern Pine Association indicate that orders held by Southern pine manufacturers averaged 706,459 ft., which is the highest on record since March, 1918, with the exception of two weeks in 1919. This week's orders are 30 per cent higher than those for the same week in August, and 62 per cent higher than during the corresponding week of last year.

Average shipments for the week of 603,496 ft. were also much larger than usual, being the highest reported since May, 1918. Orders received for the past three weeks have been greater than during any week since the middle of 1919, and show progressive increases.

## Building Revival the Cure for Unemployment, Says Meyer

The general resumption of building operations will do more to put men to work than the revival of any other one industry. This is the recently expressed opinion of Eugene Meyer, Jr., managing director of the War Finance Corp. "The housing needs are large," said Mr. Meyer, "but building still awaits a supply of money on mortgage at reasonable cost and a settlement of labor conditions, as well as a readjustment in the cost of building materials. The revival of the building business

would put more men to work than the revival of any other one industry. It would mean direct and indirect labor in great volume."

### Building Material Prices Lower in August

Wholesale prices of building materials in August were a trifle lower than in July, according to the indexed figures of the U. S. Department of Labor. The August index number is 198, a drop of 40 per cent from the peak, as compared with 200 in July and 328 in August, of 1920. The average price in 1913 equals 100.

### Will Appoint Assistant Examiner, Patent Office

The United States Civil Service announces that an examination will be held October 5, 6 and 7 for appointment as assistant examiner in the United States Patent Office. Vacancies will be filled at the entrance salary of $1,500 per year with the bonus of $20 a month recently approved by Congress. Applicants should apply at once for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C., or to the secretary of the U. S. Civil Service Board in any of the designated cities.

### Distributers of Construction Equipment Meet

The National Distributers Association of Construction Equipment held a meeting in Milwaukee, Wis., recently which was attended by firm members and representatives of many of the largest distributers and manufacturers of construction equipment. Action to recommend that manufacturers adopt a standard size of catalog, to establish a trade-practice committee at the command of both manufacturer and distributer for ascertaining facts where differences arise, and to recommend that price lists be put on standard loose leaves, was taken.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 1, the next, on October 6.

| | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products:** | | | | | | | | | |
| Structural shapes, 100 lb | $2 88 | $4 00 | $4 00 | $2 88 | $3 16 | $4 00 | $3 70 | $3.75 | $4.00 |
| Structural rivets, 100 lb | 3 70 | 5 25 | 5 50 | 3 68 | 4 15 | 4 25 | 5.50 | 5 00 | 6 50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2 78 | 3 25 | 3 50 | 2.78 | 3.18 | 3 57½ | 2.35 | 3.75 | 3.75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 52 65–5% | 45% | −65½% | −58 9-5% | −38% | 46 25% | −55% | 5% |
| Cast-iron pipe, 6 in. and over, ton | +47.30 | 40.50 | 53.30 | 45.60 | −47.80 | 52.00 | 60.00 | —55.00 | 70.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | −2 50 | 2.69 | 2 80 | −1.97 | 2.26 | 3.10 | −2.89 | 3.10 | 3.10 |
| Gravel, ¾ in., cu.yd | 2 25 | 2.13 | 3 00 | −1 65 | 2.00 | 2 50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.50 | −1.65 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 2.80 | −1.75 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 45 00 | 35.00 | 35 00 | 46 00 | 34.00 | 49 00 | −28.00 | +21 50 | 120 00 |
| Lime, finishing, hydrated, ton | 16.00 | 19.00 | 25 00 | −18 00 | 29.00 | 30 00 | 25.40 | 24.00 | 21 00 |
| Lime, common, lump, per bbl | 3 60 | 1.60 | 2 75 | −1 50 | −1.40 | 2 95 | 2.25 | 2.75 | 15 00 |
| Common brick, delivered, 1,000 | 18 40@19 40 | 10.00 | 12 72 | 11 00 | 17 00 | 14 00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .124 | −.0821 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | 11370 | 14 | 124 | 0-57 | 092 | .10 | .14½ | .12 | |
| Linseed oil, raw, 5 bbl. lots, gal | + 80 | .84 | .98 | + 87 | + .91 | 98 | .91 | .79 | +.88 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | 75@ 80 | 35 | | 72½ | 50 | 50@.55 | .81½ | .75 | |
| Common labor, non-union, hour | | 20 | 35@ 45 | 35@ 40 | 30 | − 35@.40 | .50@.55 | .50 | 30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless otherwise specified. Increases or decreases from previous quotations are indicated by + or −. For steel pipe, the prevailing discount from list prices is given. 45-5 means a discount of 45 and 5 per cent. Long-ton means a ton of 2,240 lb. Short ton means a ton of 2,000 lb. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars, $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime, white is $4.70 for Kelly Island and $4.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. The price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on 11-ath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C I pipe which is mill prices freight to railway depot at any terminal. Lumber prices are delivered at ship tackle in San Francisco ex mill. **Seattle** quotes on Douglas fir instead of pine, and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 15 per cent at present. Bag change is 80c per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

## Changes Since Last Week

Structural steel shapes are quoted at $1.70@$1.75, Pittsburgh; with reinforcing bars selling at $1.65@$1.70. Steel plates are quoted as low as $1.60 @$1.70 per 100 lb. Mill shipments, New York, of structural shapes are quoted at $2.03@$2.18; plates at $2.03 @$2.08 and reinforcing bars at $2.03 per 100 lb. Warehouse prices on steel shapes, rivets and bars have remained firm throughout the week. Increases in discounts, ranging from 2 to 6 per cent on black steel pipe, are reported in Chicago, Minneapolis, Denver and Seattle. Cast-iron pipe has dropped $5 in Seattle, $3 in Minneapolis and advanced $4 per ton in New York.

Cement prices have dropped 20c. in San Francisco and Chicago, 15c. in Minneapolis and 10c. per bbl. in New York. Chicago quotes sand and gravel at $1.65 as against $1.80 per cu.yd. and crushed stone at $1.75 as compared with $2 per cu.yd. last week.

Long leaf yellow pine has dropped $2 in San Francisco, making the present price $28 as against $30 per M. ft.

Chicago reports slight reductions in hollow tile and quotes hydrated finishing lime at $18 as compared with $20 per ton formerly. Common lump lime has dropped 10c. in Minneapolis and 15c. per bbl. in Chicago. An advance of 2c. in linseed oil is reported in New York, 3c. in Chicago and 5c. per gal. in Minneapolis.

Common labor, non-union, is available at 35@40c. per hour in Denver and Chicago. The building trades' situation in San Francisco is rapidly approaching a normal basis, for this time of the year.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, SEPTEMBER 29, 1921 — Number 13

## B. Coli Still Supreme

BY A PEN SLIP B. Welchii instead of B. Coli, was said on p. 470 of last week's editorial page to still stand supreme as a test for public water supplies. As the context, the article by Sir Alexander Houston in the same issue, and the opinions and editorial comment published in our issues of June 2 and 9 all emphatically show, the paragraph should have read: "Meanwhile, we join with an undoubtedly large majority of American and Canadian water-works men in agreeing with Sir Alexander that the B. Coli test still stands supreme."

## Advertising Its Engineers

NO EASTERN railway has done more of the pioneer type of engineering improvement in recent years than the Lackawanna. Other roads have built larger terminals and more elaborate stations, but the Lackawanna's revision of line and grade with mammoth fills, large masonry bridges, and deep and long cuts have kept its engineers busy for a decade or more. Engineers have recognized that this work has been well done but the traveling public has probably taken it as a matter of course; certainly it has not received the publicity accorded the fancy passenger stations of our larger cities. In resuming its famous "Phoebe Snow" advertising the Lackawanna is now turning the spotlight on what it calls the "engineering triumphs" of the road and is giving public credit to what its engineers have accomplished. Those who read the advertisements will appreciate now, perhaps, that railroad efficiency is not entirely the product of the operator, but that even with a road once built the engineer is a constant factor.

## Tax Relief as a Business Stimulant

BOTH the Republican and the Democratic parties during the Presidential campaign of 1920 were insistent that the excess-profits tax was a hindrance to business and a cause of high prices. Both pledged themselves to its repeal and the substitution of a tax less discouraging to business, more simple of computation, and not stimulative of inordinate price increases. Since March 4 the Republicans have been in a position to carry out their campaign pledge. The situation today, after seven months of opportunity, indicates a probable repudiation of that promise to the extent of postponing the appeal of the excess-profits tax for one year, making it effective Jan. 1, 1922, instead of Jan. 1, 1921. If industrial leaders are to be believed regarding the effect of the excess-profits tax in their own businesses, there has been no more fruitful cause of high prices than that measure. High prices and the discouragement due to the taking of these profits are factors in preventing the rapid resumption of business. Congress, if it be sincerely interested in a business revival, might well do its part by carrying out the joint Democratic and Republican pledge of the fall of 1920. When it is argued as it is by Congressman Mann, that the industries have set their prices this year with the expectation of paying an excess-profits tax, there is indicated a woeful lack of appreciation of the methods of operating industrial and business corporations. Taxes are paid not out of reserves built up the previous year, but out of the earnings of the year in question. The effect of a retention of the excess-profits tax will be to continue its blighting influence for the whole of 1922.

## Largest Activated-Sludge Plant

A CONTRACT notable in size and of unusual significance in purpose is soon to be let at Milwaukee. It embraces the aeration and sedimentation tanks and the pipe galleries for the large activated-sludge plant which will treat the sewage of Milwaukee. This plant will be by far the largest of its kind yet undertaken, or for that matter seriously proposed. Its design follows what is probably the most intense and extended experimental investigation ever made preparatory to adopting final plans for sewage-works. The completion of the plant will mark an epoch in sewage treatment.

## The Rust Devils

THE FAILURE of the kitchen ceiling slab at the Marlborough-Blenheim at Atlantic City has started a whole train of examples of the corrosion of reinforcement in concrete subject to moisture. Two of these only are given in this issue, not because they exhibit any extraordinary conditions, but because, as Professor McKibben intimates, it is a good thing to remind ourselves of the dangers of porous concrete and of the ease with which percolation and consequent corrosion can occur. Probably the average concrete of today is better than the best of ten years ago and more proof against the attacks of moist air, be it salt or fresh, but there is still a lot of poor concrete being placed. Those who neglect the necessary precautions to insure dense, strong concrete cannot expect to produce long-lived structures. The rust devils work slowly but they are persistent and powerful. Give them an opportunity to penetrate the armor of concrete and the reinforced structure is doomed.

## Practical Dredge Pump Design

CENTRIFUGAL pump design, as it concerns the dredge operator, is emphasized in the article by Col. E. J. Dent. He urges dredge operators to be more critical of hydraulic design instead of concerning themselves so exclusively with questions of wear-resisting materials and of construction which permits the quick replacement of worn parts. This stand is well taken. Perplexed by the pump-maker's talk of vane angles, exit and entrance velocities and flow spirals, the dredge operator has come to consider hydraulic design a specialty in which he cannot qualify. Furthermore, his observation of impeller blades worn to a frazzle after handling coarse gravel for a few days, has led him to

be rather contemptuous of refinements of hydraulic design. It is the merit of Colonel Dent's article that it helps the dredge operator to see more clearly that hydraulic design is not a problem outside his province and that intelligent refinement is a practicable, money-saving possibility. He has done this with facts on which the dredge-user can place a value.

### Overloading Convention Programs

THE PREPARATION of a program for an engineering society convention is, at best, a thankless task—it is far easier to criticize than to offer constructive suggestions. The trouble with a great many society programs in the past has been a total lack of appreciation on the part of the local committee on arrangements of the amount of time available for technical papers and committee reports. Generally far more material has been scheduled for presentation than could possibly be disposed of. The result has been that many engineers, on receiving in advance the programs of such meetings, have attended, on a certain day, in the hope of hearing some report or paper on the particular subject in which they are interested. They find, after arrival, that due to delays in carrying out the program the subject which they made the trip to hear about has either been crowded off the schedule or possibly postponed until the last day. Waste of time, money expended in railroad fares and hotel bills, to say nothing of the strain on a man's temper, have often been the net results of such proceedings. In the past the American Society for Municipal Improvements, which holds its annual convention at Baltimore next month, has been an offender of this sort. Last year, however, an attempt was made to introduce more business-like methods of handling the convention by segregating subjects and holding section meetings. The move was a good one and should be continued. At this year's convention some one should scrutinize the program carefully in advance, estimate the time required for the delivery of papers and reports, and make a reasonable allowance for discussion from the floor. It may then appear that the program, as originally drafted, is too heavy and cut in it may accordingly be made before the meeting.

### Making Meters Misdemeanors

OF ALL the ignorant opposition to water meters that crops up at intervals none exceeds that recently displayed at Stockton, Cal., where the City Council has passed an ordinance declaring it "unlawful and a misdemeanor" to install a meter to measure water to be consumed by any person or corporation. The penalty is a fine of not over $500 or imprisonment for not more than 180 days. Apparently, the city fathers of Stockton made the ordinance an emergency measure, or else sought to fortify themselves against legal attack, for the ordinance solemnly declares that it was "framed for the immediate preservation of the public health and safety of the city of Stockton, and is urgently required for the reason that the use of said meters creates an additional fire hazard and is detrimental to the public safety." This is enough to make one laugh or cry, according to whether he views the matter subjectively or objectively—as an example of men making a spectacle of themselves or out of sympathy for the people of a city governed by a body having so little information and judgment. Fortunately, the ordinance is to be reviewed by the Railroad Commission of California.

### Cinders in Roadmaking

THE account in the last issue of the use of cinders for building an oil-treated road in the Borough of Queens, New York City, recalls the common use in England of cinders for quite another road-building purpose. Attention has previously been called to this use of cinders in England, but the idea never seems to have caught hold in American highway engineering circles. The use referred to is that of affording a stop to the rise of a clay sub-base into macadam road crusts. In our own highway practice we know how very difficult it is to prevent clay working upward through any crust, with the exception of a concrete wearing slab or concrete base. In England, after experiment with various kinds of materials, it is the practically universal belief that nothing is quite so effective as a layer of cinders to prevent the clay from working upward. So general is this view held in England that the use of cinders may well be tried for the same purpose in our American practice where this waste product can be laid on the road at low cost.

### The Engineer's Counsel Needed

AS WAS TO BE EXPECTED as a result of the expansion of industrial plants to meet war's needs, there has come about intensive study of many manufacturers of fields into which they might well extend their endeavors. We learn of shipbuilding companies engaging in the fabrication of bridge and building steel; manufacturers of hoists for a specialized purpose adding lines applicable to other uses, and machines hitherto found only in one field being introduced into others. These developments, of course, were going on steadily and continuously even before the war. The war merely accelerated these expansion activities. In cases that have come to our attention the excursions into other fields, are going on in a rather lame way. A "first-class salesman" who is supposed to know the field into which it is desired to expand seems to be, in these instances, the sole reliance of the optimistic manufacturer. In one such case recently the manufacturer after months of endeavor was ready to throw up his hands and cease his activities when a friend suggested that what he needed was to secure an engineer thoroughly familiar with the new industry and place upon him the responsibility of a broad promotion and sales policy. The recommendation was adopted and the results, considering the slackness of business, encouraging. The thought might well be passed along to other manufacturers who are seeking expansion.

## Discounting the Snow Problem

DURING the warm days of summer hardly anybody thinks of the problem of snow removal. Yet that is just the time when a workable solution may best be arrived at, for last-minute planning is of little avail. The success of all municipal snow-removal operations depends essentially on the organization of the work and the provision of the necessary personnel and mechanical equipment well in advance of winter. This fact has been realized by the American Society of Mechanical Engineers which, through the medium of its Material Handling Section, devoted last week's meeting in New York to a forum on snow-removal methods and machines, at which not only members of the society but representatives of the city administration expressed their views. Due largely to the extreme use of

mechanical equipment last year, New York handled its snow more expeditiously than during other periods in the past when hand labor and horse-drawn carts were the only tools with which work could be done. There is, however, still room for a vast amount of improvement, particularly in the application of mechanical devices to the problem.

Last week's meeting of the mechanical engineers was noteworthy for the occasion it offered for suggestions as to improved types of snow-handling machinery. During the last year or two mechanical loaders of the inclined conveyor type have given promise of usefulness, and, in New York, an extensive use of motor trucks and tractors of the caterpillar type equipped with push-plows or blade-graders, were successful. Little progress has been made in reducing the volume of snow before handling, and it was this phase of snow removal which received a considerable amount of attention at last week's meeting. It was brought out, in fact, that more than forty years ago Thomas A. Edison had developed a briquetting machine which he has never perfected, due to the press of other work. If a reasonably priced briquetting machine can be produced which is workable in practice as well as in theory, it would be a great relief to traffic tie-ups caused by heavy falls of snow. A successful briquetting machine would mean, in fact, that the volume of snow on the city streets could be reduced about nine-tenths by compressing the snow into cubes, which could be either piled along the street or removed in motor trucks.

Until recently snow removal was never regarded as a job for engineers. The hopeful feature of last week's meeting is that many engineers have now recognized the field of snow handling as their own, and with the thought of the profession turned into this comparatively new channel important developments may be expected.

## The Railroads' View of Motor-Vehicle Competition

THE matter of license fees for motor vehicles is never going to be settled until it is settled right. We do not believe that there can be any argument about that. Nor would any one contend that the present basis of fees is right, taking all of our states into consideration. A study of Mr. Tomlin's inquiry into motor-vehicle laws is convincing on that point. The taxpayers will keep up a certain amount of agitation, and their efforts will be abetted by another interest—the railroads—which being between the devil and the deep sea, have no alternative but to fight in any direction which gives promise of some relief.

The taxpayer contends that the vehicle should be obliged to pay a share of road cost proportionate to the benefit it receives—a demand susceptible of wide variation in interpretation, but carrying certain implications nevertheless. The railroads have a right to make the same demand, but they have an added reason for protest against present average fees since, as large taxpayers, they are helping to build up competition against themselves. Such competition for short-haul business, it is well known, has seriously cut into railroad revenues in the East, and particularly in New England and around New York City.

Against this competition, if on sound, economic grounds, the railroads cannot protest. But they declare that it is not on sound, economic grounds, and they advance the familiar argument that they must build and maintain their own tracks, while the public (with only slight offset in fees) maintain roads for the motor truck. They add to this contention arguments based on their rights as big taxpayers, and point out that the public has an added interest by reason of its holdings of railroad securities, both directly and through its large insurance reserves and savings bank investments. The value of these securities is likely to be further depreciated by truck competition, the railroads urge.

The case was argued from these angles by Edward G. Riggs, executive assistant of the New York, New Haven & Hartford R.R., in *The Forum* for June. Citing nineteen states, he showed that their tax collections from railroads are, with the exception of New York and Georgia, from 3 to 100 times what they are from the motor trucks (figures are not given for all motor vehicles). New Jersey's case is particularly flagrant. With over $10,000,000 collected by various public agencies from the railroads in 1920, only $654,000 was collected from motor trucks. Mr. Riggs does not contend that all the railroad taxes go into road-building. Local authorities use some of it for police and fire protection and the usual running expenses of county and town governments. Nevertheless, garages and trucks equally require these protective activities of the local authorities.

Mr. Riggs, too, is reasonable in his demand. He asks merely that the motor vehicle pay the cost of "keeping roads in repair once they are built," letting the first cost come out of taxation. Probably he would require that reconstruction, also, be provided out of the vehicle fees. He would thus merely align himself with the many authorities who contend for a similar distribution of road costs.

Another example of railroad viewpoint on highway matters is afforded by testimony by Stuart B. Moore, formerly a construction engineer on the Southern Pacific, before the Senate Committee on Interstate Commerce. Mr. Moore very wisely advocated systems of good roads radiating from commercial centers served by railroads. Such systems would develop the back country and serve as traffic feeders. He added, however, that he advocated such systems *rather than* "parallel lines of highways whose only service is to compete with the railroads."

Obviously, public authorities, while they may well think of making the highways supplementary to the railroads must provide parallel systems as well. In advocating the one alternative as against the other, Mr. Moore is not likely to find wide support. What he might well do, however, is to join with Mr. Riggs in demanding that motor-vehicle fees be put upon a basis that will be reasonable not merely in the public's interest but be sound, as well, from the standpoint of competing transportation mediums.

Mr. Tomlin's article in our issue of Sept. 1 has already furnished much food for thought, as is evident from the comments received in this office. There is groping, however, for information as to what the fees should properly be. More study is needed along these lines, and it will do good rather than harm for the railroads to bring pressure additional to that of the taxpayers. In the interest of the highways and of motor trucking, no less than that of the public and of the railways, a settlement of the fee problem on a more defensible basis than the present is demanded.

# A Group of Articles for the "Average Engineer"

*Concrete Chimney Design—Figuring Unstayed Beams—Using Stadia on Traverses—To Determine Hopper Slopes—How a Wooden Truss Failed—Fixing Highway Grades—Special Problem in Ground Arches—How Curves Affect Channel Flow—Grade Line Adjustment—T-Beam Diagram*

## Short Cut Design of Concrete Chimneys

By William Wallace Christie
Consulting Engineer, Ridgewood, N. J.

ONE of the easiest and most reliable methods of calculating the vertical steel for a concrete chimney is first to determine the thickness of a steel chimney of the required diameter and height, and then to divide the same amount of steel into bars properly spaced in an equivalent pitch circle. One formula which uses in its derivation 65,000 lb. sq.in. stress in steel and a factor of safety of 5 is as follows:

$$t_s = \frac{1}{D} \times \left(\frac{H}{100}\right)^2$$

where $t_s$ = thickness of steel in inches, $D$ = outside bottom diameter in feet, and $H$ = height in feet.

Table I gives the results of calculating for $t_s$ by this method.

TABLE I

| Height, Ft. | Diameter in Feet | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 100 | 0.25 | 0.20 | 0.17 | 0.14 | | | |
| 125 | 0.39 | 0.32 | 0.26 | 0.23 | 0.19 | 0.17 | |
| 150 | | 0.45 | 0.38 | 0.32 | 0.28 | 0.25 | 0.23 |
| 200 | | | 0.66 | 0.58 | 0.50 | 0.44 | 0.40 |
| 250 | | | | 0.90 | 0.78 | 0.70 | 0.63 |

In 1902, some years before this table was published, the author prepared a table giving the thicknesses actually used in the construction of various chimneys that have stood the test of many years. For example, in a chimney 96 in. diameter by 215 ft. high, the 1902 table gives ½-in. thick steel, and Table I gives ½-in. thick for 200 ft. height. In another chimney 60 in. diameter by 150 ft. high, the 1902 table gives ⅜-in. steel for 145 ft. height and Table I 0.45-in. steel for 150 ft. high.

By using the above method for determining the amount of steel, the steel takes all of the tension. The concrete then should be made of sufficient thickness to take all of the compression. This will be accomplished by the use of the following formula:

$$t_c = 0.1 \times \frac{1}{42 - 0.06H} \times \frac{H^2}{D}$$

where $t_c$ = thickness of concrete chimney wall.

Table II gives the results of calculating $t_c$ by that method.

TABLE II

| Height, Ft. | Diameter in Feet | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 100 | 5.55 | 4.63 | 3.97 | | | | |
| 125 | 9.05 | 7.54 | 6.46 | | | 5.03 | |
| 150 | | 13.8 | 11.8 | | 10.41 | 9.26 | 8.34 |
| 200 | | | | | 20.62 | 14.8 | 13.33 |
| 250 | | | | | 28.92 | 25.71 | 23.14 |

*Foundation Base.*—If an octagonal base is used, in order that there shall be no tension on the soil, we have the formula:

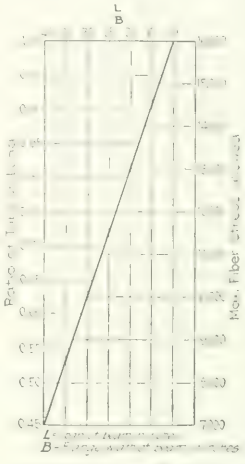
$$D_2 = W \times 0.045 \times D \times H$$

where $W$ = weight of entire chimney in tons.

The spacing of reinforcing bars should be made to conform to the best practice, and care given to have them close enough together to prevent cracking.

## Diagram for Capacity of Unstayed Beams

In the accompanying diagram the reduction of bending strength of I-beams and channels with unstayed compression flange is represented graphically. The diagram plots the American Bridge Co. formula, according to which the allowable compression in the flange shall not exceed $19{,}000 - 300L/B$, in which $L$ is the span of the beam in inches and $B$ is the flange width in inches. The maximum ratio of length to flange width is 40. The formula is not intended to allow a greater fiber stress than 16,000 lb., so that the limits of the formula are $L/B$ from 10 to 40. This diagram was prepared by N. H. Holmes, Chicago.




ALLOWABLE FLANGE STRESS IN UNSTAYED BEAMS

If some other formula for flange capacity is preferred to that used by the author it can easily be laid down on the diagram by plotting a number of computed values, two being sufficient for any straight-line formula. It is also possible to substitute other limiting values of unit-stress and unstayed flange length without affecting the application of the diagram.

## Stadia System for Traverse Work

By J. A. McDonald
Provincial Land Surveyor,
Hermanville, Prince Edward Island, Canada

THE fact that fewer men are required for a stadia party than for an ordinary transit party has led the Topographical Surveys Branch of the Canadian Department of the Interior, at Ottawa, to adopt the stadia system almost exclusively in its traverse work. In a combination of hydrographic and topographic work such as the traversing of lakes and other bodies of water, the party consists usually of a surveyor, transitman and two rodmen, with one or two boats. Such a traverse is made usually from one or more instrument stations at or near the shore.

There is an advantage in keeping one rodman on each side and surveying both sides at the same time, the rodmen following the shore in opposite directions until they meet at the far side. In general, however, the survey will be made on one side only, the front rodman traveling away from the surveyor and the rear rodman traveling towards him. The rear rodman having reached the surveyor and the front rodman having reached the next instrument station, the surveyor moves to the next station and sets up the instrument.

The rear rodman places his rod upon the previous station for orienting the transit, and the survey proceeds as before.

It is well to remember that when the sun is shining and the distance is great a rod cannot be read unless the sun is shining upon its face, so that only one of the rods can be used for measuring side shots, according to the direction of the sun. The rodman who is not giving side shots along the shore can take soundings from the boat and also gives side shots to stations on islands. When no instrument observation is taken, the instrument is oriented by means of the compass, or rather by the magnetic needle recording the azimuth of north deduced from previous readings or from astronomical observations taken from a magnetic map.

### The Rodman's Duties

It is important for the rodman to understand the significance of holding the rod vertical and ascertaining if it is hidden also how to select a new instrument station. The face of the rod should be turned slightly toward the sun when by so doing the sun can be made to shine on the graduations. A system of signals should be arranged for directing the rodman to stop or to start or to inform him that the rod is hidden. Before the rodman leaves the instrument station it is well to indicate to him, as nearly as possible, where the next station is to be. It is more important that the surveyor himself act as front rodman, or at least be with him at instrument points or stations and have the transitman at the instrument. It is also well to read the three wires for both the front and rear instrument stations as a prevention against errors. When the instrument is but a few feet above the water it is not necessary to record vertical angles. When the inclination exceeds 2° the vertical angle should be recorded, and the proper correction applied to the distance read between instrument points; this is unnecessary also in side shots if the vertical angle of inclination is large.

*Reading the Rod.* For reading distances, set the lower wire on a division on the rod. Count the number of feet, tenths and hundredths to the upper wire and estimate the fraction. Distances read by means of the whole interval are twice as accurate as if read with the half intervals. The length between stations should always be measured with the whole interval. When the distance is less than 1,300 ft., or 20 chains, the readings with the half interval will have to be made at distances greater than 20 chains, as the limit of any 13-ft. rod is but 1,300 ft. with the whole interval reading and 2,600 ft. with the half interval.

When the sum of the readings of the half intervals equals the reading of the whole interval the check is significant. The constant of each instrument, for focal length of objective plus distance from objective to center of instrument is from one to two feet, and this must be added to the readings. In inclined sights the reductions of distance may be quickly made by means of the slide rule. When the difference between the starting and closing corners differs more than 5 per cent from the distance in an original survey, the error should be located by retracting with the stadia.

*Plotting the Survey.* A rough sketch of the survey should be made or plotted in the right hand page of the field book as the work proceeds, or at least before leaving the locality. Two books may be used, one being left in the office or camp while the other is in use on the survey. Make the plot first, at least, in pencil, preferably on paper ruled to a scale of 1,000 ft. to the inch. Commence plotting carefully the instrumental stations and work in pencil the north and south points of each station. Plot the side shots by means of the protractor. Then enter on the plan the soundings taken, if any, topographical features and other information that has been collected. The left hand page of the field book is for the notes; the right hand page for a sketch of the survey. Stations are designated by numbers and side shots by letters. In the first column of the left hand page enter the letter of the side shot or the number of the station sighted upon. The second column is for the distance read or estimated, the third for the bearing and the fourth for the vertical angle, the remainder of the page being for remarks.

At each instrument station enter in the notes the nature of the shore or rise of the ground from the water's edge, the depth of the water as determined from soundings, the estimated distance of the foot or top of the slope, topographical features, the nature of the ground, whether marshy, hilly or wooded, and particulars as to rock, iron or coal outcrop.

Although 2,600 ft. is the limit of the rod reading with 13-ft. rod, using it at half interval, distances greater than 2,600 ft. can be read across water by placing the rod on a high stump, thus lengthening the rod. The target then may be the field book covered by a white handkerchief held by the rodman on the stump. In this way shots up to 4,000 ft. have been read by the writer.

## Diagram Aids Slope Determination in Hopper Design

By H. J. Adams
Sticht-Adams Co., Denver, Col.

In the building of hoppers, bins, bunkers, etc., the designer slopes the bottom so that the material handled slides out when released. Knowing the angle of repose of the material contained in the hopper, various sloping planes comprising the bottom are so inclined

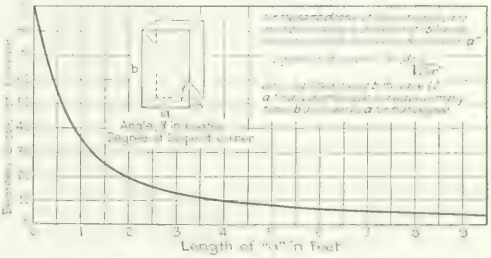



DIAGRAM TO DETERMINE SLOPE OF CORNERS IN HOPPERS

that not only they, but the corners also, are freed from material when being emptied. The inclination of any two consecutive sides is always greater than that of the corner formed by their intersection. Therefore it is the slope of the corner which must equal or exceed the angle of repose of material handled.

In all probability the majority of designers resort to

the "cut-and-try" method to accomplish the desired result. It is a time-consuming method, to say the least.

As a simplification of the process, the author has found the accompanying curve of considerable aid. It applies only to hoppers or bins of rectangular shape, the bottoms of which are formed by four intersecting planes of equal slope. From this curve one can read for a certain degree of slope of a corner the vertical and horizontal distance through which the sloping line runs.

The equation of the curve is $\tan \beta = \frac{b}{\sqrt{2}\,a^2}$ in which $\beta$ is the angle indicating degree of slope of corner: $b$ is the vertical distance through which the sloping bottom is effective; $a$ is the horizontal distance through which the slope of each bottom plane is effective. In plotting the curve, $b$ is given the value 1. The completed curve shows at a glance the ratio of $b$ to $a$ at any point. Since $b$ is always 1, $a$ at 10 deg. is $4b$, at 5 deg. $a$ is $8b$; at 22 deg. $a$ is $1\frac{3}{4}b$; at 55 deg $a$ is $\frac{1}{2}b$, and so on.

If a corner slope of 25 deg. is required for a certain material to be handled, we find immediately from the curve that $a$ must be $1\frac{1}{2}b$ to secure the desired result.

## Splitting Failure in a Wooden Truss

By H. K. Phelps
Los Gatos, Cal.

RECENTLY the sagging of a roof supported by shallow timber trusses brought to light an interesting case of truss failure in this city. The sketch herewith shows the general outline of the trusses, while Fig. 2 contains views of the middle point of the bottom chord

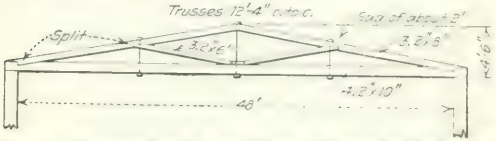
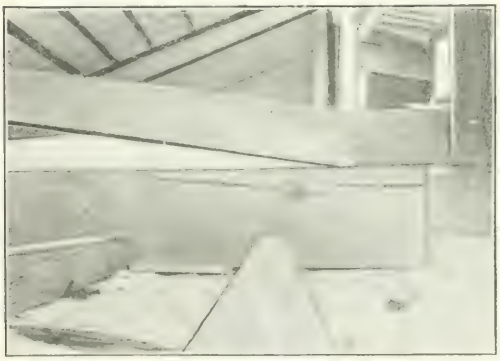



FIG. 1. DIMENSIONS OF SHALLOW WOODEN ROOF TRUSS



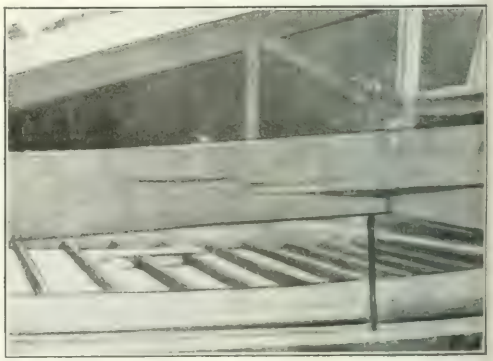


FIG. 2. DETAILS OF STRUT WITH BOTTOM CHORD AND TOP CHORD

and the joint between top chord and strut, in one of the trusses. Two out of four trusses distorted so much as to have virtually failed, while the other two sagged a less amount but yet quite noticeably.

The dimensions of the structure are indicated by the photograph. The loads supported were a ceiling of metal lath and plaster and a roof covering of 1-in. sheathing covered with tar and gravel; the sheathing was carried on 2 x 6 fir purlins spaced 2 ft. on centers. The roof was built about four years ago, but failure was not noticed until this spring. It is not possible now to determine whether the trusses were designed by a technical man or were built according to the carpenter's own judgment, but the latter appears probable.

Probably the cause of failure was the defective bearing of the strut against the top chord, producing a wedge effect and splitting the top chord. There did not seem to be lateral displacement at any of the joints. Doubtless the extreme flatness of the trusses had something to do with the failure. In rebuilding the roof, trusses 10 ft. 6 in. high, with members of make-up similar to that found in the old trusses, were put in.

*A Group of Articles for*

## Highway Grades Determined by More Exact Methods

By Arthur W. Consoer
Consoer Engineering Co., Chicago

BECAUSE of the recognized value of grading in the development of highway systems to serve traffic needs, the question of the scientific establishment of grades in highway work becomes increasingly important. The actual mechanical process of grade running for the various types of improved roads is a subject that receives scant attention or none at all in the leading text and reference books on highway engineering. There are many points of vital importance to an engineer seeking to run a satisfactory and economical grade line, upon which no definite information is given.

In actual practice much of this work is performed in haphazard fashion and the full scientific possibilities of the subject are not developed. To keep down the cost per mile of completed plans the work is often done very hurriedly. There is sometimes a tendency to overlook obvious economies in the establishment of grades. In many public offices there is a tendency to judge engineers engaged in the work of running grades by the mileage of grade established daily.

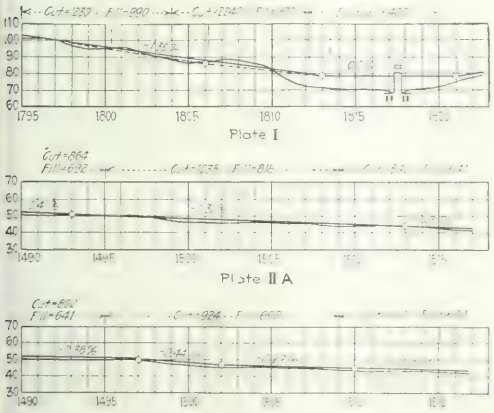
In many highway offices it is common practice for an engineer to run a mile or more of grade line in one day,

## *the "Average Engineer"*

using the ordinary methods of measuring cross-sectional areas with the planimeter. The first apparently satisfactory grade line which balances cuts and fills is accepted as final, and no further trials are taken to determine whether or not there is another equally satisfactory grade which is more economical of earthwork. It is obvious to anyone who has made a study of drainage and grade economies that this hasty procedure is extremely wasteful from the standpoint of correct design for service, and because of the economic loss entailed in moving larger quantities of earth than are really necessary.

The following examples taken from actual practice will illustrate the importance of slowing up the work of grade running:

Attention is called to the erroneous placing of balance points in Plate I and also to the large amounts of cut, fill and borrow. A placing of balance points started on high level ground has been carried down into the depression, and much of the dirt is moving uphill for fill which should be moving down. The amount of earthwork is greatly increased by adhering to an absolute uniformity of grade instead of a practical uniformity. A grade such as is shown in dotted lines would have saved at least 1,000 cu.yd. of earthwork with no appreciable difference in drainage efficiency or riding qualities of the surface.




PROFILES SHOW COMMON ERRORS IN LOCATING HIGHWAY GRADES

The error in grade shown in Plates IIA and IIB is not as striking or as apparent as in the first example. However, it is an error which is extremely common even in the best conducted road offices. In Plate IIA a uniform grade of 0.32 per cent from station 1495 to station 1509 produces earthwork totals of 1,038 cu.yd. of cut and 818 cu.yd. of fill. A very slight change to the grade shown in Plate IIB reduces the earthwork to 924 cu.yd. of cut and 690 cu.yd. of fill at no sacrifice of drainage or riding qualities of the surface. The change in gradient from 0.44 per cent to 0.27 per cent when translated into more easily grasped figures means a change of about 2 in. per 100 ft. This slight change, unnoticeable to the driver of a vehicle over the finished surface, would represent a saving of over one hundred dollars in the cost of the grading of 1,400 feet.

In the writer's opinion the fundamental theory of economical grade which every engineer working on grade line should keep constantly before him is: that the most economical grade is one which comes as closely to balancing cuts and fills at each cross-section as is consistent with other necessary principles of design. Factors interfering with the ideal application of this principle are limiting grade, a certain desirable uniformity of grade, and drainage. All of these factors vary with the type of pavement and the character of the traffic to be expected after the road is open for travel. Except as thus modified the finished grade line should always be a graphical representation of the economical theory, and not a haphazard balancing of cut and fill.

The first step in running a grade line after the profiles and cross-sections have been plotted should consist of a thorough study of drainage conditions. The method of drainage, whether by tile or side ditches should be determined. After the culvert and bridge locations have been made and designs made for these waterway openings in the road, the correct grade elevations of the low points where fills are needed can be established. This having been done, trial grades should be run in both directions from the low points. The engineer can then determine whether the fill can be made within balance points with cut obtained by using the standard construction cross-section. If not the relative economies of widening and deepening the ditches and borrow should be figured, and the most economical selected.

## To Spring a Groined Arch Between High Column and Low Walls

By Perry Thompson
Sanitary Engineer, Yonkers, N. Y.

IN COVERING two existing open sand-water filters at Yonkers, N. Y., it was necessary either to spring the proposed groined arch roof down to a cut-down level of the disintegrated side wall or to build that wall up so as to provide a symmetrical arch with abutments at the same elevation. The former method was resorted to, after an analysis described below.

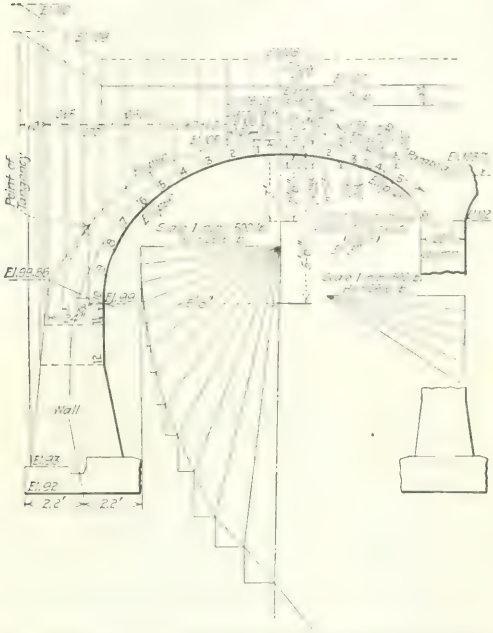
It had previously been decided to use cinders averaging about 2.5 ft. deep for the bulk of the filling over the vaulting because of their cheapness, availability, lightness and good drainage qualities. Over the cinders 9 in. of soil or loam was to be placed, and it was assumed that 12 in. of wet, compact snow represented the probable maximum load from that source. Concrete was taken to weigh 145 lb., cinders (wet) 70 lb., earth (wet) 100 lb. and saturated snow 50 lb., all per cu.ft.

It was recognized at once by mere inspection that the crown should be nearer the columns than the wall, but it was not till after a trial force diagram was drawn and the line of resistance was shown to pass out at the extrados that it was found necessary to load the arch toward the wall entirely with earth; even the bank, which protects the filters from flood water in the river, was moved over till the toe of the slope was over the inner face of the wall.

The voussoir method and least crown thrust theory were employed and the arches divided into a convenient number of imaginary blocks. The origin of moments was taken at the lower edge of the middle third of the fourth "joint" to the right of the assumed crown. A table of vertical and horizontal forces was prepared and their moments about the assumed origin computed. This gave an estimated crown thrust of 2,616 lb. per ft. of arch, which thrust was then laid off to a scale of

1 in. to 500 lb. and a force diagram constructed and carried just far enough to ascertain whether the line of resistance would pass through the origin of moments. This proving to be the case, and the unit stress on the concrete not being excessive, the crown thrust was employed to begin a new force diagram laid off in the opposite direction for use in connection with the portion of the arch toward the wall.

The diagram is thought to be sufficiently plain to




GRAPHIC ANALYSIS OF ECCENTRIC GROINED ARCH ROOF

require no explanation. The resultant is shown passing through the arch at all points within the middle third and finally passing through the lowest block practically in the center and slightly inclined inward where its horizontal component is amply taken care of by the floor, while its vertical component of less than one ton per square foot will be easily resisted by hard clay stratified with sand.

But this is not all of the problem. The lines laid down on paper had to be reproduced in the field in the shape of forms, to insure accuracy in which the specifications called for full-size drawings to be furnished to the contractor. This could be accomplished in two ways: First, by the use of foci nearly 14.5 ft. apart (for the longest span) laid off on a floor, and a very flexible line over 18 ft. long that would not stretch; second, by the use of abscissas and ordinates laid off on heavy brown drawing paper on two large drafting tables.

The latter method proved more satisfactory; furthermore, the co-ordinates could be used again on the work to check up forms and centers as constructed and as set, while the string and foci method would be very troublesome, if not impossible. It was found that for points about 6 in. apart on the curve the ordinates must be figured to $\frac{1}{16}$ in., and the + and − signs used virtually made $\frac{1}{32}$ in., giving a smooth curve. Drawings on a scale of 1 in. to 1 ft. for field use were then made.

## *A Group of Articles for*

## Effect of Curvature Upon Flow in Open Channels

By Harrison P. Eddy
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

IT IS a well recognized fact that changes of direction in a conduit cause resistance to flow and corresponding loss of head. It is also appreciated that the amount of such loss is influenced by the velocity of flow, by the sharpness of the deflection or radius of curvature, and by the occurrence of reversals in the direction of curvature. The length of the curve is also generally believed to be a factor, although Ivan E. Houk (Technical Reports, Part IV, of the Miami Conservancy District, entitled "Calculation of Flow in Open Channels") states that "the actual length of the curve probably does not have much effect on the amount of the retardation due to their presence. The increased roughness is probably brought about by the changes in velocity distribution and water surface level necessary when the flow enters or leaves the curved stretches rather than in the continued flow in a given curve." While there may be greater disturbance at the ends of the curves, due to readjustment of velocity distribution as stated, there still remains the loss of the energy required to constantly deflect the mass of water throughout the length of the curve, and it is probable that the curve lengths should be taken into account in making allowance for curvature.

Data relating to losses due to curvature in closed pipes up to 30 in. in diameter are fairly complete for 90 deg. changes in direction and short radii and moderate velocities, but are very fragmentary and unsatisfactory for other conditions, and very little information relative to the losses due to curvature in open channels is available. The application to open channels of data obtained on closed pipes under pressure is open to error because the conditions differ so widely. pipes are usually of small size as compared to open channels. In pipes, the area and hydraulic radius remain constant from point to point and conditions of uniform flow exist; in open channels, unless the slope of the bottom happens to be at all points parallel to that of the water surface—a condition that practically never occurs except in long tangents—the flow is variable; the area of the section, the velocity and hyraulic radius are constantly changing. If the bottom has a uniform slope, the resistance due to a curve in alignment will cause the water to back up and produce a "back water curve" in the lower portion of the tangent above. In measuring the hydraulic slope in the tangent, the effect of this backwater must be avoided, since the backing up at the beginning of the curve will result in greater depth, less velocity, etc., than in the undisturbed portion of the tangent, conditions for which the hydraulic slope will be lessened.

Where the curve joins the tangent below, or changes to a curve of different radius, there will again occur a backwater curve (either up or down), so that the determination of the true slope due to curvature is not possible from observations at the beginning and end of the curve alone. This fact has not usually been recognized.

The earliest attempt to deduce an expression for the

## *the "Average Engineer"*

loss of head due to curvature in open channels is probably that of Humphreys and Abbot, who published in 1861 a report upon their researches on the Mississippi River. Their results, as given in Church's "Hydraulics," are expressed by the equation

$$h_c = v^2/536 - 6A/\pi,$$

where $h_c$ represents the loss due to curvature through an angle of deflection of $A$ expressed in circular measure. Since this formula was derived for conditions of great width of channel and large radius of curvature, its application to comparatively small channels and bends of relatively small radius is at least questionable. More recent investigations also tend to discredit the investigations of Humphreys and Abbot.

Formulas for loss due to curvature have been derived for the relatively low increase in the value of $n$ in this case.

Mr. Houk, in Part IV, Technical Reports of the Miami Conservancy District, previously referred to, makes the very general statement concerning allowance for curvature that: "The Value of 0.025, which is applicable for a smooth uniform straight channel in gravel, free from vegetation or other obstructions—may be increased 10 per cent or more by curvature in alignment."

*Conclusion*—The available information is so fragmentary and indefinite that it is impossible to draw entirely satisfactory conclusions, but it appears probable that in artificial channels for which the coefficient $n$ in Kutter's formula would not exceed about 0.025 for a straight channel, an addition of from 0.003 to 0.005 should be made to the coefficient for sections in which the amount of curvature is considerable.

TABLE I. EFFECT OF CURVATURE UPON VALUE OF "n" CALCULATED FROM EXPERIMENTAL DATA

| Channel All Concrete Lined | Value of "n": On Tangent Alone | On Curves Alone (Computed) | Addition for Curvature | Radius of Curves, Ft. | Velocity of Flow, Ft. per Sec. |
|---|---|---|---|---|---|
| Umatilla conduit | 0 0135 to 0 0137 | 0 0176 to 0 0184 | 0 0049 to 0 0039 | 50 | 7 |
| | | 0 0162 to 0 0169 | 0 0025 to 0 0034 | 100 | 7 |
| | | 0 0160 to 0 0173 | 0 0023 to 0 0038 | 250 | 7 |
| Sulphur Creek Wasteway | 0 0108 | 0 0140 | 0 0032 | 2.865 | 20 |
| Ridenbaugh Canal | 0 0121 | 0 0145 | 0 0024 | 955 | 3 7 |
| North Canal, Central Oregon Irrigation Co. | 0 0177 | 0 0202 | 0 0025 | 410 | 3 0 |
| | 0 0176 | 0 0205 | 0 0029 | and | 2 9 |
| | 0 0192 | 0 0222 | 0 0030 | 383 | 2 1 |

y Markmann (1910), Weston E. Fuller (1913), and Morreell (1916). Markmann's formula was based wholly pon a theoretical study, and has not been supported by xperiments; Morreell's and Fuller's expressions have een derived from the results of experiments upon osed pipes, all of small size, especially as compared ith stream channels; and none of them are believed be applicable to such conditions as exist in the stream annels either natural or improved.

E. G. Hopson reports figures of observed losses due to rves in open channels in an article entitled "Gagings the Concrete Conduit of the Umatilla Project," in *ngineering Record*, Oct. 21, 1911. These were all made ith velocities of approximately 7 ft. per second, and, erefore, do not furnish a basis for estimating change resistance with change of velocity.

Computations of probable conditions of flow, so far as n be determined from the published data, indicate the parent effect of the curves upon the value of the ughness coefficient $n$ in the Kutter formula. The sults are included in the accompanying table. The nge in values is caused by variations in certain sumptions made necessary by the absence of detail the published data.

Bulletin No. 194, U. S. Department of Agriculture Also in Table 112, King's "Handbook of Hydraulics"), ntains notes upon the values of $n$ found in experiments on Sulphur Creek Wasteway, Ridenbaugh Canal, and rth Canal. Although the lack of detail in the data troduces considerable uncertainty, the data of such ses may be used for rough computations of the effect curvature upon the value of $n$ and the results of such lculations are included in the accompanying table.

Except in the first instances, the velocities are seen to relatively low; and it is to be expected that higher locities would give greater losses on the curves. The lphur Creek Wasteway, although having a high locity, has a curve of very long radius, which accounts

There seems to be at least a probability that the frictional loss due to curvature varies with the radius of curvature and with the velocity of flow and that when more complete information is available it may be possible to make proper allowance for these factors. At present, however, there does not seem to be any more satisfactory method of providing for the effect of curvature than by increasing the coefficient $n$, as indicated above.

## Diagram for Final Adjustment of Grade Line Location

By S. E. Redd

Engineer, Greenlee County Highway Commission, Morenci, Ariz.

BOTH IN the location of railroads and highways there has always been great difficulty in securing a location that was *exactly* right in regard to economy and good standards. It is a common thought among most conservative engineers that no line is ever located exactly right, but that the best locations are only very close approximations; the more skillful the engineer making the location, the more approximately correct the location will be. One of the principal difficulties in location is to get the quantities of excavation and embankment as small as possible, and also to balance each other as closely as possible.

The following is offered as a method for studying a preliminary location very closely and easily, and the writer has found it of great assistance in laying his location close to the ground and in balancing the quantities. After the usual maps, profiles and cross-sections have been made and calculated the following diagram will be of assistance: Take some cross-section or profile paper; use the same horizontal scale that is used on the regular profile, but with ordinates at each station such that each ordinate will represent the area of the cross-section at that station. In most highways there

will generally be two ordinates at each station, one for the cross-section of the excavation and the other for cross-section of the embankment. There will be developed two lines, one for the excavation and one for the embankment, which should be represented differently, say the excavation by a solid line and the embankment by a dotted line. Both lines had best be drawn on the same side of the base from which the ordinates are measured.

When such a diagram of a section of line has been drawn one can immediately see that it has the following properties: The difference between the ordinates at any station will be the difference between the sectional areas of the excavation and embankment at that station. The area contained between the ordinates of two stations and one of the lines and the base, from which the ordinates are drawn, will be the volume of excavation or embankment, according to which line was taken. The area between the lines of excavation and embankment and the two ordinates of two stations will be the difference between the volume of the excavation and embankment between those stations.

The object to be derived from the study of such a diagram will be to bring the two lines of excavation and embankment as close together as possible without injuring the alignment, also, where it is impossible to bring these lines together, to make the areas showing excavations as closely equal to the areas showing embankment as possible. This object, of course, is always the object of any locating engineer, but the writer believes that a diagram as above shows the faults of a location much more plainly than any other method that he has ever tried. The ease and speed with which such a diagram is drawn can be seen as soon as one tries it.

The ordinary mass diagram is very convenient in studying the balance of cuts and fills in heavy through work as usually found in railroad work, but it does not furnish the information so easily on side-hill work such as found in highway work.

The writer usually uses this diagram after cross-sections have been first taken. It is usually at this point that certain unforeseen features of the line cause excessive work at certain points. This diagram not only shows the points but aids in the study of improvement.

## Fresnos Keep Sand Drifts Off Plank Road

The shifting sand dunes in Imperial County, Cal., have made it necessary for the California Highway Commission to provide means for keeping the plank road built through that territory free from sand drifts. The drifts frequently form in depths of 5 to 6 ft. and range to 100 ft. in length. Usually one man and team are assigned to the maintenance and inspection work on the planked section, which is 5½ miles long. During periods when the wind blows continuously, more teams have to be added to keep the road clear. The sand is scraped off the road with fresnos onto the side away from the direction in which the prevailing winds blow.

# *A Group of Articles for*

## Tables for Computing Irregular Street Intersections

By R. D. Gladding
Gladding & Morrison, Municipal Engineers, Wilson, N. C.

TABLES for computing areas and radii of irregular street intersections can be used as a refinement of the method described by the writer in *Engineering News-Record*, Aug. 9, 1917, p. 265, where graphs were used. The problem involves the computation of the area included by the tangents and the arc of a circle, without the necessity of measuring the angle of intersection. All the data needed, therefore, can be taken by using the tape only.

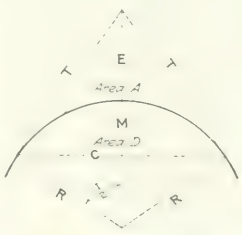



TABLE I. RADIUS OF CIRCLE

$$R = \frac{1 - 4B^2}{4B} T = ST;\ R = \frac{4B^2 + 1}{8B} C = S'C;\ B = \frac{E}{2T} = \frac{M}{C}$$

| B | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | ∞ | 25.0 | 12.5 | 8.30 | 6.21 | 4.95 | 4.11 | 3.50 | 3.05 | 2.69 | S |
| | | 12.5 | 6.25 | 4.17 | 3.13 | 2.53 | 2.12 | 1.82 | 1.60 | 1.44 | S' |
| 0.1 | 2.40 | 2.16 | 1.94 | 1.79 | 1.65 | 1.51 | 1.40 | 1.30 | 1.21 | 1.13 | S |
| | 1.30 | 1.19 | 1.10 | 1.03 | 0.962 | 0.909 | 0.859 | 0.822 | 0.785 | 0.753 | S' |
| 0.2 | 1.05 | 0.980 | 0.917 | 0.857 | 0.802 | 0.750 | 0.702 | 0.657 | 0.613 | 0.572 | S |
| | 0.725 | 0.699 | 0.679 | 0.659 | 0.640 | 0.625 | 0.611 | 0.598 | 0.586 | 0.576 | S' |
| 0.3 | 0.533 | 0.497 | 0.461 | 0.428 | 0.395 | 0.364 | 0.335 | 0.306 | 0.278 | 0.251 | S |
| | 0.567 | 0.558 | 0.551 | 0.543 | 0.538 | 0.532 | 0.527 | 0.523 | 0.519 | 0.516 | S' |
| 0.4 | 0.225 | 0.200 | 0.175 | 0.151 | 0.128 | 0.106 | 0.0835 | 0.0620 | 0.0408 | 0.0202 | S |
| | 0.513 | 0.510 | 0.508 | 0.507 | 0.505 | 0.503 | 0.502 | 0.501 | 0.500 | 0.500 | S' |
| 0.5 | 0.00 | .... | .... | .... | .... | .... | .... | .... | .... | .... | S |
| | 0.500 | .... | .... | .... | .... | .... | .... | .... | .... | .... | S' |

TABLE II. VALUES OF $\frac{I}{2}$ FOR "B"

| B | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 2.29 | 4.57 | 6.87 | 9.14 | 11.39 | 13.68 | 15.96 | 18.18 | 20.41 |
| 0.1 | 22.61 | 24.84 | 27.00 | 29.15 | 31.27 | 33.40 | 35.48 | 37.56 | 39.60 | 41.61 |
| 0.2 | 43.59 | 45.57 | 47.51 | 49.38 | 51.28 | 53.13 | 54.93 | 56.73 | 58.50 | 60.21 |
| 0.3 | 61.89 | 63.58 | 65.24 | 66.86 | 68.43 | 69.98 | 71.50 | 73.00 | 74.46 | 75.91 |
| 0.4 | 77.31 | 78.70 | 80.05 | 81.39 | 82.69 | 83.97 | 85.22 | 86.45 | 87.66 | 88.84 |
| 0.5 | 90.00 | ... | ... | ... | ... | ... | ..... | ..... | ..... | ..... |

TABLE III. AREA "D" FOR RADIUS = 1

| I.2 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Diff |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.01745 | 0.03491 | 0.05236 | 0.06981 | 0.08727 | 0.1047 | 0.1222 | 0.1396 | 0.1571 | 0.01745 |
| 10 | 0.1745 | 0.1920 | 0.2094 | 0.2269 | 0.2443 | 0.2618 | 0.2792 | 0.2967 | 0.3143 | 0.3316 | 0.01745 |
| 20 | 0.3491 | 0.3665 | 0.3840 | 0.4014 | 0.4189 | 0.4363 | 0.4538 | 0.4712 | 0.4887 | 0.5061 | 0.01745 |
| 30 | 0.5236 | 0.5410 | 0.5585 | 0.5759 | 0.5934 | 0.6109 | 0.6283 | 0.6458 | 0.6632 | 0.6807 | 0.01745 |
| 40 | 0.6981 | 0.7156 | 0.7330 | 0.7505 | 0.7679 | 0.7854 | 0.8038 | 0.8203 | 0.8377 | 0.8552 | 0.01745 |
| 50 | 0.8727 | 0.8901 | 0.9076 | 0.9250 | 0.9425 | 0.9599 | 0.9774 | 0.9948 | 1.012 | 1.030 | 0.01745 |
| 60 | 1.047 | 1.065 | 1.082 | 1.100 | 1.117 | 1.134 | 1.152 | 1.169 | 1.187 | 1.204 | 0.01745 |
| 70 | 1.221 | 1.240 | 1.257 | 1.274 | 1.292 | 1.309 | 1.326 | 1.344 | 1.361 | 1.379 | 0.01745 |
| 80 | 1.396 | 1.414 | 1.431 | 1.449 | 1.466 | 1.484 | 1.501 | 1.518 | 1.536 | 1.553 | 0.01745 |
| 90 | 1.571 | .. | .. | .. | ..... | .. | .. | ..... | ..... | ..... | 0.01745 |

The underlying principle is that the ratio of the external secant to the tangent equals the ratio of the versed sine to the sine. This allows one table to give the values needed in the problem using both these ratios.

Usually, in the field, only one set of distances can be measured, either $E$ and $T$ or $M$ and $C$. The illustrative problem supposes that both sets could be measured. In the problem, an arc was drawn and the distances scaled.

The ratio $B$ equals $E/2T$ equals $M/C$. From this ratio, using the tables, the factors $S$ and $S'$ may be multiplied by $T$ or $C$ respectively to obtain the radius, and the value of $I/2$ can be easily found.

*Example:*

$B = 9.15/31.4 = .291$;
$B = 4.49/15.6 = .288$ (average, .290);
From Table I, $S = .572$, and $S' = .576$;

## *the "Average Engineer"*

Radius = .572 × 15.7 = 8.97;
Radius = .576 × 15.6 = 8.98 (average, 8.98);
(Area $A$) + (Area $D$) = 8.98 × 15.7 = 141.0;
With value of $B$ given, from Table II, I/2 = 60.21 deg.
From Table III, $D = 1.047 + 0.21 \times 0.0175$
$= 1.051$;
(Area $D$) = $1.051 \times 8.98^2 = 84.8$;
Therefore, $A = 56.2$.

This method has been found very accurate for determining the area, and does not require much time in the field and office. The tables may be used for other computations of the circle, as readily suggested by the diagram.

## Some Notes on Field Methods in Running Land Lines

By F. Ernest Brackett
Civil and Mining Engineer, Cumberland, Md.

FOR TRANSIT WORK on land lines, etc., such as the country practitioner with a "scrub" corps is likely to encounter, the following notes may be useful. They constitute a simple and well-tried method of transit survey in connection with the old compass work in the field.

In such surveys the beginning point and probably variation of the compass will have been determined. The most convenient method of reading the angles is by the continuous vernier system—magnetic north equals zero. The first line of the transit survey will often be a random back sight on the beginning to avoid a fence on the line. The survey then proceeds as closely as practical to the old courses and land marks. The legal location of the land line where these latter differ is of course a matter of local law and custom; but the engineer is constantly required to keep in touch with the relations between his transit line, the old compass courses, and the existing land marks. On large or important work this is usually worked out in the office after the survey is made, but in the class of work referred to it is often advisable that it be done in the field while all interested are present.

To pass a line around a tree or other obstacle a very convenient method is the use of a very obtuse isosceles triangle. Thus, in Fig. 1, to establish a point $C$ on the line $XA$; set $B$ at random, deflect left at $B$ twice the right deflection at $A$, and make $BC$ equal $AB$. Or if inconvenient to make the legs equal: compute the offset $bB$ or measure it with a hand tape after setting stake $B$ and before turning the deflection, set up at $B$ and turn the telescope to a line parallel to $XA$, now with the hand tape lay off the offset $cC$ equals $bB$ and drive $C$ at any desired point on the line $XA$ extended. The azimuth of $BC$ may then be read and recorded.

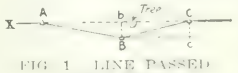
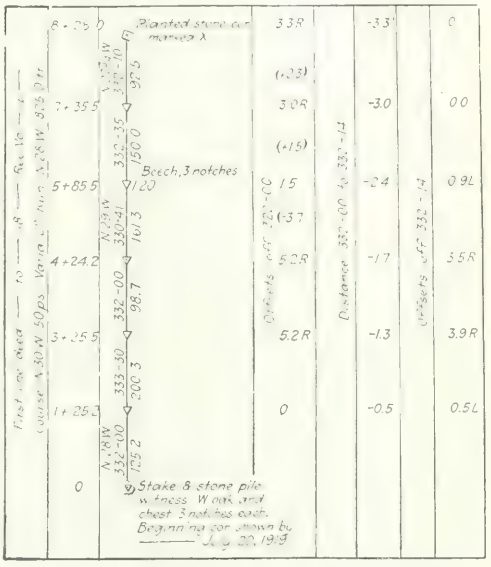


FIG. 1. LINE PASSED AROUND SINGLE OBSTACLE

Often, however, in the woods obstacles are so numerous and tedious for a small corps to remove that immediate return to the original line is time lost. In that case the plus and minus offsets may be carried ahead on the notebook indefinitely and a stake set on the original line whenever required. As the angles from the original line are all small, the plus to a stake so set or its total distance from the beginning, may be considered equal to the sum of the actual lines run. Thus the terminal stake of any course and distance may be set at once. In many other cases the marked corner will be found at some point more or less off the line originally assumed and a correction in variation


Planted stone cor. marked X
Beech, 3 notches
Stake & stone pile witness Work and chest 3 notches each. Beginning corner shown by
Offsets
Distance
Offsets for 332-14
FIG. 2. FIELD NOTES AND COMPUTATIONS FOR OFFSET LINE ENCOUNTERING RANDOM OBSTACLES

of the compass made. The notes for a survey of this kind may be kept as in Fig. 2.

In Fig. 2, two points forming the terminals of a random survey which closely approximates a straight line must be joined by an accurate line. The correction to be applied to the azimuth of the assumed line is easily computed from the final offset and the total distance. Thus, in the notes, the assumed line is 332-00; the final offset, or algebraic sum of the deviations of each line of the random survey, is 3.3 ft., dividing this by the total distance, 828 ft., to find the sine or tangent (approximately equal) the correction is found to be 14 minutes to the right; the required azimuth is therefore 332-14.

The offset of all existing stakes from the new line may now be computed in the same manner as they were from the assumed line. Otherwise the surveyor may proceed as follows: By simple proportion on the slide rule, compute the distance between the new and old lines at each plus, and correct the offsets formerly arrived at by this amount. This method is shown to the right in the notes given. The position of the true line can now be readily marked.

It might be well to remark here that where a random line of the kind described consists of a number of equal courses the average of the azimuths is (approximately) equal to the azimuth of a line drawn between the terminals. Where they are not equal the weight of each angle in the average is proportional to the length of the course. The first of these conditions

rarely occurs and the second is too tedious to be of much practical use if accurately carried out. The point to be noted, however, is that both furnish a ready means of determining an approximate azimuth. Thus the actual average from the notes given is 332-09—an error amounting to only 1.2 ft. in the whole length of the line. Or the process might be made more accurate by assuming 100 ft. as the unit weight in the rough average. This unit weight would be given the first, third and sixth courses; that is, the azimuths of these lines would appear but once in the summation. The azimuth of the second course would be multiplied by two, while those of the fourth and fifth courses multiplied by, say, one and one-half. The total sum thus arrived at (2,658-04) is then divided by the sum of the weights (eight). The result (332-15) in this case is only one minute in error.

### Method Saves Time

The above methods often save much time in the field where the closing line in a circuit must be computed by latitudes and departures. It frequently happens both on the surface and underground, that the circuit really consists of a few long courses although the actual transit line consists of many short ones deviating only a few degrees at most from the main directions. By consolidating these short courses in groups the length of the traverse table is often very much shortened. Moreover, since the ratios of the sum of the random lines to the true length between terminals in each of the groups are about equal, the error in assuming the length of the line between terminals equal to the above sum has very slight influence on the accuracy of the azimuth of the closing line determined on that basis.

This method may at first seem to involve almost as much work as the full traverse but it will be observed that the cosine calculation on random courses is avoided and that slide rule work becomes more convenient since small offsets are principally involved. Besides that the computation is certainly less exacting on the mind and less liable to material error because any great error in computing the major courses is generally apparent on direct comparison with the notes.

## Ship Concrete in Germany

German engineers are studying concrete for ships with a view to getting a light, strong and impermeable material. As a result some experimenters are recommending adding to portland cement 10 to 25 per cent pulverized calcined limestone and 20 to 35 per cent of a pulverized silicate of magnesia, preferably white talcum, rich in silicates, and containing no chlorides. To this carefully prepared mixture some of the well-known porous ingredients are added, and then the substance is stored in a dry and airy place. Thereafter it is used for preparing the concrete in the same way as ordinary cement would be used, but in a richer proportion. The concrete obtained therefrom, by casting or ramming, is light, waterproof, elastic, acid-proof and tough, is reported to possess the good qualities of concrete for shipbuilding purposes in a higher degree than concrete made of pure portland cement. A great deal of experimenting is going on both in Germany and Austria in concrete ships and barges, particularly the latter for use on the inland waterway systems.

*A Group of Articles for*

## Concrete T-Beam Diagram Permits Direct Designing and Checking

By A. V. Karpof and V. T. Givotovsky
Reinforced Concrete Engineers, Standard Arch Co., New York City

MOST diagrams for the design of reinforced-concrete beams only solve part of the problem and require considerable slide-rule or other computation. The writers have devised several diagrams which permit direct designing and checking and present herewith one of them—a chart for reinforced-concrete T-beams. It is worked out for concrete stress $f_c = 650$ lb. per square inch, steel stress, $f_s$=16,000 and according to the formulas of the 1916 Joint Committee report. Its use may be illustrated by the following examples:

Example 1

Given $M = 300{,}000$ ft. lb.
$V = 30{,}000$ lb.
$t = 6$ in.
$b = 6$ ft.

*To find effective depth "d."*—Find on the axis of moments the point corresponding to $M = 300{,}000$ ft. lb. then project vertically up until the vertical intersects the ray $b = 6$ ft. From this point of intersection project horizontally to the left until the horizontal intersects the vertical drawn from the point corresponding to $t = 6$ in. This intersection from interpolation between curves of $d$ gives $d = 22.3$, say 22 in.

*To find steel area, "$A_s$".*—Find on the axis of moments the point corresponding to $M = 300{,}000$ ft. lb. then project vertically down until the vertical intersects the ray $d = 22$ in. Then project horizontally to left and on the axis of steel area the reinforcement is found to be $A_s = 11.36$ sq.in.

*To find width of stem, "b".*—Assume unit shear must not exceed 120 lb. per square inch. Find on the scale of shearing force the point corresponding to $V = 30{,}000$ lb. then project vertically until the vertical intersects the ray $d = 22$ in. From this point of intersection project horizontally to the left until the horizontal intersects the vertical drawn from the corresponding point $V = 120$. This intersection from interpolation between rays of $b^1$ gives $b^1 = 12.5$ in.

*To find perimeter of rods, "$E_o$".*—Assume that rods are to be deformed. Find on the scale of shearing force the point corresponding to $V = 30{,}000$ lb. Project vertically until the vertical intersects the ray $d = 22$ in. Then project horizontally to the right and the perimeter of rods is found to be $E_o = 14$ in. on the deformed rods perimeter scale. If the rods would have been plain the perimeter required would have been found on the plain rods perimeter scale, and would have been $E_o = 16.8$ in.

Had the $d$ and $b^1$ just found been inconvenient to use from an architectural or other standpoint adjustment could be easily made on the diagram and new values of $d$, $b$; $A_s$ and $E_o$ found by changing the unit shear and the width of flange.

Example 2

Given $M = 200{,}000$ ft. lb.
$V = 25{,}000$ lb.
$d = 30$ in.
$t = 5$ in.
$v = 60$ lb. per sq.in.

*To find width of flange "b."*—Find on the axis of thickness of slab the point corresponding to $t = 5$ in. Project vertically up until the vertical intersects the curve $d = 30$ in. Then project horizontally to the right until the horizontal intersects the vertical drawn from the point corresponding to $M = 200{,}000$ ft. lb. This intersection from interpolation between rays of $b$ gives $b = 2.83$ ft. The steel area, $A_s$, width of stem, $b^1$, and perimeter of rods $E_o$ are found in the same way as in example 1 and equal

$A_s = 5.6$ sq.in.
$b^1 = 15.5$ in.
deformed $E_o = 9$ in.

## the "Average Engineer"

EXAMPLE 3

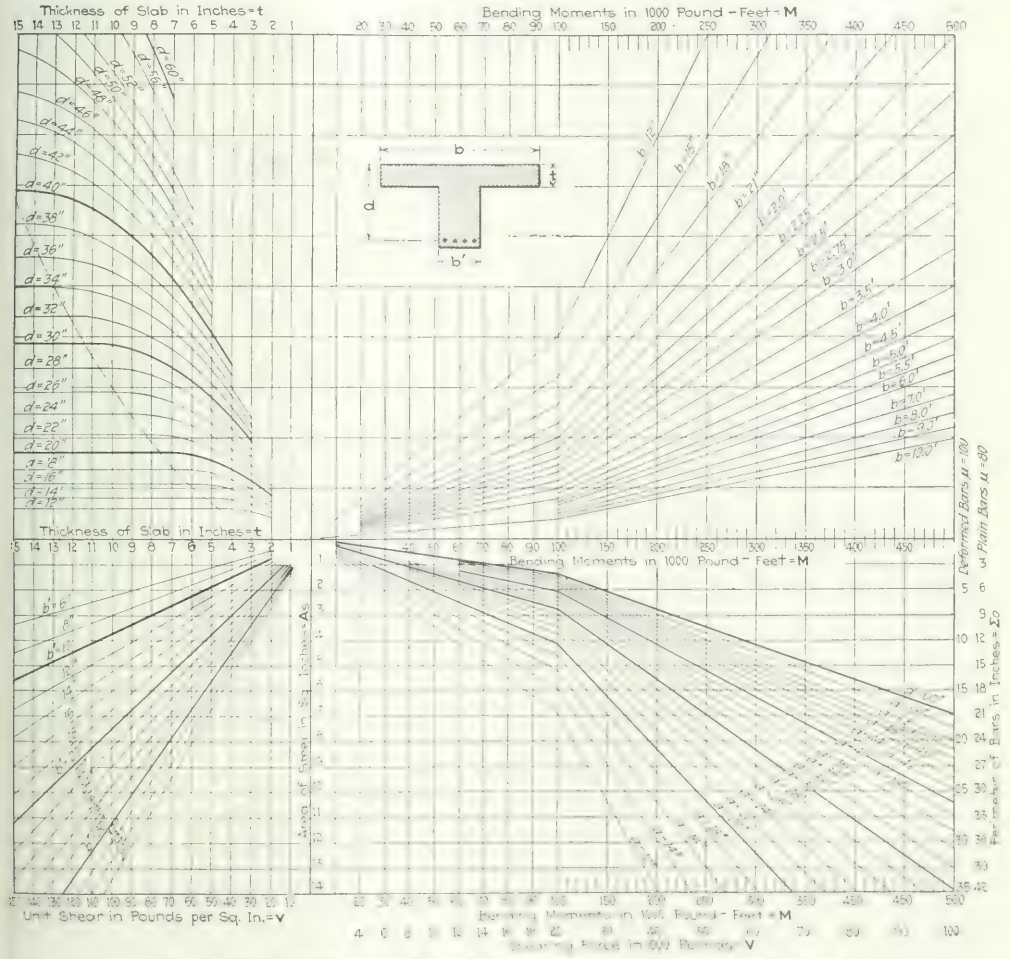
Given $M = 80{,}000$ ft. lb.
$V = 12{,}000$ lb.
$b = 2$ ft.
$d = 20$ in.
$b = 12$ in.

*To find "t."* — Find on the axis of moments the point corresponding to $M = 80{,}000$ ft. lb. Project vertically up until the vertical intersects the ray $b = 2.0$ ft. From this point of intersection project horizontally to the left until the horizontal intersects the curve $d = 20$ in. Then project down vertically from the point of intersection just found. The thickness of slab is found on the intersection of last drawn vertical and the axis of slab thickness to be $t = 5.3$ in.

*To find unit shear, "V."* — Find on the scale of shearing force $V$ the point corresponding to $V = 12{,}000$ lb. Project vertically until the vertical intersects the ray $d = 20$ in. From this point of intersection project horizontally to left hand corner of the diagram until it intersects the ray $b' = 12$ in. Then project vertically from the point of intersection just found. The unit shear is found at the point of intersection of the last drawn vertical and the scale of unit shear to be $V = 55$. The steel area and perimeter of rods are found in same way as in example 1, and are equal to $A_s = 3.35$ sq.in.; deformed $E_o = 6.5$ in.

The dotted curve in the upper left hand corner of the diagram shows the transference of the neutral axis from the stem of T-beam into the flange when the beam must be designed as a rectangular beam and further increase in thickness of the slab will not result in any increase in moment. Therefore, beginning at the left of the dotted line the curves of effective depths of $d$ transform themselves into straight horizontal lines.

Note that the scale of moments from 0 to 100,000 ft. lb. is larger than the scale of moments from 10,000 ft. lb. to 500,000 ft. lb. and that the scale of total shear from 0 to 20,000 lb. is larger than from 20,000 to 100,000 lb.


Thickness of Slab in Inches=t
Bending Moments in 1000 Pound-Feet=M
Unit Shear in Pounds per Sq. In.=v
Area of Steel in Sq. Inches=As
Perimeter of Bars in Inches=Eo
Deformed Bars μ=120
Plain Bars μ=80

DESIGNING AND CHECKING DIAGRAM FOR REINFORCED-CONCRETE T-BEAMS

# Detours Form Part of Service-to-Traffic Policy

## Wayne County (Mich.) Commission Provides Many Temporary Routes—Some at River Crossings

By Edward N. Hines
Chairman, Board of County Road Commissioners, Wayne County, Mich.

THE Board of County Road Commissioners of Wayne County, Mich., is not merely building so many miles of concrete road annually, but is building and maintaining a transportation system. In order that the public may receive the greatest benefit from the unrestricted use of this system it is desirable that good detours be provided, particularly along main highways, when a road is being built or is closed from any cause. Providing detours around a road is a simple matter except where there are rivers or streams to cross. In cases of the latter type the commission has shown considerable initiative and ingenuity.

On the Dix road crossing the River Rouge there was built in 1912 a Strauss heel-trunnion bascule bridge, the movable leaf of which is 112 ft. long, the fixed span or A-frame 30 ft. long, and the clear width of the roadway 18 ft. The clear channel secured with the bridge in open position is 100 ft. wide.

The widening and deepening of the channel by the War Department necessitated the replacement of the foundations under this bridge. During the work of reconstruction traffic was maintained with only one stoppage of about 24 hr. from the beginning of the work in March until Sept. 1, 1920. Traffic was again stopped until Sept. 9 while sheet-piling was being driven under the bridge. On Sept. 22 the bridge was again closed to highway traffic and was not permanently reopened until Nov. 8.

### Detours at Bridges

On the Plymouth-Northville road the commission began construction of a bridge 1 mile south of Northville, replacing an old township truss bridge which had been in service 35 years, and was designed to carry a 6-ton moving load. The old bridge is on a bad curve and it was necessary to build the new bridge on a new right-of-way, straighten the road and take care of traffic during construction, as shown in Fig. 1.

The new bridge is a reinforced-concrete, T-beam and slab structure consisting of two spans each 42 ft. long having a clear roadway of 24 ft. in width and designed to carry a 24-ton moving load. This bridge is now open to traffic.

Another detour on the Plymouth-Northville road which is being maintained for the convenience of traffic is at the new bridge being constructed at the Plymouth village limits. The existing steel bridge was skidded bodily to one side onto temporary foundations which had been previously constructed to receive it. A detour road (Fig. 2) was built in the meantime so that the only delay to highway traffic was of less than an hour's duration while the bridge was being moved. With the spring thaw the detour roadway softened up to such an extent that the heavy highway traffic created deep ruts and became mired at times. The commission provided a team of horses to tow the traffic through when necessary and also filled the ruts with large pebbles, dragging the road at convenient intervals, so that in a short time the detour was again passable.

On Gratiot road where the city of Detroit found it necessary to cut an open trench through a concrete road, because tunneling was prevented by quicksand, a plank road detour (Fig. 3) was constructed and maintained as a convenience to traffic.

On the Seven-Mile road, east of Woodward, a macadam road (Fig. 4) was built as a detour to avoid a big sewer job being constructed by the city of Detroit.

### Plank Road Built

On Fort St., where the board is building a large bascule bridge over the River Rouge (Fig. 5) a concrete road was constructed as a detour over private property to the drawbridge owned and operated by the Detroit United Railway. A plank roadway was built between the tracks and traffic carried through onto Fort St. in the village of Oakwood. With the detour constructed the old bridge on Fort St. could be removed and work started on the new structure.

The board has also provided a substantial detour on Jefferson Ave. and the River Rouge, where a large bascule bridge is under construction. A location for a temporary bridge was selected about 200 ft. up-stream from the old bridge and right of way for a temporary road to this bridge from Jefferson Ave. was procured.

After a study of the situation it was decided to be unsafe to attempt to move the present bridge into this new location because of its poor condition and inadequate strength to carry present-day traffic. Fortunately the Michigan Central Railroad, in accordance with the orders of the War Department for improvement of the River Rouge, was building a new bascule bridge ½-mile upstream from the county's bridge site and was willing to sell its old drawspan.

According to pre-arranged plans a flotilla of scows was on hand when the day arrived to take over our project. The scows were pumped nearly full of water and towed under the bridge at the Michigan Central Railroad crossing. By unwatering the scows the 600,000-lb. bridge was raised clear of its foundations and towed downstream (Fig. 6) to its new resting place as a detour for Jefferson Ave. traffic. By filling the scows with water again the bridge was successfully landed on its new foundations.

The floor of the bridge was then planked, a sidewalk was constructed and rails laid for the Detroit United Railway. The detour thus provided is now serving traffic in an effective manner.

On Plymouth road, halfway to Plymouth from Grand River, is another ingenious detour. The old span was a light and narrow, 16-ft. wide, clear through truss span, 100 ft. long, supported on flimsy foundations. The new span is a heavy pony truss span, 120 ft. long and having a clear width of roadway of 24 ft. It is supported on heavy and substantial concrete foundations. The old bridge is at one end of a very narrow roadway on a high fill which will be widened to give the equivalent of a 24-ft. gravel road, thus eliminating a serious obstacle to traffic.

The foundations for the new bridge which were built last winter were constructed without interruption to roadway traffic. The excavation for the new foundation was spanned by temporary bridging. The new steel structure was erected with only one or two half-hour interruptions to traffic and one interruption of half a

## How Wayne County Provides Detours for Vehicular Traffic

**Fig. 1. Plymouth-Northville Road Detour at New Bridge. Fig. 2. How Traffic Was Routed Around a Second Bridge, Plymouth-Northville Road. Fig. 3. Plank Road Detour at Gratiot Road Where Sewer is Under Construction. Fig. 4. Macadam Road Built to By-Pass Vehicles on Seven Mile Road. Fig. 5. Concrete Road Detour at River Rouge Bridge Crossing. Fig. 6. Floating Temporary Detour Bridge to Place at Jefferson Ave.**

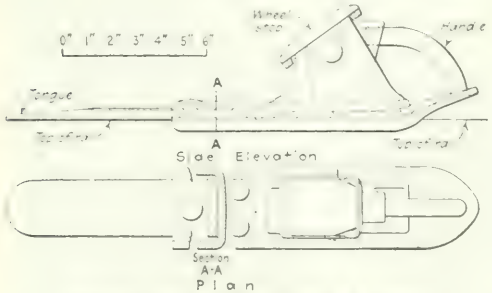
day. The latter was so timed as to occur when traffic was a minimum and when dry weather had left the detours in good shape.

The new steel trusses were erected on falsework on either side of the old bridge. The old bridge was then jacked up about 3 ft. to allow the floor of the new bridge to be built underneath the old bridge. It was during this jacking that the half day tie-up occurred. A plank roadway was built on half of the new bridge floor and the old bridge was then removed. Traffic used this plank roadway while a concrete roadway was poured on the other half of the new bridge. After the concrete had set sufficiently traffic was turned on to it and the plank roadway torn out to allow the other half of the roadway to be concreted.

These various detour expedients are much appreciated by the travelling public, and are great savers in time, tires, and gasoline consumption. In many instances traffic would be taken out of its normal channels from 3 to 5 miles.

## Skid Brake for Gravity Switching

A SLIDING SHOE or skid to check cars in gravity yards has been introduced on the Northeastern Ry., England, and is shown in the accompanying drawing. Since an English freight car has its brakes operated by a lever at the side, with the operator standing on the ground, it is necessary in gravity switching to let the car travel unchecked on the classification track or to have a man run beside it from the foot of the hump grade. The former practice results in more or less




ENGLISH SKID TO STOP CARS IN YARDS

damage to cars and freight, but the latter is dangerous on account of the number of rails and switches to be crossed. The skid is a flat plate, held on the rail by flanges and having one end beveled to receive the car wheel. The other end is bent up to ride over switch points and irregular rail joints and has a stop riveted to it.

When the wheel engages the tongue of the skid the movement of the car is checked, and when the wheel strikes the stop the friction between rail and skid soon brings the car to rest, with a slight recoil causing it to back off the inclined tongue so that the switchman can remove the skid with a hooked stick. According to the *Railway Gazette*, London, a car or cut of cars moving at 15 m.p.h. can be stopped in twice its length by the skid. It is stated that, since the switchman remains at the yard tracks and the car moves freely until it approaches its destination, greater speed can be made in putting cars over the hump. This skid brake is the invention of O. H. Lindberg, assistant superintendent.

# Eight-Cable Suspension Bridge of 1803 Ft. Span for Detroit

### Double-Deck Construction to Accommodate Railway and Highway Traffic— Four-Cable Bridge at First

DEVELOPMENT of the plans for the Detroit River bridge to connect Detroit and Windsor, a project that has been under consideration during the past two years, has progressed far enough to put into concrete form some of the outstanding individual features of the proposed structure. A span of 1,803 ft. center to center of towers will be required, and for this purpose

FIG. 1. HOW THE DETROIT RIVER CROSSING WILL APPEAR

a suspension bridge with unloaded backstays, carrying two decks for separate accommodation of railway and highway traffic, has been designed. The plan has been adapted to the requirement of construction in two stages, the highway deck to be constructed first and the railway deck to be added later together with the cables and extra stiffening-truss capacity required to take care of it. The unprecedented span length and the high load capacity necessary for the service to be carried made the design a difficult problem. Some drawings of the design prepared by Charles E. Fowler, chief engineer, and D. B. Steinman, assistant to the chief engineer, are reproduced herewith.

During the past few months the interests back of the bridge have obtained the necessary authority from Congress and from the Dominion Parliament through the granting of charters to an American and a Canadian company for the construction of the bridge. These companies have since been organized for joint action. Arrangements have also been concluded with a security brokerage house to sell the bonds and stock of the enterprise. In the meantime an advisory board of engineers has been formed, comprising George H. Pegram, Prof. William H. Burr, C. N. Monsarrat and Prof. C. R. Young.

The principal dimensions of the structure are given in Fig. 2 herewith. The towers are of steel, consisting each of four posts in the vertical planes of the four pairs of cables (one pair to each stiffening-truss). A sag ratio of one-tenth has been adopted, with stiffening-truss depth one-fiftieth of the span length; a sag ratio of one-ninth and a truss depth of one-sixtieth are being investigated for economy, deflection and general appearance of the structure. The sag in question is the mean of that of upper and lower cables. The two decks are spaced the full depth of the trusses. The lateral system has a paneling of four times the length of the stiffening-truss panel.

On account of the heavy loading, special effort has been made to utilize the material to fullest efficiency by

careful adaptation of the unit stresses to the available strength. For the floor, normal concentrations have been taken into account, including E60 loading on the railway deck, with impact 50 per cent of that specified by the Pencoyd formula, for railway speed of 20 m.p.h.; for the major elements of the structure, a total live load of 36,000 lb. per lineal foot of bridge (24,000 lb. for four railway tracks, 5,000 lb. for two trolley tracks, and 7,000 lb. roadway and sidewalk load). This is regarded as full or "congested" loading, a condition that would probably never be possible of realization as a test load, and to which extreme unit stresses might be applied. The normal live load, for the application of normal unit stresses, is made up of three-quarters of the congested railway load (four tracks at 4,500 lb.), 40 per cent of the trolley load (two tracks at 1,000 lb.), and

Eight cables proved necessary primarily because of the long span and great load. Cables of 21 in. diameter were considered the largest practicable for construction and efficiency. However, this arrangement also afforded a ready solution of the problem of two-stage construction. Six of the eight will be 21 in. in diameter, containing 7,980 parallel wires each, of 0.192 in. diameter, galvanized. Two of them will be 18 in., with 6,700 wires of the same size. Wire of 215,000 lb. ultimate and 70% elastic limit was counted on, though material of about 10% higher elastic value may be obtained. The cables are to be continuous from anchorage to anchorage, and to be wrapped with No. 9 soft annealed galvanized steel wire; the suspenders will be pairs of galvanized-wire ropes $1\frac{3}{4}$- and $1\frac{5}{8}$-in. diameter. Maximum cable stress amounts to 19,700,000

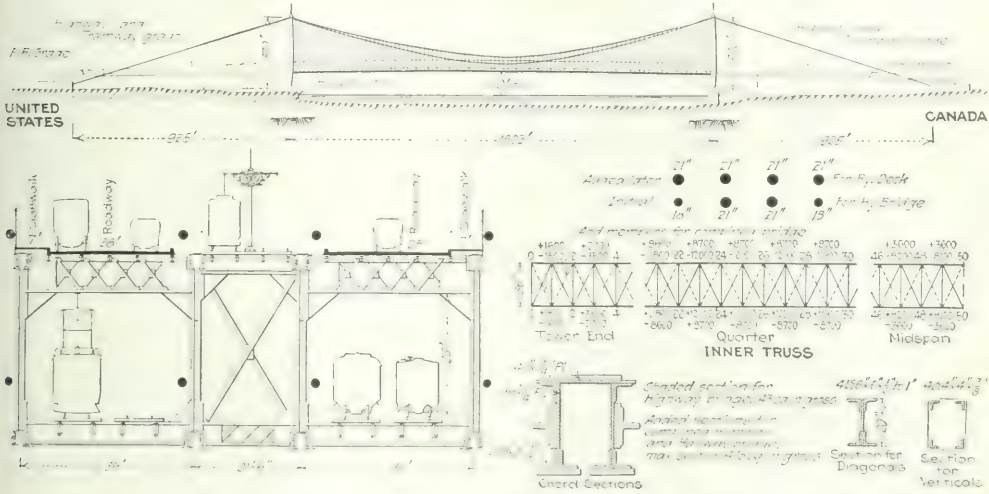



FIG. 2. DIMENSIONS AND STRUCTURAL ARRANGEMENT OF PROPOSED DETROIT-WINDSOR BRIDGE—TRUSS REINFORCEMENT WHEN SECOND DECK IS ADDED

half the roadway and sidewalk loading (50 lb. per sq.ft.), making a total of 23,500 lb. per lineal foot of bridge, or 65 per cent of the congested loading. Wind was computed at 30 lb. per square foot of exposed surface, including the projected surface of two trusses and train and traffic loading, a total of 1,850 lb. per lineal foot of bridge, considered as a moving load. The railway and highway floors will however absorb nearly half the lateral force. A temperature variation of 60 deg. F. above and below mean was allowed for. The suspended dead load for the design as worked out amounts to 37,700 lb. per lineal foot, of which the cables and suspenders make up 6,700 lb. and the four trusses 16,500 lb.

Unit stresses have been applied as follows, the two stresses given being in each case extreme and working, respectively: Cables, 100,000 and 85,000; suspenders, 50,000 and 40,000; alloy steel for towers and trusses, 45,000-150 $l/r$ and 30,000-120 $l/r$; structural steel, 20,000-80 $l/r$. The extreme stresses are to be applied to congested loading and temperature, or to normal loading with temperature and wind. The working stresses are to be applied to normal load and temperature, or to empty bridge with temperature and wind.

lb. for a 21-in. cable, under normal load with temperature.

As the development of railroad traffic arrangements and connections is believed likely to delay the realization of the project if construction to full capacity at the start is contemplated, the present intention is to build a highway bridge first, under such method of construction that only so much is built as is necessary to support the highway deck, while at the same time the additional supporting and carrying structure for the railway deck can be provided by direct attachment to the original bridge. Accordingly the design is such that the four lower cables (inner 21 in., outer 18 in.), the four stiffening-trusses, and the entire upper deck structure could be built first, but with the omission of one (of two separate) web systems and of reinforcing plates of the chords of the stiffening-trusses. The second or upper set of cables would be reeved and assembled only when the railway or lower deck is required. These cables, separated near midspan from the lower ones by a height of some 20 ft., are to pass over saddles directly above the saddles of the lower cables and then run closely parallel to them along the backstay length to separate anchor chains. Anchorages, tower piers

and towers are to be built of full capacity in the beginning, on account of the difficulty or impracticability of two-stage construction.

Two special elements of the structure are sketched in Fig. 3, showing one of the towers and one of the anchorages. The four posts of each tower are portal-braced instead of being connected by full diagonal bracing. Below roadway level they are braced by transverse diaphragms. While these towers are to be built of alloy steel, the working stresses in compression will not exceed 35,000-140 $l/r$ even under congested loading. The maximum compression in an inner tower post is 30,500,000 lb., for working live-load conditions, with extreme temperature and wind action. The towers are hinged at the base to allow for movement of the saddles due to temperature change of the cables. Their weight is about 20,000,000 lb., while towers fixed at the base would be more than twice as heavy.

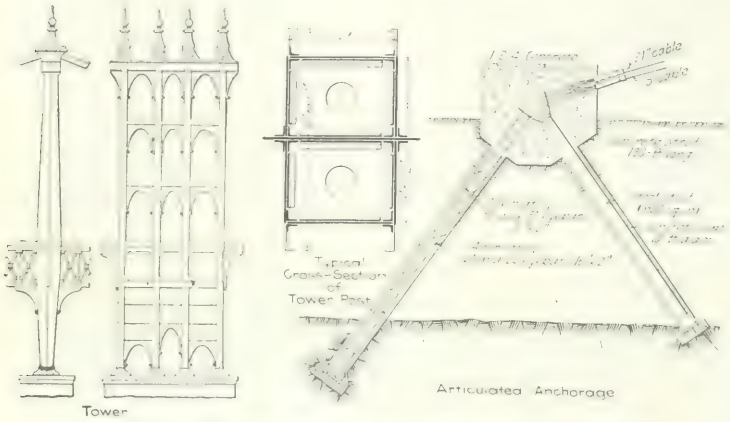



FIG. 3. PORTAL-BRACED TOWER AND STRUT-AND-TIE ANCHORAGE, DETROIT BRIDGE

The stiffening trusses were designed two-hinged for reduction of deflections and to avoid high suspender loads near midspan such as may occur with a center hinge; the weights of two-hinged and three-hinged truss were found to be about equal for the conditions of the Detroit bridge.

Unloaded backstays were used primarily on account of a curve in the railway approach, but the avoidance of large deflections in the side spans and decrease of main-span deflection were considered weighty additional reasons for this type as against loaded backstays, although there was little difference in economy between the two arrangements.

For the anchorages the novel construction sketched has been devised to provide for direct transfer of the cable pull to the underlying rock with a concrete anchorage block only heavy enough for the desired solidity of construction and for the purposes of bracing the four strut frames. This is attained by providing an inclined strut from rock up to the anchorage saddle, from which saddle (taking the pull of one upper and one lower cable) two eyebar chains pass backward and downward into a pit in the rock containing anchorage girders. Both strut and anchor chains are incased in shafts of concrete as protection from corrosion and indirectly a reinforcement of the anchorage.

# Progress in City Planning in the United States

By Jacob L. Crane, Jr.
Cambridge, Mass.

Is THIS significant new movement, the re-planning of our towns and cities, really taking hold in America? Then where, when, and by whom has it been seriously undertaken? To answer these questions by a summary of the data now available, the writer has used principally a recent bulletin, "Municipal Accomplishment in City Planning," edited by Miss Theodora Kimball, Librarian of the Harvard School of Landscape Architecture. The study has been confined to the replanning of existing cities and their environs, and does not include the laying out of new villages. Only those cities have been included where comprehensive replanning has been done for the entire community. Full data are not yet available from several cities where re-planning has been done, but on each question proposed sufficient information was tabulated to indicate the trend in the movement.

The work undertaken so far has been confined mostly to the larger towns. All of the first sixteen cities in the United States are in this list; and 57 of the first 100 are here. There are at least 1,700 towns of over 5,000 population and virtually all of the villages and rural communities where this fundamental civic enterprise has still to be taken up.

## Who Started City Planning Projects?

The city planning work in these communities was initiated directly by and the work done for the municipal governments, one department or another, in 65 cases; by citizens' committees, women's clubs, and special civic organizations in 25 cities; by chambers of commerce, boards of trade, and similar organizations in 8 cases; by city and chamber of commerce combined in 4 cities; by an organization outside the city altogether in 2 cases; by municipal art commissions in 2 cases; and by the federal government in 2 cases. Features of these data are the large proportion of work started by the municipalities and that started by citizens' committees.

City planning, arising as a new profession, has drawn men from various older professions. Table II shows the number of cities which employed experts from the several professions indicated. While many of the experts are now classed as City Planners, they are here included in the group of the older profession to which they also belong. In some cases, where several men were engaged, it has been necessary to class a city in the group of the expert who headed or directed the work. The technical work done by city forces is usually directed by the city engineer, often with the co-operation of the park board and the other departments.

TABLE I. GEOGRAPHICAL DISTRIBUTION OF CITY PLANNING

| | Under-taken Planning* | City Planning Comss.† | | Under-taken Planning* | City Planning Comss.† |
|---|---|---|---|---|---|
| Massachusetts | 15 | 41 | Maine | 2 | 1 |
| Pennsylvania | 13 | 28 | Maryland | 1 | 1 |
| California | 10 | 19 | New Mexico | 1 | 1 |
| Ohio | 6 | 9 | North Carolina | 1 | 0 |
| New York | 10 | 6 | Oklahoma | 1 | 1 |
| Michigan | 7 | 5 | Oregon | 1 | 1 |
| Connecticut | 4 | 4 | Rhode Island | 2 | 1 |
| Indiana | 1 | 3 | Tennessee | 0 | 1 |
| New Jersey | 8 | 3 | Texas | 3 | 1 |
| Washington | 2 | 3 | Utah | 0 | 1 |
| Wisconsin | 3 | 3 | Virginia | 2 | 1 |
| Illinois | 7 | 2 | West Virginia | 0 | 1 |
| Iowa | 4 | 2 | Dist. of Columbia | 1 | 0 |
| Kansas | 0 | 2 | | | |
| Minnesota | 3 | 2 | Total | 120 | 148 |
| Missouri | 2 | 2 | | | |
| Nebraska | 1 | 2 | | | |
| South Carolina | 2 | 0 | | | |
| Alabama | 1 | 0 | | | |
| Arizona | 1 | 1 | | | |
| Colorado | 4 | 0 | | | |
| Georgia | 0 | 1 | | | |

* Comprehensive, its planning done and data available, with or without commissions.

† As of Nov. 1 1920. Some have not yet produced evidence that work has been started.

PER CENT DISTRIBUTION

| | | |
|---|---|---|
| New England | 20 | 32 |
| Total East of Mississippi | 73 | 76 |
| Total in Northern States | 80 | 80 |

| Group | Number of City |
|---|---|
| Previous to 1900 | 2 |
| 1900 1905 | 3 |
| 1905 1910 | 26 |
| 1910 1915 | 38 |
| 1915–1920 | 51 |

CLASSIFICATION BY SIZE OF CITIES 1920 CENSUS

| Population Group | Number of Cities | Population Group | Number of Cities |
|---|---|---|---|
| Less than 5,000 | 6 | Total 25,000 100,000 | 48 |
| 5,000-10,000 | 9 | 100,000 250,000 | 25 |
| 10,000-25,000 | 9 | 250,000 500,000 | 11 |
| Total up to 25,000 | 24 | 500,000 1,000,000 | 9 |
| 25,000 50,000 | 29 | Over 1,000,000 | 3 |
| 50,000 100,000 | 19 | Total over 100,000 | 48 |

Most of the work grouped under civic expert was done by the late Charles Mulford Robinson. The landscape architect has directed more work than have members of any other profession. He has been the moving spirit behind the idea and the project in many cities. The engineer however has done more comprehensive city planning than may be commonly supposed, most of his work being as a member of the permanent city forces

TABLE II. KIND OF PROFESSIONAL SERVICE EMPLOYED

| Profession of Expert | Number of Cities |
|---|---|
| Landscape architect | 36 |
| City forces (engineering and other departments) | 20 |
| Civic expert | 18 |
| Architect | 13 |
| Engineer (outside of city forces) | 4 |
| Architect and landscape architect | 3 |
| Engineer and landscape architect | 3 |
| Engineer and civic expert | 3 |
| Landscape architect and civic expert | 1 |
| Associated landscape architect, engineer, and architect | 2 |
| Total in which landscape architect appears | 45 |
| Total in which engineer appears (including city forces) | 32 |
| Total in which civic expert appears | 22 |
| Total in which architect appears | 18 |

It may well be considered that the soundest method of undertaking city planning work is by the forces of the city departments (preferably under a separate commission or board with a technical staff), since they are most responsive to the traditions and needs of the community. Outside consultant engineers, architects, landscape architects, and sociologists may be called in for advice on particular phases of the work. The tri-partite board—landscape architect, architect, and engineer—has proved most effective in certain instances, notably in the work of the U. S. Housing Corporation, which, however, has not been included in this study for obvious reasons. The individual who may combine the qualifications of these three in his own training, and add to them the insight of the sociologist, is perhaps best qualified to direct work as an individual. Always, however, numerous sources of local advice must be consulted, since city planning purposes to be the art of interpreting, formulating and making effective the best traditions and aspirations of the community, not of the expert.

### Comprehensiveness of Planning Projects

It was possible to get only a most general idea of how detailed the planning work has been. Only 20 cities were found where the planning could be called "complete," while in 80 cities it could be termed "general," although not complete. While planning cannot be most effective unless it is complete in all details, the "general" planning on a comprehensive scale is invaluable because it forms the framework within which the complete details can be developed.

Out of 113 cities there were 62 with a plan commission or some comparable body, with the function of carrying on the planning as a separate municipal enterprise, and of recommending (or, in one case, ordering) the work to be done by the other departments. Somewhat less than half, 51, still operate through the existing city departments. Genuine progress has averaged much greater in the cities with planning commissions.

In at least 31 cities, out of probably 50 where some time has elapsed since the planning was done, many of the improvements recommended in the planning reports have been carried out, and in 38 cities at least some improvements which would probably not have been undertaken if it were not for the re-planning, have been put under construction. No city has started execution of all the proposals of a complete plan. Many, however, have definite programs for carrying out the projects through a period of years. This seems to be a sensible scheme of procedure. Only three cities state that the proposals of the plan have been ignored in the subsequent improvements, but there are about a dozen other cities where the present officials seem to be ignorant of the planning that has been done in their cities. An important element of putting the city plans into effect, namely the control of platting of annexed lands to accord with the plan, has been definitely adopted by at least four cities and in greater or less degree by many more.

Chicago leads in the execution of projects of fundamental importance to the development of the city. Philadelphia has started work on several huge projects. The execution of work according to city plans is definitely under way in: Akron, Albany, Baltimore, Boston, Cleveland, Dallas, Detroit, Flint, Milwaukee, Minneapolis, Pittsburgh, Rochester, St. Louis, San Francisco, Springfield, Mass., and Syracuse.

The commonest causes for delay in converting plans into construction projects are the obvious ones of lack of public support and particularly lack of financial support. The latter has been an unusually severe drawback during the period of war activity and war prices.

Most popular interest is liable to center in individual projects, one or two at a time, and so long as these projects are a part of the plan, it is practical to carry out work in this way. Much recent interest has been in the housing deficiency and many planning reports include, as they properly should, sections on housing facilities.

At the present moment zoning is by all odds the most active phase of city planning work. Its popularity may

be attributed to the facts that its benefits are easily understood, immediately available, and easily and cheaply secured. The zoning work will be valuable, but its full effectiveness cannot of course be secured unless it goes hand in hand with comprehensive planning, in fact it has been shown that zoning without planning may be a dangerous expedient.

### State Interest in City Planning

State interest in city planning projects has shown at least two important recent developments. In Massachusetts, following the compulsory Town Planning Commission law of 1913 and the enabling Survey act of 1916, the old Homestead Commission has lately been superseded by a Division of Housing and Town Planning in the State Department of Public Welfare. It is expected that this bureau will serve to stimulate the execution of plans in Massachusetts. In Pennsylvania the recently established Division of City Planning of the State Bureau of Municipalities has been carrying out a regional survey in the Wilkes-Barre region.

The data here submitted showing the progress and the tendencies in the art of city planning seem noteworthy and prophetic. The movement promises a complete rehabilitation of urban environment in the United States. The engineer's part in the work will become increasingly important as he interests himself in the broader functional planning of towns and cities.

## 20-In. Suction Dredge Operated Entirely by Electricity

THE 20-in. suction dredge, "Tacoma," which is operated by the Marsh Construction Co. on the Sumas River in Washington, was recently converted from steam to electric operation. As now arranged, it has a total connected load of 1,322.5 hp. and uses motors ranging in capacity up to 1,000 hp. Both 2,300- and 440-volt current is used, a cable and reel maintaining connection with the shore as the dredge moves forward in its work.

The source of the energy is a 34,000-volt transmission line which parallels the line of operation of the dredge. Leads tapped onto this high tension line run to a bank of three 500-kva. transformers mounted on a scow which is moored to the bank of the river. Scow and dredge are connected by a 1,000-ft. length of submarine cable carried by a reel mounted on a small scow lashed to the dredge; the cable being automatically paid out as the dredge moves ahead. When the cable is all reeled out, the transformer scow is cast adrift and moved ahead, the slack in the submarine cable is coiled up on the reel, and new connections with the transmission line are served to the transformer bank in its new location.

The two largest power units on the dredge are the 1,000-hp. motor which drives the main pump at the rate of 300 r.p.m and the 150-hp. motor which operates the cutter by means of reduction gears. Early in September, after a few weeks of operation, the dredge was reported to be moving material at the rate of about 600 cu.yd. per hour at a power cost of 1 to 1¼ cents per cubic yard. Under normal operation the dredge requires from 900 kw. to 1,000 kw. and has a power factor of about 85 per cent.

The electrical features of the dredge were designed and installed by Thompson & Castleton, Inc., of Seattle.

## Pronounced Reinforcement Corrosion Due to Sea Water or Electrolysis

By Welton A. Snow
Sandquist & Snow, Engineers and Contractors, Miami, Fla.

ON JULY 18, 1921, we were called to investigate the deterioration of reinforced-concrete floorbeams in the first floor of a residence located on one of the many island keys along the east coast of Florida. The building is located on a fill at the water's edge, with the foundation walls resting on piling, the first floor about 7 ft. above mean low water. The floor construction is hollow tile combined with reinforced-concrete joist with 4 in. concrete top finish. The tile are 8 x 12 in. with 4 in. concrete joist 16 in. c. to c., the bottom of concrete joist and hollow tile being flush. The joist contains two ⅝-in. reinforcing bars in long spans, and one ¾-in. reinforcing bar in the short spans.

We found upon going into the basement, that a section of the underside of the first floor had been fractured as shown in the view. The reinforcing steel in the beams was exposed as shown and fragments of concrete and tile were lying on the basement floor. The reinforcing steel so exposed was severely corroded, large flakes of rust being attached to the fragments of concrete found on the floor. The steel bars were materially decreased in area in many places and upon further examination of the rest of the floor we found that similar conditions existed, although concrete and tile had not been displaced. Existing cracks and hollow sounds noted when tapping the beams indicated severe corrosion.

On checking back over the history of the house we found that sea water had been used in the original concrete mix. We also found that direct current is used in the building and that the lighting system had been continually giving trouble. After carefully studying these conditions and consulting all available literature at hand relative to the corrosion of reinforcing steel in concrete we arrived at the following conclusions.

(1) Undoubtedly the fact that salt water had been used in the concrete mix accounts for rusting of the steel to a certain extent.

(2) The fact that the basement ceiling and walls had been constantly exposed to warm salt water vapor and had not been damp-proof tended to increase the rate of corrosion.

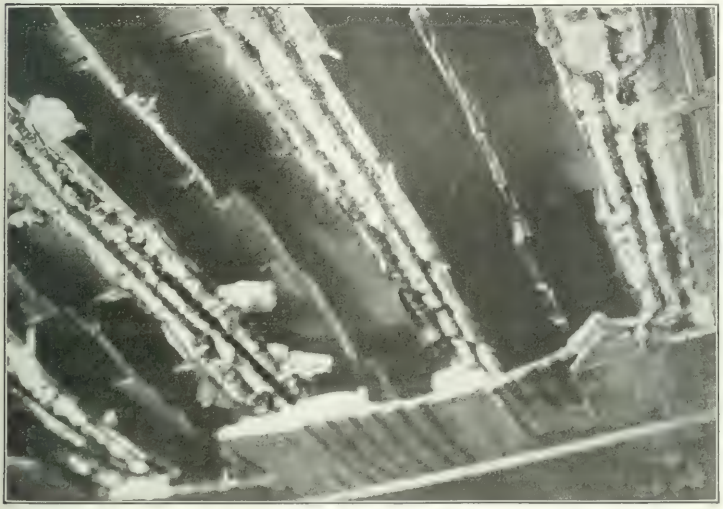
(3) All indications seem to point to severe ground electrical currents in the building, such currents very likely passing through the reinforcing steel in various sections.

Conclusion No. 3 we believed to be the most serious condition and consequently our first step was to take a thorough examination and test of the electrical system for ground circuits. As a result of this, we found two especially severe grounds in the lighting circuits. The worst one of the two circuits passed through the general area in the basement where the most serious corrosion of steel was taking place. At three points in this circuit the insulation had been penetrated and the copper was in touch with the conduit, which in turn was in direct contact with the concrete beams.

As a result of our findings we believe that the severe corrosion of the reinforcing steel in this instance was primarily caused by the constant exposure of the unprotected beams to warm salt water vapor which penetrated through the rather coarse concrete to the

steel; that the ground circuits in the building materially increased this corrosion causing excessive action and the concrete and tile to fracture; that the salt water used in the original mix tended also to help the corrosive action to a great extent.

The concrete is of average quality for this section of the country. The rock used almost entirely in the southern part of Florida is a rather soft rock, an oolitic limestone formation, in many instances of a coral formation. The sand used is for the most part that known as beach sand, containing a great many small particles of broken shells. With these aggregates, the resulting concrete is not as hard or as dense as the concrete obtained in the north where a harder rock is used and a much sharper sand. Therefore the concrete of average quality used in this section of the country with no waterproof coating is more easily penetrated by moisture than concrete in the north. It may be that a chemical reaction within the concrete itself has caused it to become porous and more easily penetrated by water vapor.



CORRODED STEEL CAUSES BREAKING UP OF PROTECTING CONCRETE

### Rainstorm Totals at Providence, R. I.

The total precipitation for each period of rainfall at Providence, R. I., in the 43 years from 1877 to 1920 was 8, 7 and 6 in. once each; 5 and 4½ in. three times each; 4¼ in. once; 4 in. twice; 3¾ in. six times; 3½ and 3¼ in. 12 times each; 3 in. 15 times; and so on in increasing numbers of times until 174 storms each of 1¼ and 1 in. respectively are reached, according to the 1920 report of M. H. Brondson, city engineer of Providence. From that point on the figures are given for each tenth of an inch, reaching 630 rainfalls of 0.1 for the 43 years or an average of 14.3 such rainfalls per year. For the same period there were 306 rainfalls of 0.01, or an average of 7 such a year. Rainfalls between the depths reported are credited to whichever depth they are nearest. The 8 in. rainstorm was in 1886, the 7-in. in 1899 and the 6-in. in 1904.

# Practical Economics of Dredge Pump Design

## Smooth Flow Lines Require Less Power—Wear Reduced and Output Increased—Two Designs Compared on Actual Work

By E. J. Dent
Asst.-Col. Corps of Engineers, U. S. A., U. S. Engineer Office, New Orleans, La.

DREDGING superintendents cannot be expected to qualify as expert designers of centrifugal pumps. There is, however, one item in the design of dredge pumps which the outdoor superintendent can readily appreciate and which he should insist upon having incorporated. This item is smooth flow lines. Without smooth flow lines, a dredge pump becomes a serious waster of power, a machine for churning water as well as for pumping it, and a machine for using the sand and gravel pumped as a sand blast for wearing out the machine itself.

Wear and tear on dredge pumps varies greatly with the material handled and the lift against which it is being pumped. The wear is always so great that the men in charge of dredging operations are quickly impressed with the cost of buying spare parts and with the cost of delays incident to the installation of these spare parts. With these expenses before them, they have insisted upon designs in which the spare parts cost a minimum for manufacture and upon an assembly which permits the installation of the new parts with a minimum loss of time. Generally the power consumed receives little attention for the reason that it cannot be readily measured. The cost of wasted power is, however, in many cases far greater than the cost of repairs. Moreover, a design calculated to economize in the expenditure of power may often show an economy in replacement expenses.

### Two Designs Tested

These general statements are well illustrated by the installation made at the writer's suggestion, of an improved design of pump, Fig. 2, on the dredge "Raritan." This dredge is of the seagoing hopper type and is equipped identically except that one pump is a right and one a left. The pumps discharge into two bins, one located in the forward end and one in the after end of the vessel. The yardage excavated is measured accurately by the bins.

After the new pump had been installed, comparative tests were made. A number of loads were dredged, using one pump at a time. After a load had been obtained with one pump, a second load was dredged with the other pump under as nearly identical conditions as possible. Later the pumps were so connected up that

they could be operated simultaneously, one pump discharging into the forward bin and one pump into the after bin.

In the case of the "Raritan" the increased efficiency of the new pump was utilized to increase the output of the dredge without changing the expenditure of power. The installation of a more efficient unit had precisely the same effect upon the capacity as would have been obtained by the installation of a more powerful unit having the same efficiency as the one replaced. The results of actual dredging tests are summarized below and are expressed in terms of percentages, the output of the old pump being called 100 per cent:

| | Old Pump | New Pump |
|---|---|---|
| [illegible] | 100 | 115 |
| [illegible] | 100 | 96 |
| [illegible] | 100 | 164 |

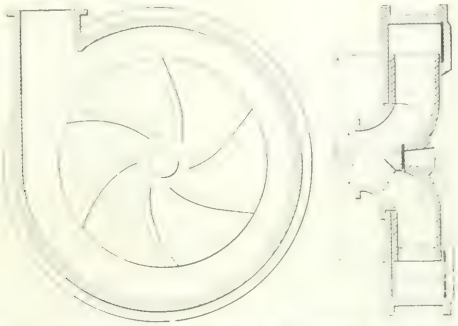


FIG. 4. ORIGINAL PUMP FOR U. S. DREDGE "RARITAN"

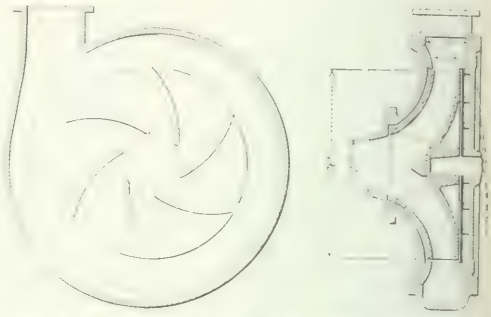


FIG. 5. NEW PUMP FOR U. S. DREDGE "RARITAN"

The moral of the above figures is obvious. The increased output of the plant was obtained without any additional expenditure for power. Operations since the new pump was installed have shown that the wear and tear on the new pump is less than on the old pump and that the cost of new parts, including their installation, has been reduced.

The acceptance trial of the new pump was made while pumping water only, under conditions as nearly identical with actual dredging conditions as could be obtained. If the old and new pumps had been operated by electric motors, with watt-meters attached for recording the power consumed, and if the two pumps had been adjusted to deliver identical quantities of water against identical heads, the results would have been about as follows:

| | |
|---|---|
| [illegible] pump | 85 |
| [illegible] new pump | 261 |
| [illegible] | 7 |

That in ordinary dredging operations the power consumed by the pump is not recorded does not alter the fact that with a pump of poor design a very expensive waste of power, such as shown above, is actually taking place. The pumps on the "Raritan" are operated over 3,000 hours each year. An annual wastage of 225,000 kw.-hr. is not to be despised.

The accompanying figures show the new pump for the dredge "Raritan" and the pump which it replaced. The new pump was designed by Henry R. Worthington in accordance with specifications prepared by the writer. In preparing the specifications, every effort was made to obtain a pump suited for dredging conditions and at the same time to incorporate in that pump every feature found in high efficiency waterworks pumps, so long as those features were not incompatible with dredging operations. The most important changes were the elimination of the angular form of hub shown in the old pump, the conversion of the runner into what may be called a long sweep elbow, the extension of the inner tips of the vanes to a point as near the axis as possible, the elimination of an excessive width of vane at the outer periphery, the elimination of the sudden enlargement of the water passages at the outer periphery of the old impeller, and the incorporation of small vanes on the outside of the impeller on the suction side with a view to the reduction of circulation losses. The new pump has openings that will pass solids slightly larger than solids that can pass the old pump. The new pump has worn better than the old pump. If conditions require a thicker volute, it can readily be provided without altering the essentials of the design.

Certain features of a dredge pump are so different from the corresponding features of a high efficiency waterworks pump that many designers assume from the beginning that high efficiency is unattainable. The following figures, giving the actual results obtained with the new pump on the dredge "Raritan" show that in this instance suitability for dredging operations was not incompatible with high economy:

| | |
|---|---|
| Revolutions per minute | 150 |
| Output, cubic feet per second | 51.7 |
| Total dynamic head | 50.8 |
| Combined efficiency of pump and engine | 72.4 |

The writer believes that the results on the dredge "Raritan" should receive consideration by both dredge operators and pump manufacturers. It rarely happens that a dredge pump is found in which some fundamental error in hydraulic design has not been incorporated

## Redwood Survey Stakes Stand 47 Years

Redwood stakes driven into the ground along the California coast by the United States Coast and Geodetic Survey in 1874 are reported to be still in a fair state of preservation. The stakes are 2 x 3 in. in section and were not painted. Old corners which were marked by these stakes are being located again in connection with the accurate determination of the position of the new radio compass stations along the California coast, which is now being done by the United States Coast and Geodetic Survey. One of the stakes taken from Point Arguello is being sent to Washington to bear out the report of long service.

# Some Examples of Corrosion of Reinforcing Steel

## Fourteen Structures in Which Chemical Action Had Caused Steel Rusting and Partial Failure of Concrete

By Frank P. McKibben
Civil Engineering Department, Union College, Schenectady, N. Y.

IN CONNECTION with articles in recent issues of *Engineering News-Record* describing the collapse of a reinforced-concrete roof slab in Atlantic City the following observations pertaining to corrosion of steel reinforcement in some structures which I examined in 1913 may be of interest.

In each of the fourteen structures hereinafter mentioned, corrosion of the reinforcement was very marked, in several cases so much so as to cause danger. Corrosion of the steel may be due to chemical action or to electrolysis. I am sure that in no structure examined was electrolytic action present. Chemical action, generally due to the presence of salt, caused the steel rods to rust, thereby increasing their diameters and resulting in a tension which caused, in the surrounding concrete, cracks parallel to the rods.

*Meat Packing Plant in Buffalo.*—This structure, used for curing and packing meat, was subjected to much moisture and salt. For the most part the floors consisted of concrete slabs 8 in. thick reinforced with steel mesh, the slabs being supported by I-beams or wooden beams. Some I-beams were entirely encased in concrete, and others only partially so. Because of corrosion of I-beams or reinforcing mesh the concrete was cracked, blistered or pushed off in many places. At one point the corrosion of the mesh pushed off the concrete protection on the bottom of slabs leaving the metal exposed over an area of 2 by 14 ft. In many places in this building the mesh was completely rusted away leaving only rust-stained marks on the concrete. The concrete covering the bottom flanges of many I-beams which supported floor slabs was cracked parallel with the steel. Alternating current which was used within the building for light and power does not cause electrolysis of steel in concrete.

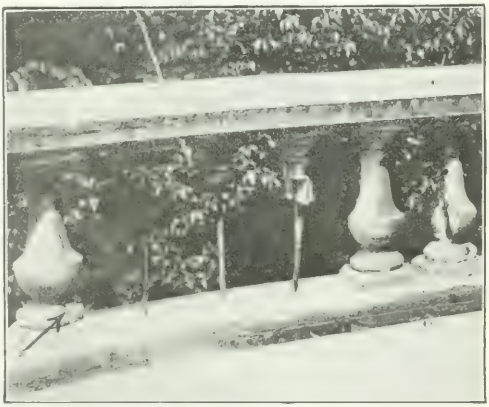
*Residence in British West Indies.*—This residence, a very elaborate reinforced-concrete structure of two stories, stood about 150 ft. from the sea shore and in many places the concrete was either cracked, blistered or pushed off from the steel. Exposed rods were in every case very rusty even in the ceiling of a bed room. Both in the interior and on the exterior of the building all cracks in concrete were parallel with reinforcing rods.

An adjoining pavilion, a reinforced-concrete structure consisting of a floor on which stood eight columns supporting a dome-shaped roof, was about 18 ft. high and 21 ft. in diameter. The columns and roof were reinforced and as a result of corrosion of imbedded steel the concrete was pushed off in many places leaving the badly corroded rods exposed, while in other places the concrete was cracked and blistered and stained by rust from within. A reinforced-concrete bridge was near the pavilion and in many places the concrete was pushed off by corrosion of imbedded rods.

There were no electric wires near the pavilion or the bridge, but the residence was lighted by alternating current. I was informed that salt water and unwashed sand from the sea were used in mixing the concrete.

*Reinforced-Concrete Bridge Model.*—This reinforced-concrete girder bridge was a model 28 ft. long built in 1903 and rested upon four masonry piers in the yard of a testing laboratory. The bridge after 10 years was very badly disintegrated, the concrete being cracked off or blistered in hundreds of places leaving the very rusty steel exposed to view. As the structure was many miles from the sea and as no electric current was within at least 100 feet, it seems quite evident that the concrete protection outside of the steel was so porous and thin as to allow the steel to corrode from atmospheric causes.

*Railing Near Nice, France.*—The view shows the form and disintegration of a concrete railing bordering a sidewalk on a hill approximately 270 ft. above the Mediterranean Sea and about one-quarter mile therefrom. Each concrete spindle of the railing had a minimum diameter of 4¼ in. and was reinforced axially with one or two steel rods extending from the bottom of the spindle, upward through the spindle into the railing on top. As a result of corrosion of the central reinforcement, out of a total of 39 spindles in the central section of the railing every spindle was cracked or badly disintegrated, some having been completely destroyed.



DETERIORATION OF CONCRETE RAILING NEAR NICE, FRANCE

The thickness of the concrete around the steel was generally 1½ in. but the minimum thickness was 1 in. As the spindles rested on a concrete wall, water could easily penetrate the horizontal joints between the spindles and the wall thus initiating corrosion at the bottom of the reinforcing rods with consequent splitting of the spindles from the bottom upward as shown in the spindle at the left end of Fig. 2.

*Structures at Atlantic City.*—One of the best known amusement piers at Atlantic City was carried on reinforced-concrete beams which were so badly disintegrated that wooden piles were inserted to support the pier. The reinforced-concrete beams were practically useless because corrosion of the steel reinforcement split off the concrete below and around the rods in many cases throughout the entire length of the beams. For example, in one series of 13 beams, all were in bad condition, while in another series of 13 out of 14 beams were also disintegrated and of no value in carrying load.

A small pavilion, also in Atlantic City, was about 20 ft. square and was carried upon nine reinforced col-

umns resting on the beach, the reinforced-concrete floor being about 10 ft. above the beach. Here again the concrete was badly cracked, blistered or pushed off exposing rusty steel in many places. The cracks and blisters had characteristic rust stains from the rusting steel within. The extent to which the structure was damaged in 1913 was indicated by the presence of 75 places on the hand railing alone where steel was exposed.

Another pavilion at Atlantic City was a reinforced structure about 45 ft. long by 30 ft. wide, and was badly disintegrated by rusting steel reinforcement. In several hundred places rust stained blisters occurred in the concrete, which upon being broken open invariably revealed corroded steel. In the main reinforced-concrete beams supporting the floor slab cracks from 2 to 6 ft. long existed parallel with the rods within.

The disintegration similar to that just described in the pavilion was also taking place at the following structures at Atlantic City: Reinforced-concrete beams supporting floors of two well known amusement piers along the Boardwalk, reinforced girders supporting the Boardwalk near Victoria St., pavilion on Boardwalk at foot of Atlantic Ave., a new apartment house on the Boardwalk. This apartment house case is interesting because the building was fairly new when examined, and because the concrete veneer under the reinforcing rods of beams had cracked off not only where the veneer was thin but in at least one place where the veneer was 3 in. thick. On the side of this beam, however, the concrete protection was only 1 in. thick.

More than half of the above structures had no electric wiring and in those which carried wires the current was alternating. Moreover, electrical readings showed no evidence whatever that electrolysis was in any way connected with the corrosion of the steel, and, furthermore, the character of the corrosion indicated clearly the usual chemical corrosive action. It will be observed that of the above noted fourteen structures showing evidence of steel corrosion all but two were near the sea coast; and of these two, one was a meat packing plant subjected internally to much moisture and salt.

By calling attention to these structures it is not my purpose to indict reinforced concrete, for the above are only fourteen structures contrasted with many thousands of others which are rendering good service. My purpose is to call attention to the importance of careful designing, careful building, and careful inspection, both during and after construction, of reinforced-concrete structures located in exposed positions on the sea coast. Moreover, the owner should be given the facts. He should not be led to believe he has something as enduring as Verdi's "Il Trovatore" or Dante's "Divine Commedia."

# Street Car Tracks Paved with Grouted Concrete

## Large Mileage of Modified Hassam Pavement Being Laid in Detroit—Force Account Construction Adopted

CONCRETE pavement constructed by grouting coarse broken stone after the manner of constructing Hassam pavement, is being placed in the track zone of a large mileage of streets occupied by the new municipal street railway system of Detroit, Mich. The equivalent of about 40 miles of 16-ft. pavement is represented by the construction planned for 1921. A mile of completed track each working day, equivalent to half a mile of 16-ft. pavement, is the schedule contemplated and being rapidly approached. An immense construction outfit, to carry on work in several places at once, is securing the high speed. To assure the high quality of workmanship required for the success of grouted concrete, all work is being performed by force account under rigid engineering supervision.

*Structure and Plant.*—About 100 miles of new track construction is planned. Of this trackage 18 miles were completed in 1920 using a wood tie construction embedded in mixed 1:3:5 concrete. The remaining 82 miles, scheduled for 1921, is of different construction as indicated for double track by the drawings of Fig. 1. In a trench 17½ in. deep and 16½ ft. wide is a center drain. Over this and the whole bottom of the trench, is a 2-in. layer of slag. Then comes a layer of 1:2:4 mixed concrete embedding the steel track structure to just above the base of the rails. Over all is grouted concrete, called "compressed concrete" by the street railway department engineers.

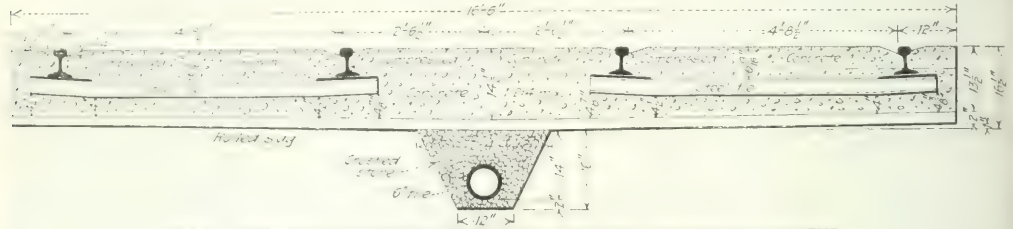


FIG. 1. SECTION OF DOUBLE TRACK WITH GROUTED CONCRETE PAVEMENT

### Advantages of Design

As a design of street railway track, the construction illustrated is not so expensive as the wood tie construction because it requires 4½ in. less depth of trench. It provides particularly good drainage. The structure is a monolith of exceptional rigidity. Chiefly, however, it provides, it is considered, a pavement surface of much better quality, by using imported granite for the top course, than could be secured with mixed concrete, using local aggregates. It is the pavement construction which is chiefly of technical interest to the engineer concerned with highway design and construction.

An excellent plant is provided for the force account operations. The larger items of equipment are twelve steam shovels, six locomotive cranes, six concrete mixers, four locomotives and ninety industrial cars and four miles of industrial track besides special machines, such as rail welders and pole-hole diggers. About 200 motor trucks are being rented for hauling, and 1,800 men are employed in the construction force.

FIG. 2. CENTRAL MIXING PLANT AT STREET INTERSECTION

*Preparing Track Foundation.*—Construction is begun by opening a trench about 18 in. deep and 16½ ft. wide. In paved streets, generally asphalt on concrete, the trench sides are cut by chisels and the pavement between is broken up by the improvised breaker described in *Engineering News-Record*, July 28, 1921, p. 163.

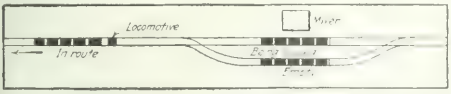



FIG. 3. DIAGRAM OF TRAIN MOVEMENTS AT THE MIXER

Steam shovels tear up the broken pavement and excavate the trench. The ditch for the tile drain is dug, the tile laid and the backfilling performed by hand.

Slag hauled in by motor trucks is spread over the trench bottom and rolled into the clay to a depth of 2 in. The purpose of this careful foundation preparation is to secure a dry track bed in an impervious clay. An 8-ton roller drives the slag into the clay and makes a very solid foundation bed and also one that keeps dry by drainage to the tile drain. The slag bed also makes an unyielding support for the precast concrete blocks on which the track is erected, leveled and welded by methods usual in electric railway construction.

FIG. 4. CONCRETE CARS DISCHARGE ONTO SHOVELING PLATE

*Placing Mixed Concrete.*—Mixed concrete for the main body of the track slab is hauled 1,000 ft. each way by industrial railway from central mixing plants. After a 2,000-ft. length is concreted the mixing plant is moved and re-erected at the middle point of another 2,000-ft. length. These mixing plants, as indicated by Fig. 2, are usually placed at street intersections. Here the concrete material is brought in motor trucks, unloaded onto the street and rehandled from the street piles to elevated bins by locomotive cranes operating clamshells. The bins are of knock-down construction, so as to be easily shifted. Regulation portable mixers with elevating charging skips are employed. They are moved from station to station by rollers or tractors and when set up stand in front of the bins so that the bin chutes feed directly into the charging skip. The cement is charged by hand. The mixers discharge directly into industrial cars holding 14-cu.ft. batches.

One locomotive and three five-car trains serve each

FIG. 5. SPREADING GRANITE FOR GROUTED CONCRETE

FIG. 6. ROLLING GRANITE BEFORE GROUTING

mixer. With a double-end switch at the mixer, the schedule of operation is as shown by the sketch plan, Fig. 3. Normally one train is in route, one is being loaded and one is empty on the siding. The train in route is pushed to the work, and, coming back, is pulled. The returning train pulls onto the siding where the empty cars are left while the locomotive couples onto the train previously on the siding, runs it out onto the main track and back to the mixer. There it lets the empty train stand while it couples to the train just loaded at the mixer and pushes it to the work. The empty cars at the mixer are spotted by hand, a car at a time, loaded and coupled up ready for the returning locomotive.

Where the concrete is being placed, the cars are

FIG. 7. GROUT DISCHARGE HEAD FILLING ROLLED STONE

dumped into a steel pan, Fig. 4, from which the batch is shoveled into the track. The surface is leveled up to templet and when stiff, is roughened to make closer bond with the paving course which is placed only when the base concrete is thoroughly set.

*Placing Grouted Concrete.*—Crushed granite from Wisconsin is used for the grouted concrete pavement course. It is required that the stones shall pass a 3-in. screen and be retained on a 2-in. screen and that the granite shall have a crushing strength of 12,000 lb. per square inch. This stone, piled along the street by motor trucks, is spread with forks, Fig. 5, to a level slightly above the rail tops and is then rolled with an 8-ton tandem roller until it is thoroughly compressed and keyed. The rolling requires care and skill but by starting easily and riding one side of the roller on the rail, Fig. 6, until initial compression is secured the operation is not difficult.

FIG. 8. SKETCH SHOWING FLANGEWAY FORMS

Grouting is the third operation. The mixer is a double tank paddle-mixer with an elevating skip on one side for charging. Each tank discharges through a spout with a strainer head. Grouting is done, toward the mixer, by swinging the head, Fig. 7, transversely across the zone being grouted and gradually backing up as the stone fills with grout. A 1:2 grout is used and pouring continues until it flushes to the top and covers the stone.

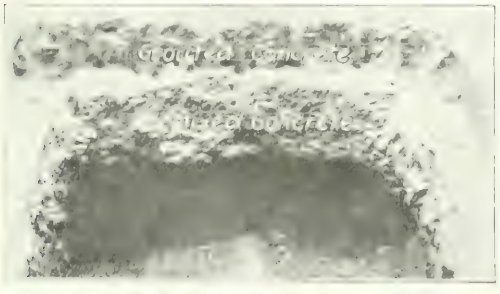


FIG. 9. SECTION THROUGH TRACK SLAB SHOWING QUALITY OF CONCRETE

When grouted the concrete is rolled, again using an 8-ton tandem roller, until no bubbles come to the surface and there is no wave ahead of the roller. Just before rolling the flangeway forms shown by Fig. 8 are placed. They are triangular timbers sheeted with steel. Following the rolling, men with tampers correct irregularities and rough spots. Men with brooms finally cross-brush the grout top.

*Advantages of Grouted Concrete.*—Grouted concrete was selected for paving the track zone because it was considered that a better pavement would be secured, and, because of its compression by rolling, a better bond with the steel track structure would be obtained. Its advantages are considered to be greater density, a more homogeneous composition, freedom from sand pockets and, by the use of large stone, greater endurance against wear. This perfection depends upon very careful construction and in particular upon perfect grouting. In grouting the greatest care is taken in respect to consistency and in the application, to secure penetration and complete filling of the voids from the bottom up. Where the completed pavement has been cut through in several places for inspection the penetration and bond has, it is stated, been found excellent. Fig. 9 is a view of one of these test pits made between tracks and excavated to expose the tile drain.

Resemblance of this pavement to Hassam pavement is noted. The construction is the same except that one size of stone is employed while in regulation Hassam construction a layer of coarse stone is first grouted and then a layer of finer stone and finally a surfacing of grout and pea stone is spread.

Construction is by force account with H. P. Hevenor, as construction engineer, and W. R. Dunham, assistant in direct charge.

## Six Years' Experience with Convicts on California Road Work

In the six years since the first convict road camp was established in California, 1,235 men have been sent from San Quentin prison to road construction camps located in remote districts in the northern part of the state. Out of this total 55 men escaped or attempted to escape and of these 35 have been returned to the prison, and 20 are still at large. That is, 4.45 per cent of the convicts sent out on road work attempted to escape and 1.62 per cent were successful. At present 2,185 men are under committment to the San Quentin prison and 252 of these, or 11.53 per cent are assigned to one of the three road construction camps now operating in the northern part of the state.

In supplying the foregoing figures, J. A. Johnston, warden of the San Quentin prison, states; "I have considered the matter from the standpoint of its effect upon the individual—inculcating the habit of industry and developing the desire to render useful service—as well as the value of getting roads built in remote regions where otherwise construction might be long delayed and I am heartily in favor of the employment of prisoners on road work.

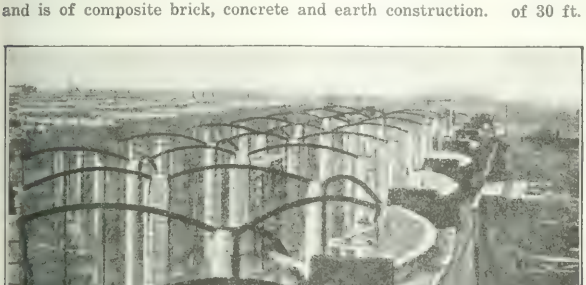
"We have a number of long term men assigned to road work. One man has been in camp since 1916; another since 1917; two since 1918 and eleven since 1919. Long term men are frequently selected and are just as good risks as men with short terms. A number of life term prisoners are working on the roads at the present time."

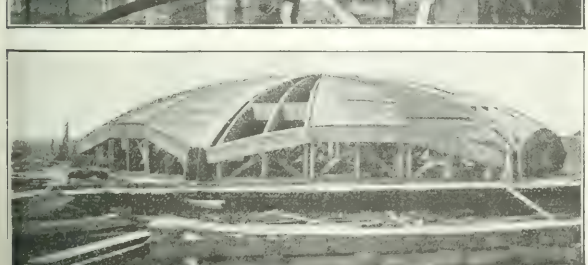
# Curious Structural Layout in New British Reservoir

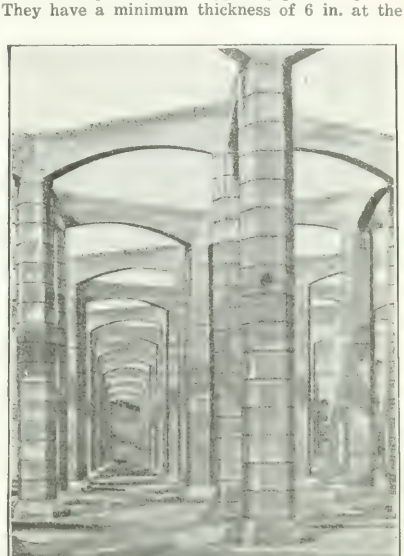
## Combines Precast Concrete, Structural Steel, Brick and Reinforced Concrete With Groined Roof Panels

NATIONAL peculiarities of engineering design cannot be better illustrated than in a brief description of the new Cross Hill Reservoir of the Birkenhead water supply recently noted in the English technical papers. The views herewith are reproduced from "The Engineer" and "Engineering" and the following description is taken from the latter journal:

The Cross Hill reservoir has an area of 3.6 acres, the total available depth being 28 ft. The reservoir is covered and is of composite brick, concrete and earth construction.







VIEWS DURING CONSTRUCTION OF CROSS HILL RESERVOIR, BIRKENHEAD, ENG., WATER-SUPPLY

Upper left, I-beam arches tying together the posts, also arched outer walls of brick and concrete; lower left, orange-peel shaped roof forms; right, precast concrete block posts with I-beam groins incased in concrete.

It is designed so that the thrust when full is taken by a surrounding earth embankment, but when empty the pressure of the latter is taken by a series of horizontal brick arches.

In plan the reservoir is hexagonal, each side being made up of eight horizontal arches of 30 ft. span and a radius of 27 ft. 6¼ in., with smaller spans at the angle points where two sides meet. At the springing of these horizontal arches there is in each case a vertical steel plate girder, 1 ft. over flanges by over 30 ft. in height. The bases of these vertical girders are embedded in concrete. The upper ends are tied to the interior structure of the tank as will be presently described. The girders are cased in concrete and special molded blocks which form the springers for the horizontal arches built of brindle brick. The latter work is 14 in. thick to 11 ft. 3 in. above the floor, and 9 in. thick above. It is backed by concrete, 12 in. to 18 in. thick, at the arch center and 5 ft. thick at the haunches, where it enclosed the plate girders. A layer of asphalt, ¾ in. thick, is laid between the concrete and brickwork. The earth bank outside is trimmed to a 2½ to 1 slope, the walls being 21 ft. thick at the top.

The reservoir is roofed in by 217 domes, supported by the side walls and 432 concrete island pillars. The majority of the domes are thus carried on groins connecting six pillars, the plan of each unit being a regular hexagon. The pillars are of molded hexagonal concrete blocks, 18 in. deep, chamfered top and bottom. A 6-in. hole is cored in the center, and this was filled with cement mortar. At the top a steel gusset plate is fixed, and to this gusset are attached the ends of the joists forming the reinforcement of the connecting groins. At the outside ring the other ends of this reinforcement are attached to the steel vertical girders, thus tying the whole structure right across the reservoir. The groin reinforcement is 3 in. by 11 lb. steel joist, and the groins themselves in which it is embedded are 14 n. wide and project 14 in. below the dome, and are arched on the underside to a radius of 20 ft. 4 in. These groins were molded in place.

The domes have a span between opposing parallel groins of 30 ft. They have a minimum thickness of 6 in. at the crown, increasing to 13 in. at the center of the groins. The intrados is struck to a curve varying from 50 ft. radius at the center to 17 ft. radius at the springing. Double shuttering was not required for this work. Some elaborate tests were carried out on a section of a dome, in the course of the work, with both symmetrical and unsymmetrical loading, the latter including a test load on one-half of the span of 12 tons of bricks, which the section stood with only ¼ in. deflection and no sign of failure.

The centering adopted consisted of triangular scaffolds mounted on wheels. Six scaffolds were placed together between the pillars and on the top was placed the dome centering, consisting of 18 dome sections and a keypiece. This centering proved very portable and was quickly moved and re-set as the progress of the work required.

Of this amazing structure, into which went apparently every kind of material and type of design, "The Engineer" says "it is claimed to be the most economical reservoir in the world," although no comparative figures or competing designs are mentioned. No intimation is given that the design is considered extraordinary.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## A Chance To Help: Books and Instruments Needed at Antioch

Sir—Antioch College needs a great extension to its technical library. I am sure that many other engineers over the country have been in the position in which I have found myself of endeavoring to move about the country and carry along a large accumulation of technical books.

I wish we might have your assistance in making known to the engineering profession our need of a technical library, as doubtless very many engineers would be willing to make a gift of duplicate copies or of libraries they cannot carry with them, or at least would be willing to make and indefinite loan of such books.

We are increasing not only our technical library, but also our supply of general literature. We are putting small alcove libraries on each floor of our two dormitories, so that during his college course the student will be put in close association with good books without having to go through the routine of library procedure. I should be very grateful for any assistance in building up this equipment.

We also find ourselves in need of engineering equipment beyond the limit of our budget. Assistance in supplying some of this would be as helpful as cash contributions to our undertaking.

ARTHUR E. MORGAN,
President, Antioch College.

Yellow Springs, Ohio,
Sept. 19.

## Engineering Education and the Engineer's Status Abroad

[*It is an interesting coincidence that each of the following three letters discussing Prof. Burr's paper on engineering education (see "Engineering News-Record," July 14, p. 65) makes reference to the engineer's status abroad.*—EDITOR.]

Sir—Professor Burr's discussion of higher education for engineers is particularly important and valuable to the profession because it represents the conclusions reached by one of its most widely experienced members, and if for no other reason, should be given the serious consideration of all who are in any way interested in its progress.

In previous years it has been the first consideration of those contemplating studying engineering (speaking of the majority), how quickly they can finish the course and get out and earn money. The purely commercial point of view has been too much evident for the good of any profession, and especially if the impression of the public and its attitude toward the engineer is concerned. A better professional spirit no doubt is inculcated through a greater familiarity with those subjects dealing with the political, social and economical progress of humanity. It would bring the engineer closer to the public.

To my mind the physician, lawyer and minister come more closely into contact with the great majority of the people than does the engineer, and furthermore devote more time to matters that are given daily publicity in newspapers and other publications. It is therefore to be expected that they are given greater recognition by society. This may be due not so much to their having been trained in the "higher education" any more so than engineers, for sometimes the contrary appears to be evident, judging from the position taken by some of them on important questions covering the best interests of the public.

The aloofness of engineers in general from association with the lay public in helping to determine public policy and assisting in clarifying the minds of non-technical men in matters that may need at times the benefit of the judgment and imagination of the scientifically trained person, and even in cases where scientific or technical questions are not involved, would continue to keep the engineer in the background so long as that attitude is maintained.

Commercial, governmental, public as well as semi-public officials and committees would welcome the service that engineers could bring into their various deliberations on moot questions and discussions.

It is my belief that the higher cultural training for the engineer would be more apt to create in him a greater interest and understanding of public affairs and greater realization that the interest of the engineer is bound up with that of the public. He will then more frequently finds his place willingly and naturally alongside of men of other professions on directorates of large and small corporations, as heads of large industries, commercial or public organizations, and on their committees. The public in its press would soon recognize the contribution of the engineer to the general public welfare and his lack of recognition by society would no longer be a subject for consideration by the profession.

The lack of a definite constructive policy toward developing and apprenticeship for engineers and skilled labor, is a condition that today underlies a great many of our economic troubles.

In Europe it would be evident to any American engineer visiting there, how different the attitude of the public is toward the technical professions, how much more the engineer and engineering associations are devoted to an interest in public affairs, and how much they assist in formulating policies and activities. The higher cultural education generally of European engineers is perhaps accountable for this.

MAURICE DEUTSCH,
Architect and Engineer.

New York, Aug. 15.

Sir—Engineers, generally, are prone to rail at the public for not according them a proper recognition. The columns of your journal have contained many comments upon this subject by engineers who call attention to the need of educating the public along this line.

Public sentiment on this subject should not be blamed, neither will it change until the term "engineer" has a more definite signification than at present. Just as soon as the interest in civic affairs, the educational attainments, and what may be termed "polish" of engineers as a whole merit it, they will doubtless be accorded by the layman the same high status as lawyers and doctors.

The civil engineer in European countries is regarded by his countrymen as at the top of the professional ladder. The civil engineer in America is accorded by the public more nearly the status of a carpenter. There is, I believe, no other reason for this viewpoint than the fact that in Europe the public is aware the term "engineer" invariably signifies a cultured man of scientific attainments, while all too frequently, in this country, our self-styled "civil engineer" has mental attainments no higher than those of a carpenter. Unfortunately the public mind does not have sufficient opportunity to differentiate properly between the "quack" and the educated man of true technical ability.

Railways, I believe, are by far the largest employers of men engaged in engineering work in this country, and many able engineers are numbered among their employees. Too many, however, of our so-called engineers, employed on railways, are made by the following formula: Add to a preliminary survey party passing through Podunkville, a corner grocer's clerk, ornamented with a red bandana and a pair of high boots, and armed with a bundle of stakes. The following year replace his stakes with level or transit and add a smattering of engineering terms. By the end of the third year, the trick is accomplished. Is it any wonder that the public feels no awe in their presence? These men have a useful place in the world, and if they have grit enough to acquire through their own efforts and study the technical principles of engineering, let all doors be open and all hands extended to them. In the meanwhile, they have no more right to be considered engineers than have hospital attendants to be considered doctors: or law clerks, lawyers.

The greatest need of the engineering profession today in America is a curb upon the present custom of permitting

who so will to call himself an engineer, and open up upon the public. The quickest and most effective way to accomplish this end is that adopted by lawyers and doctors; i. e., requiring a license before a title can be had, or before the practice of the profession can be taken up. The various engineering societies should exert themselves to this end and offer helpful suggestions as to how it can be best brought about.

As a class, engineers are disposed to be diffident and to avoid publicity, as compared with lawyers and doctors. This is to their decided detriment in reaching their proper standing in the community, and is, in large measure, the fault of their college training. Few, if any, of our engineering institutions lay sufficient stress upon the importance of an engineer's ability to write correctly and to speak the English or any other language, or to appear at ease before an audience. In consequence, thousands of otherwise capable engineers feel handicapped, and make a bad impression when participating in public discussions. It is not sufficient that instruction along this line be given in the preparatory schools only, but should be accorded a very definite place, and its importance impressed upon the student throughout his college course.

As to attaining higher technical education, Prof. Burr's suggestions of a strictly technical course, subsequent to that of the college training is unquestionably the correct solution and is in line with the practice of European countries.

F. D. NASH.

St. Louis, Mo., Aug. 23.

---

Sir—There are two different points in the problem of engineering education which interest the engineering profession and which have to be analyzed separately:

*First:* More recognition from the public, and

*Second:* A fair compensation for the services rendered to the community.

The *first* point is attained in Europe (especially on the continent), where an engineer enjoys practically the same social standing as a doctor or a lawyer. There are two principal reasons why engineers do not get in this country the recognition to which they are entitled.

The first reason lies in the denomination "engineer" itself, which is applied both to the professional man and to the man who attends an engine. The number of the "engineers" (manual laborers) being much larger than that of the "engineers" (professional men), how can it be expected that the public has a special recognition for "engineers," when the chances are that the ordinary person, on hearing that "so and so is an engineer" will think of him as a locomotive driver?

This condition does not exist in Europe (except in England), where the professional engineer is called an "ingénieur," whereas the engineer (manual laborer) is called mécanicien, machinist," etc.

The remedy is obvious, although not easy to apply, and likely to meet with considerable opposition. It would consist in adopting a denomination which contains the root of the original word "ingenium," for instance, "ingeneers" or something similar.

The second reason is to be found in the large proportion of non-graduate engineers in this country. While many of these are excellent engineers and have great achievements to their credit, it is also true that such a condition does not exist in the medical or legal profession, and it will be readily admitted that this influences the opinion of the public for the engineering profession in an unfavorable manner. This condition does not exist in Europe (especially not on the continent) because, almost without exception, engineers are college graduates.

The remedy lies in regulations, registration, etc.

Coming now to the *second* point, which deals with a fair compensation for the services rendered, I find that here there is one aspect of the problem which seems to have been overlooked by all your correspondents so far, and which is in my opinion the most important of all.

From a business point of view, engineering services are but one of the very large variety of wordly goods which are bought and sold. As such, engineering services are subject to the universal law of supply and demand. Large demand and scarce supply, mean high prices and premiums (here adequate salaries) while scarce demand and large supply mean low prices (here insufficient salaries).

It is a recognized fact that the amount of engineers available is too high for the amount of engineering services which the world requires. This is just as true in this country as it is in Europe, where the compensation is therefore also inadequate.

This excess supply of engineers is brought about chiefly by the illusions which many young fellows have as to the conditions of the engineer's life (open air, rapid advancement, recognition, etc.). The real conditions of the engineering profession should be made perfectly clear to the young men, so that such illusions would be abandoned. A real service would thus be given, and much disappointment in life avoided, as many of them would turn to other fields of activity, for which they are very likely better fitted. At the same time, offer and demand of engineering services being more balanced, an improvement in compensation would follow.

A. J. GILARDI,
Civil Engineer.

Jackson, Mich., Aug. 17.

---

## Epes Randolph

Sir—Your journal of September 1, p. 379, carries an appreciative summary of the career of the late Colonel Epes Randolph. His ability and character were so pre-eminent, his career so striking, that the writer, a friend from the time of his young manhood, begs of you space for further tribute. The article in question outlines the salient engagements of his career, but touches all too lightly on his remarkable qualities of charm, discernment, consideration for others, and, dominating all, judgment of men, and foresight as to future events.

In the late '80's he came into the service of the Chesapeake & Ohio Ry. during the construction of its link from Huntington to Cincinnati, and there attracted the attention of C. P. Huntingdon.

It was while in charge of the line from Louisville to Memphis, that Col. Randolph, from overexertion during a strike, contracted tuberculosis, by which his activity during the remainder of his life was sadly limited.

He was carried to the Southwest, in a desperate condition from which his doctors foresaw small chance for recovery. He spent nearly a year on the edge of the Salton Desert, making recovery to the degree that he could do a certain amount of work. It is well known that it was the intention of Mr. Huntington to place Col. Randolph at the head of the Southern Pacific system, to succeed the then general manager, whose health was failing. In fact the position was informally tendered to him. The disease, however, had so impaired his strength that it was declined, and he accepted the limitations of his condition which compelled residence in the arid land.

The division of the Southern Pacific from Yuma to El Paso was put in his charge with practically a free hand, to manage it according to his own judgment. Just before the death of Mr. Huntington, conditions arose which threatened the construction by well-known copper operators, of a road paralleling a portion of the system. Certain concessions were recommended by Col. Randolph to Mr. Huntington, which probably would have been made had he lived, and should have prevented the construction of that road, which has taken many millions of traffic from the Southern Pacific.

After the death of Mr. Huntington, Col. Randolph resigned from the Southern Pacific, moved to Los Angeles, and undertook the construction, for H. E. Huntington, of the Pacific Electric system of Los Angeles and suburbs. This system was largely, if not chiefly, the vision of Col. Randolph. Under this task, his health again broke down and he returned to Arizona to recuperate.

When the late E. H. Harriman came to study the problems of the Southwest, certain recommendations of policy by Col. Randolph, on file in the New York office, were brought to his attention. He asked who Randolph was,

and bade them invite him to New York. The reply was that his health would not permit. On his next visit to the Southwest, he invited Col. Randolph to meet him and asked him to undertake services for the Southern Pacific system. One was to secure the Cananea Ry., the other to prevent the construction of the Santa Fe system up the Gila River. In both of these he was successful. He was then placed in charge of all the subsidiary lines of Arizona controlled by the Southern Pacific Ry.

About this time the break in the Colorado River occurred. The river turned into the Salton Sink and threatened, unless halted, not only to fill that depression, forcing the Southern Pacific line west of Yuma to a new location above sea level along the foothills, with its saw-tooth profile, but to destroy the possibility of cultivation of the Imperial Valley which even at that time had a large and growing population. The California Development Company threw itself into the hands of the Southern Pacific, as the only organization with power to meet the crisis. Mr. Harriman demanded the property be put in the hands of Col. Randolph, as his representative, and entrusted him with the gigantic task of closing the break.

He made several attempts, resulting in failure. Many engineers, including those of influence in the Southern Pacific system, questioned the possibility of success. Col. Randolph maintained that it could be done, Mr. Harriman almost alone sustained his judgment. The outcome was that, with the help of every quarry on the Southern Pacific system for 300 miles east and west of Yuma, by the use of almost the entire flat car equipment and its bridge and pile-driver staff, Col. Randolph, after his preparations were made and trestles driven, closed, in three days, a stream 1,100 ft. wide, 34 ft. deep in the middle, flowing at the rate of 4½ miles an hour, and turned the Colorado River back into its old channel to the Gulf.

During this time Col. Randolph suffered an attack of his old trouble. One of the dramatic pictures of the engineer's life is that of him, with temperature at 102½, lying in his car on a siding at the end of the trestle, supervising the work until it came to success. It is needless to say that such success still further confirmed Mr. Harriman's confidence in Col. Randolph's judgment.

About this time, a renewed offer was made by the Mexican government to the Southern Pacific to build a line down the west coast of Mexico. This had been Col. Randolph's vision and he advised it. As a result, it was undertaken by Mr. Harriman and has been constructed, save for the gap of less than 100 miles where the Sierras must be climbed from Tepic. It has met a disastrous experience, due to the revolutions of the past ten years, but it holds a domination of the Pacific Coast of that country with which nothing can interfere, and ultimately when stability reaches that troubled land, will be of great value.

These be some of the salient and dramatic episodes in his career. It is almost impossible to picture his human qualities, with the wonderful judgment of men. There was in him at all times a sympathy for those who needed help, which made him sometimes a victim, but which in the aggregate left as his debtors and friends many, many men scattered throughout the whole Southwestern country. He was at no place and at no time without friends at his command. Curious episodes of service rendered to him without even knowledge on his part of whence the favor came, could, but may not, be told.

As the writer in your issue of September 1 has said, the remarkable thing about him is that his great work was done when he was physically impaired. For nearly thirty years he was a weakened victim of tuberculosis, incapable of any continued physical exertion, compelled by his condition to yield the utmost attention to his limitations and yet carrying on with indomitable spirit, and a brain seething with vigor and initiative. He held vision and judgment equalled by few. But for the limitations of body, his field of activity would have been larger, his name would have been known beyond his profession, but he would have left no more cordial friends and no warmer place in the hearts of those who knew him.

St. Louis, Sept. 8, 1921. PHILIP N. MOORE.

## Moving a Wireless Tower

Sir—In an article in *Engineering News-Record*, Sept. 8, p. 420, which describes the moving of a wireless tower 200 ft. high at Fort Sam Houston, the writer, Lieut. A. T. Colwell, Corps of Engineers, omitted to mention that the tower was moved by the Construction Service of the Quartermaster Corps on duty at that station.

CONSTRUCTING QUARTERMASTER.

Fort Sam Houston, Texas, Sept. 17.

## Wood and Cast-Iron Pipe

Sir—I can readily understand your motive in writing the editorial note, "Wood Water Pipe at Norfolk," in your issue of Sept. 8 but may I not suggest carrying the same idea a little further? "Thoughtless people" might also get the impression from Mr. Ledoux's article that tuberculation is an incurable cast-iron pipe disease and that wood pipe is to be preferred to cast-iron on this account. As a matter of fact, we all know that many waters will not cause tuberculation at all, and even where it does occur it can be remedied by cleaning the main.

Cleaning a water main that becomes tuberculated to such an extent as to seriously interfere with the flow should be part of the regular maintenance work. Furthermore, with the efficient cleaning methods now used, it is hardly fair to figure pipe discharges using a co-efficient for pipe thirty years or more old, since regular cleaning should keep this figure well down toward the ten-year value. While I have no figures at hand as to the cost of the repairs on the Norfolk main, my guess is that it would have paid for several cleanings of cast-iron pipe, and if cast-iron pipe had been used, instead of now having a patched conduit Norfolk would have one in good shape with another hundred years of life still in it. THOMAS F. WOLFE,

Secretary Cast Iron Pipe Publicity Bureau.

Chicago, Ill., Sept. 17.

## Plumber or Sanitary Engineer

Sir—I am enclosing an article clipped from a monthly periodical issued by one of the great manufacturing organizations of this country.

It is rather interesting to the engineering—I was going to write "profession," but I am growing more and more in doubt whether there *is* any such *profession*.

Perhaps you may think the article worthy of editorial comment. AN OLD CIVIL ENGINEER.

New York, Sept. 6, 1921.

The enclosure, from *The Valve World*, a house organ of Crane Co., Chicago, is an article by R. Vessey, entitled, "Let's Put It Over." It reads as follows:

"The latest state to adopt the term 'Sanitary Engineer' for plumber is Colorado. We now have Indiana, Tennessee, Minnesota and Colorado. At the latest convention of California Master Plumbers it was suggested to change the name to Domestic Sanitary Engineers, but this did not carry which is very unfortunate. Still, all things require time.

"When I suggested first the term in 1913 in an article which I prepared for the *Plumbers' Trade Journal*, I had set ten years as the time required to 'put it over,' which leaves about two and a half years to go.

"Hundreds of individual plumbers are changing from Plumbers to Sanitary Engineers in every state of the Union and in most cases they are the live wires in their community, real business men with a thought for the future, not only for their business but their families, their social standing and general uplift.

"The peculiar thing to us is that the term has been adopted by progressive states in the West and South but the East lags. Is the East going to allow the West and South to beat it to it? We hope not.

"Let us all get together and put it over 'now.'"

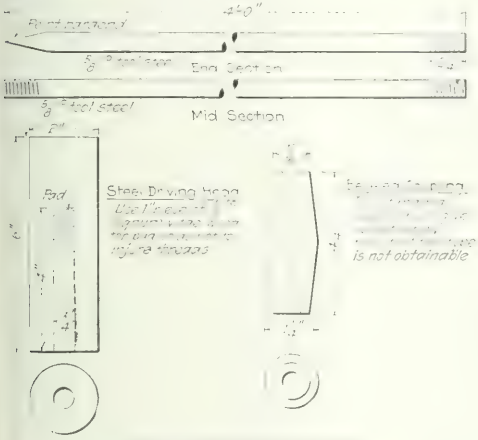
[Our comment will be very brief. It is our judgment that the Federated American Engineering Societies and the national and local engineering societies should bestir themselves and see to it that the plumbers do not "put it over." Otherwise we, the professional engineers, will shortly be nameless.—EDITOR.]

# HINTS FOR THE CONTRACTOR

## Determining Character of Subsoil With Sounding Rods

BY GEORGE E. HORR
Construction Department, Turner Construction Company, New York City

WASH borings may give valuable information regarding the nature of the subsoil when soil-bearing footings are contemplated, but the information obtained from such borings is largely negative when rock or pile-bearing footings are in question. The writer knows of one case where seven wash borings made on a building site indicated rock slightly below grade. When excavation was carried to this level it developed that in each case the wash boring had brought




DETAILS OF SOUNDING ROD

up on large boulders. The considerable expense of these borings might have been saved and just as definite information could have been obtained at small cost by using sounding rods.

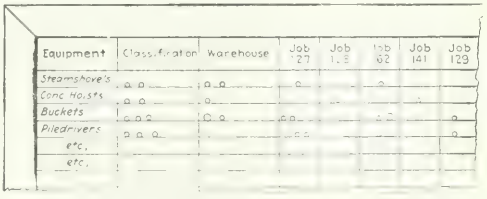
The information obtained by the use of rods is, of course, also negative, but the small cost of the equipment and the low labor cost of making the soundings seems to warrant more general use of this method for comparatively shallow explorations. Such soundings may often be made to advantage as a preliminary step before deeper borings. When piles are contemplated the results of the soundings will give valuable data regarding the penetrability of the soil and probable lengths of piles required. It is frequently possible to locate sub-surface obstructions which would not permit the driving of piles.

A satisfactory set of rods can be made of ¾-in. round tool steel consisting of one pointed-end section, as many mid-sections as may be needed to sound the desired depth, couplings, and a driving head, as indicated in the sketch. The only tools required are an 8-lb. sledge hammer, two stillson wrenches, a short piece of chain and a lever to pull the rods. The pointed section of rod is driven into the ground until almost to grade, then a mid-section is coupled on and the driving continued until another mid-section is required. When refusal is obtained, under average blows, the rod is pulled. Another sounding should be made about 4 ft. away to determine if the first might have hit a boulder. If the rod brings up only a few feet below the surface, a test pit should be dug to determine if boulders are obstructing or whether rock has been found.

Two men can make a sounding to the depth of 25 ft., including the pulling of the rods, in about one hour.

## Locating Contractors' Equipment

WITH colored thumb-tacks and a blackboard arranged as indicated by the accompanying sketch, the Dravo Contracting Co., Pittsburgh, Pa., keeps a visual equipment-location record which is useful wherever a number of contracts are in progress. A tack of a certain color indicates each type of equipment and a numeral on the tack tells the number of items of the type. These tacks are placed in the "classification" column and indicate the equipment on hand. Similar




BLACKBOARD EQUIPMENT-LOCATION RECORD

tacks in the remaining columns show the distribution. Taking, for example, buckets, the "classification" column shows three types of buckets and the numerals show, say, three of one type and two each of the other types. Two buckets are in the warehouse, one, indicated by a small tack, being in process of repair, and the other, indicated by a large tack, with repairs completed and the bucket ready for shipment. The other buckets are distributed between jobs 127, 162, and 129. On job 162 one bucket, indicated by a large tack, is no longer required and can be transferred to another job. The small tacks indicate the other buckets to be in use.

### Fast Pavement Construction in Iowa

Using an industrial railway outfit, 1,020 ft. of concrete pavement, 7 in. thick, at the sides and 8 in. thick in the center, 18 ft. wide was recently completed in 16 hours continuous run on the Lincoln Highway in Clinton County, Iowa. The mixer was kept supplied by one locomotive hauling ten cars to each train. As this portion of the highway is on an approximately 5 per cent down grade, ½ mile long, another locomotive was kept at the mixer to prevent the cars from getting away on the hill. The average haul from the material yard was one mile. Work was started at 4:30 a.m. and the header board was in and the joint finished by 9:30 p.m., with one hour lay-off, altogether, for meals. The work progressed at the average rate of 64 ft. an hour. The contractor was Koss Construction Co., of Des Moines.

# NEWS OF THE WEEK

New York, September 29, 1921

## To Aid in Solving Snow Removal Problem

### Methods and Equipment Discussed at Forum of American Society of Mechanical Engineers

A wide range of methods and machines for the solution of the snow-removal problem in New York and other cities was introduced at the meeting of the Material-Handling Section of the American Society of Mechanical Engineers in New York, Sept. 23, following a presentation of the facts in the case from the point of view of the city official by John P. Leo and John T. Fetherston, commissioner and ex-commissioner, respectively, of the New York Department of Street Cleaning, and John Kenlon, chief of the Fire Department. The meeting, at which Nathan C. Johnson presided, was the outgrowth of a recommendation for a forum on snow removal, made after last February's severe storm by Henry L. Doherty.

The discussion centered on various snow-removal devices, including mechanical loaders of the conveyor type, rotary plows adapted to municipal operations from the experience of Western railroads, and snow-melting devices.

#### Possibilities in Briquetting

A number of speakers presented plans for the briquetting of snow, the object being to reduce its volume about nine-tenths, thus enabling the material to be piled along the street so as to occupy a comparatively small area, or loaded into trucks which could, with loads of briquetted snow, more nearly operate at their ratio carrying capacities than is possible with loose snow. Mr. Doherty expressed confidence in the development of some practical scheme of briquetting snow and it was brought out in the discussion that a device of this sort had been developed 40 years ago by Thomas A. Edison.

The problem of city snow removal was tersely stated by former commissioner Fetherston when he said that answers are needed to the following three fundamental questions: (1) For what depth of fall, density, rate duration, and occurrence of snow shall the city reasonably prepare each winter? (2) What are the allowable maximums for the design of the organization and apparatus? (3) How many hours or days should reasonably be allowed for the removal of snow from the scheduled area, meantime keeping the streets free for the movement of traffic in order that the citizens of the town may judge, reasonably, of the efficiency of the organization, methods, procedure, management and apparatus?

## Memphis Club Favors Commissions for Sanitary Engineers

The Engineers' Club of Memphis has passed resolutions endorsing the bill now before Congress to commission sanitary engineers in the United States Public Health Service (H.R. 7541), noted in this journal, Aug. 18, p. 26.

The following data regarding snow in New York City were presented: The average annual snowfall amounts to 32 in. The weight of newly fallen snow varies from 6 to 30 lb. per cubic foot; compacted snow weighs from 30 to 50 lb. per cubic foot. Average snow loaded in trucks weighs 36 lb. per cubic foot. The maximum rate of snowfall is about 1 in. per hour and the average rate ½ in. per hour. The snowstorms of longest duration seldom exceed 30 hr. Between 1905 and 1914 the greatest single snowstorm had a depth of 14.5 in. In 1917-18 the New York Street Cleaning Department scheduled for snow removal 953 miles of streets with an area of 33,537,577 sq.yd. equal to a roadway 60 ft. wide extending from New York to Chicago. A 6-in. fall on this area deposits 5,500,000 cu.yd.

#### Fetherston's Recommendations

The following recommendations were made by Mr. Fetherston as a means of solving the snow problem: (1) Set up standards of quantity, quality, time and conditions as a basis for the design of organization, methods, procedure and equipment. (2) Provide personnel and apparatus to meet the conditions, and make the work attractive to available forces by offering pay commensurate with work and the results secured. (3) Assure long tenure of office to competent city officials. There have been 11 commissioners of street cleaning in New York City in 23 years.

The meeting concluded with the passage of a resolution authorizing the council of the American Society of Mechanical Engineers to appoint a committee of its members to co-operate with city officials on the snow-removal problem and the development of mechanical apparatus therefor.

### Illinois Wants Bids on 61 Bridges

**Bids will be received up to Oct. 4 for the construction of 61 bridges, involving 109 concrete and 8 steel spans, which compose the 1922 state bond issue bridge program of the Illinois Division of Highways. Three of the projects, only, are scheduled to be completed this year.**

## Calaveras Dam to Be Raised to Height of 175 Ft.

Work on the Calaveras dam of the Spring Valley Water Co. in California has recently been resumed in accordance with an order of the California Railroad Commission. At its present height of 85 ft. the dam stores 8,000,000,000 gal.; when raised to 175 ft. it will impound 43,000,000,000 gal. and will increase the available daily supply of San Francisco by 24,000,000 gal. The present work is of a preparatory nature. The method to be used in handling and depositing the material has not yet been decided.

## No Danger of Settlement of Lincoln Memorial

Published reports that the Lincoln memorial at Washington, D. C., is threatened by subsidence are denied emphatically by Colonel C. O. Sherrill, in charge of public buildings and grounds. Colonel Sherrill states that there has been no difficulty whatever with the memorial itself. It rests on concrete piles, which were carried down 50 ft. to bed rock. The entire area occupied by the monument and grounds was filled hydraulically. The land had not consolidated completely at the time the memorial was erected and in an effort to keep within the appropriation, the foundations of the approaches to the monument were not carried to bed rock. After their completion, settlement was noticed and work now is in progress to extend their foundations to a permanent stratum.

## Tractive Resistance Data Wanted

The committee on economic theory of highway improvement of the National Research Council, through Major Mark L. Ireland, Quartermaster Corps, U. S. Army, has sent out a request for data on the tractive resistance of roads. Bibliographies or experimental data on the following subjects are desired: Tractive resistance of roads; manner of energy absorption in motor vehicles; gasoline consumption of various vehicles on various roads; scientific testing of automobiles; economics of highway transportation.

The research, which is to be undertaken through a combination of War Department interests and those of the Massachusetts Institute of Technology, will be confined, for the present, to determining the tractive resistance of concrete surfaced highways to 1½ and 3-ton gasoline trucks. Information may be sent to Major Ireland, c/o Electrical Engineering Department, Massachusetts Institute of Technology, Cambridge, Mass.

## Milwaukee To Ask Bids on Activated Sludge Plant

**Plans to Award Lump-Sum Contract for Sewage Works in December**

Proposals for building the concrete aeration and sedimentation tanks for the activated-sludge sewage disposal plant now being constructed by the Sewerage Commission of Milwaukee will be asked soon with the expectation of awarding contracts in December.

As planned the work consists of 24 aeration tanks, 237 ft. 8 in. long, 45 ft. wide and 16 ft. 7 in. deep; 11 sedimentation tanks 98 ft. in diameter and 16 ft. deep, and 4 sedimentation tanks 43 ft. 4 in. in diameter and 16 ft. deep, all of reinforced concrete. There will also be 1,440 lin.ft. of pipe galleries 17 ft. wide by 13 ft. high, of brick construction, and conduits, piping, sluice gates, valves, meters and miscellaneous equipment. About 5,000 tons of steel reinforcing rods; 62,000 cu.yd. of concrete; 80,000 filtros diffusion plates, and 42 meters will be used on the work, together with a large quantity of cast-iron pipe, from 66 in. to 10 in. in diameter, and galvanized-iron pipe and fittings, from 2 in. to 1 in. in diameter.

LUMP-SUM BASIS

The work is to be done on the lump sum basis, the Sewerage Commission furnishing the steel, cement, brick, cast-iron pipe, meters, valves and sluice gates. Pile foundations have been provided for the tanks so that the preliminary preparation work is largely eliminated.

All plans have been prepared with a view of simplifying construction by means of uniform concrete forms, so far as these may be possible. Railways and boats reach the site of the work, which is so located as to be free from all municipal transportation difficulties.

At the present time contracts amounting to $2,233,600 have been awarded for the disposal plant construction, and, including the work described above and other work to be contracted during the next 18 months, this sum will be increased about $5,000,000. T. Chalkley Hatton is chief engineer.

## Engineer Registration Board for Pennsylvania Appointed

Governor Sproul, of Pennsylvania, on Aug. 24, announced the following appointments to the state board for the registration of professional engineers and land surveyors: Richard L. Humphrey, consulting engineer, Philadelphia; Henry S. Drinker, Lehigh University, South Bethlehem; William McClellan, consulting engineer, Philadelphia; A. B. Clemens, International Correspondence Schools, Scranton; Samuel D. Foster, consulting highway engineer, Pittsburgh. In the order above named the new members of the board will serve respectively 5, 4, 3, 2, and 1 years.

## National Drainage Congress Meets in St. Paul

At the tenth annual meeting of the National Drainage Congress, held in St. Paul, Minn., Sept. 22-24, resolutions were passed urging more adequate state protection of settlers on reclaimed lands and the improvement and simplification of state laws affecting drainage and other forms of reclamation.

Dr. F. H. Newell, of Washington, D. C., in an address on colonization of reclaimed lands, stated that while many millions of dollars have been spent for reclaiming lands by drainage, irrigation and clearing, the most fundamental activity of all, that of properly selecting and caring for settlers, is still shamefully neglected.

Clark E. Jacoby, of Kansas City, Mo., newly elected president of the organization, advocated reclaiming through private enterprise, instead of state or federal aid.

If artificial drainage of swamp lands in Minnesota is continued, said J. N. Ryker, government meteorologist, the Mississippi River will soon lose most of its value for navigation unless locks and dams are installed at intervals to control the water.

Drainage projects, by carrying off water from the subsoil and natural reservoirs, prevent the ground from holding water and giving it off gradually, according to Mr. Ryker. The result is that rains are carried off into streams at once, causing abnormal floods for the time being, and abnormally low water afterwards.

Drainage experts attending the congress did not deny the truth of Mr. Ryker's statements, but held to the theory that the benefits resulting from drainage outweigh the damages.

## Fall Letting of Highway Contracts for New York State

*THE principle of letting contracts for the 1922 highway program this fall has been accepted by the New York State Commission of Highways. "Engineering News-Record" has received from Commissioner Herbert S. Sisson the following official statement of policy:*

**"I have your letter of the 19th. We expect to let something less than 50 per cent of the contracts for highway construction during the season of 1922 this Fall. We would be glad to to contract for the full construction program for next season as soon as possible, but owing to the fact that no appropriations are available for at least 50 per cent of the work to be done next year, we must wait until the Legislature makes an appropriation necessary for construction work. Our Legislature convenes on or about Jan. 1, and I believe will provide funds for highway construction very early in the session.**

**"We hope to be in a position to contract for our entire 1922 program on or before May 15."**

## Col. Keller Heads Capital's Engineering Department

**Succeeds Col. Kutz as Engineer-Commissioner of District of Columbia**

Col. Charles Keller, Corps of Engineers, U. S. Army, has been appointed by the President, acting upon the recommendation of Major-Gen. Lansing H. Beach, Chief of Engineers, to be engineer-commissioner of the District of Columbia, succeeding Col. Charles W. Kutz. The duties of this position are practically those of city engineer, in addition to participation in administering the affairs of the district as a member of the board of three commissioners. Col. Keller's most recent detail has been in the office of the Chief of Engineers at Washington, where he has devoted a considerable part of his time to studies of port and waterway problems, having served, also, as a member of the War Department's board of engineers for rivers and harbors. During the World War he served in France, with rank of brigadier-general, as assistant to Major-Gen. William C. Langfitt, chief engineer, A. E. F., being station first at Tours and later at General Headquarters at Chaumont, where he acted as the chief engineer's representative in relations with the General Staff. He is generally regarded as one of the ablest engineering executives in the Corps.

Col. Keller is a native of New York and was graduated from the U. S. Military Academy in 1890. He has filled many important engineering positions with the Corps of Engineers in this country, in addition to his service in the Philippines and in France. During the last two years he has represented the State Department in negotiations with the Canadian Government regarding boundary waters. He is a holder of the Distinguished Service Medal and was decorated by the French Government with the Legion of Honor. His citation for the Distinguished Service Medal reads as follows:

"For exceptionally meritorious and distinguished service. As assistant to the Chief of Engineers, U. S. Army, he was instrumental in initiating policies which protected the channels and anchorages of our important harbors from observation by enemy aliens. As power administrator on behalf of the United States he organized the Power Section of the War Industries Board and initiated measures as a result of which the war program of the country was successfully protected against serious delay due to power shortage."

## Cantilever Bridge for Australia

The cantilever bridge which is proposed to span the neck of the harbor at Sydney, New South Wales, is to have a span of 1,600 ft. c. to c. of piers, according to a statement issued by the Harbor Trust Commissioners. Both cantilever and anchor arms will be 500 ft. long, the former carrying a 600-ft. suspended span. A clear head room of 140 ft. above the water will be provided. There will be four tracks for electric suburban trains, a 35-ft. roadway for ordinary vehicles, and 18-ft. roadway for automobiles and a 15-ft. sidewalk. The maximum live load will be equivalent to about 11,000 tons. This bridge in relation to the rapid-transit system of the city of Sydney was described in *Engineering News-Record*, July 8, 1920, p. 56.

## F. T. Sheets Named Head of Illinois Highways

**New Executive, 31 Years Old, Started Work With Department in 1907 as Engineering Clerk**

Frank T. Sheets, until recently engineer of design in the Division of Highways, Illinois Department of Public Works, has been promoted, through appointment by the Governor, to the position of superintendent of highways formerly held by S. E. Bradt, who has resigned to devote his time to private interests in DeKalb. At the age of 31 Mr. Sheets thus becomes the administrative head of the state highway organization which has already completed more than 1,200 miles of high type pavement and is finishing its connected system of state roads, with a bond issue program of $60,000,000 to be carried out.

Following his graduation from the University of Illinois in 1914, Mr. Sheets was appointed assistant engineer in the Illinois State Highway Department, with which he had previously been connected in various subordinate engineering capacities prior to his entry into college and during his summer vacations. Mr. Sheets has come up through the ranks to his present position, having started work with the department in 1907 as an engineering clerk. Since that time his duties have related to practically every feature of state highway engineering, including surveys, design of reinforced-concrete and steel bridges, superintendance of day labor and maintenance. Since June, 1919, in his capacity of engineer of design, Mr. Sheets has supervised the work of the offices of road engineer, bridge engineer, and nine district engineers of the highway division on location, surveys, plans, estimates, specifications and contracts for work amounting to about $35,000,000.

## Changes Affecting Organization Made by A. G. C.

Several changes affecting the organization of the Associated General Contractors of America were made by the executive board at the recent meeting at White Sulphur Springs, W. Va.

The revisions provide among other features, for: (1) Membership through local chapters; (2) state or construction area divisions to be known as "branches"; (3) a new schedule of dues favoring the contractor doing an annual business of less than $500,000; (4) an increase of the board of directors from 12 to 19 and election by territory.

In addition to these resolutions, the board recommended that the committee on organization take under advisement a plan creating a junior membership with limited privileges, which would include general contractors not now eligible for membership in the A. G. C., and superintendents.

## Metropolitan Water District for Twin Cities Opposed

Opposing the proposal to form a metropolitan water district for Minneapolis and St. Paul, John W. Kelsey, general superintendent, Bureau of Water, St. Paul, in the September *Bulletin* of the Minnesota Federation of Architectural and Engineering Societies, concludes that since both cities must obtain their water from the Mississippi River there is little economic or physical reason for combining the two systems.

St. Paul plans to tap the Mississippi River four and a half miles north of the Minneapolis intake and pump water by conduit to Charles Lake, a tributary to Pleasant Lake, one of the existing impounding reservoirs. This scheme eliminates duplicate conduit and pumping machinery and also makes use of the lakes as a sedimentation basins.

## City Classification an Issue in Appeal for Road Funds

Of direct interest to smaller cities of the state of Washington and to all others in relation to apportionment of state highway maintenance funds within the corporate limits of first and second class cities, is a recent decision of the Supreme Court that third-class cities do not automatically become second-class cities simply by adopting the commission form of government. Further compliance with statutory procedure is necessary in the holding of an election and completion of all formal requirements involving the transfer of classification.

The ruling is made in denial of a writ of mandate petitioned for by the city to Yakima to compel the state auditor to apportion that city $500 per mile for highway maintenance, under the maintenance statute, instead of $300 as fixed for third class city apportionment. Yakima relied upon its adoption of commission government for its admission into second-class rating and the consequent $500 apportionment.

## Roadmasters and Engineers Talk on Track

**Budget System for Maintenance Work—Economy of Treated Ties—Curve Lining**

Real discussions in which many members described their own methods and expressed opinions freely featured the annual meeting of the Roadmasters and Maintenance of Way Association, held in Chicago Sept. 20 to 23, W. P. Wiltsee, assistant engineer, Norfolk & Western R.R., presiding. C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., strongly advocated the budget system in distributing appropriations for track maintenance, classifications of work and records of unit costs.

### Tie Service Records

Records covering thousands of ties in many states, presented by J. H. Waterman, superintendent of timber preservation, C., B. & Q. R.R., show that where from 1 to 20 per cent of treated ties have been removed on account of decay, the renewals of untreated ties of the same woods have been from 70 to 100 per cent. Where certain untreated ties had a life of from 2 to 6 years, treated ties of the same wood are still in use after 20 years' service. For tie renewals a force of eight men or less is preferable to a large gang, according to the report of a committee headed by E. P. Hawkins, division engineer, Missouri Pacific R.R.

Track crossings with single-piece castings of manganese steel and having a concrete slab allowing for 8 to 10 in. of ballast were recommended for heavy-traffic main lines in a report by D. O'Hern, E., J. & E. R.R. Longitudinal plates under rails carrying the heavier traffic were considered preferable to corner plates under rail intersections, as the latter interfere with proper tamping.

### String Lining for Curves

Different methods of string lining for curves, in order to take out irregularities, were submitted by H. L. Pierce, supervisor, Pennsylvania R.R. His address was accompanied by tables showing the amounts of throw required at different points to move the curve in and out to its true position. As a result of investigation the Pennsylvania R.R. has adopted a rule that the alignment of curves should be maintained by means of the string method. Classification and distribution of second-hand rail was reported on by a committee headed by L. E. Sale, supervisor, Pennsylvania R.R. Reports and accounts for the roadmaster's office were presented by F. J. Meyer, assistant engineer of the N. Y., O. & W. R.R.

The new president is L. M. Denney, supervisor of the C., C., C. & L. Ry. at Indianapolis, Ind. It was voted to hold the next annual meeting of the associatoin in Cleveland, the date to be announced later.

## To Visit Sanitary Works in and Near New York City

Inspections of various sanitary engineering works in and near New York City, together with addresses on water-supply, sewage and garbage disposal, are a part of the program of the Public Health Institute, Nov. 8-12, the week preceding the fiftieth annual convention of the American Public Health Association in New York City. Opportunities to gain information in other fields of public health work will also be afforded by the Institute. Enrolments, open to non-members as well as members of the A. P. H. A., may be made with Dr. H. B. Armstrong, director of the Institute, 370 Seventh Ave., New York City. An enrolling fee of not more than $10 will be charged. Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City, is chairman of the Institute's committee on sanitary engineering.

## Bar Association Favors Increased Pay for Patent Office Force

At the recent meeting of the American Bar Association in Cincinnati, substantial salary increases for examiners in the U. S. Patent Office were recommended. Resignations of a large number of experienced examiners are due solely, it was claimed, to the present insufficient salaries. To meet the increased cost the association recommended raising the fee for filing applications for patents from $15 to $20.

## No Reduction in Canadian Freight Rates for Present

The Canadian Board of Railway Commissioners has decided that there will be no general reduction of freight-rates at present. Two reports, one by Chief Commisisoner Carvell and Commissoner Nantel, recommended a general reduction of 10 per cent, except in cases where the rates had been already lowered. The majority report of the three other members of the board opposed any reduction at present, since the question of wage decreases is the pivotal one in considering a lowering of operating cost. As the wage question is now under investigation by a special tribunal, the railroad commission does not feel justified in recommending a reduction in freight rates.

## N. J. Publishes Highway Bulletin

The New Jersey State Highway Department has begun the publication of a monthly bulletin, named "The Highwayman." Its object is to "build up the double-barreled spirit of co-operation and healthy competition within the department" and to keep the public informed of the state's road building activities. The first issue is a four-page illustrated folder, with an insert listing the detours adopted by the department July 6. Its contents includes biographical sketches of Thomas J. Wasser, state highway engineer, and George L. Burton, chairman of the commission.

## Rainfall and Runoff Is Subject of Am. Soc. C. E. Meeting

Rainfall and runoff has been selected as the subject for the next regular business meeting of the American Society of Civil Engineers to be held at the Engineering Societies' Building, New York City, Oct. 5, at 8 p. m. The discussion will be upon papers published in the September Proceedings, including "Rainfall and Runoff," by C. E. Grunsky; "The Flood of June, 1921, in the Arkansas River at Pueblo, Colo., by James Munn and J. L. Savage; and "The Recent Flood at San Antonio, Tex.," by C. Terrell Barnett.

The result of the ballot on proposed amendments to the constitution of the society will be canvassed at this meeting.

## To Reconsider Highway Bill

*The first meeting of the conferees of the Senate and of the House of Representatives to take up the reconciliation of the differences between the highway bill passed by the House and that passed by the Senate will be held during the week of Oct. 3.*

## Grand Trunk Stocks Worthless, Arbiters Declare

None of the issues of the common and preferred stock of the Grand Trunk Ry. and the Grand Trunk Pacific is of any value, according to the opinion of the majority of the Grand Trunk arbitration board in its decision given out at Ottawa, Sept. 7.

The majority report charges that dividends were declared and paid but not earned, such moneys in reality being due for claims owed the government. It is held that this has destroyed "any value to be derived from stock market quotations."

The decision involves stock issues of par value aggregating £37,073,492. It is expected that the railroad will exercise its right of appeal.

## Propose Water-Rail Terminal in Gulf of California

A party of railroad and harbor engineers, accompanied by divers, have been engaged in making a study of a proposed rail and water terminal at Rocky Point in the northwestern portion of St. George's bay, Gulf of California, which is about 100 miles north of Guaymas, according to reports received at San Francisco from the American Consul at Guaymas, Sonora, Mexico. A terminal at this point, if served by an extension from the present terminus of the Tucson, Cornelia & Gila Bend R.R. at Ajo, Ariz., would provide a much needed western outlet for products of Arizona copper mines. The proposed tidewater terminal at Rocky Point would be only 105 miles from Ajo and it is claimed that a railroad could be located over this distance with a grade of less than 1 per cent.

## Col. Patrick New Chief of Army Air Service

### Engineer Officer, With Distinguished Service Record in France, to Be Major-General

Col. Mason M. Patrick, Corps of Engineers, U. S. Army, who, during the war, was chief of the Air Service of the A. E. F., has been selected by the Secretary of War to be director of the Army Air Service, with rank of major-general which he had previously held in France.

Gen. Patrick was graduated from the U. S. Military Academy in 1886 and, prior to the war, served on several important assignments as engineer of river and harbor projects and as commandant of the Engineer School at Washington Barracks. He was chief engineer of the army of Cuban pacification, 1906-8, and served in the Brownsville district in 1916. Gen. Patrick was a member of the engineer board which was charged with the raising of the battleship "Maine" in Havana harbor, a work which involved the construction of a huge cofferdam made up of earth-filled cylinders of steel sheet-piling.

The War Department has issued an official statement regarding Gen. Patrick's appointment from which the following extracts are taken: "Gen. Patrick is selected for this important position by reason of the special qualifications for it which he demonstrated as chief of the Air Service of the A. E. F. and because of the exceptional ability as an executive and organizer which he has shown in other important capacities."

Prior to his assignment to the Air Service in France, Gen. Patrick served with distinction as the chief engineer of the line of communication and later as director of the Division of Construction and Forestry, a post in which he was succeeded by Brig.-Gen. Edgar Jadwin. At the time of the armistice Gen. Patrick had under his direction a personnel of about 78,000 men. Among his prominent achievements in France was the development of the great air service production center at Romorantin. He received the Distinguished Service Medal and a number of citations from foreign governments, including the French Legion of Honor and the Order of the British Empire. Gen. Patrick's most recent detail has been in command of the Engineers School at Camp Humphreys, Va.

## Am. Soc. C. E. Has 10,115 Members

The total membership of the American Society of Civil Engineers on Aug. 2 was 10,115.

### A. G. C. Upholds Awards Board

A resolution was passed at the mid-year meeting of the executive board of the Associated General Contractors of America upholding the action of the National Board for Jurisdictional Awards regarding hollow metal doors and trim, and hollow metal window frames and sash, a decision which was taken exception to by the brotherhood of carpenters. The attitude of the carpenters in not adhering to the award board's ruling has been condemned by the A. G. C. in resolution form. It is investigating the possibility of initiating legal action against the carpenters or its members in connection with the actions in disturbing the building industry on account of the above-referred-to award.

### H. G. Shirley Heads A. A. A. Good Roads Board

Henry G. Shirley, county engineer of Baltimore County, Md., and until recently secretary of the Federal Highway Council, Washington, D. C., was appointed last week chairman of the good roads board of the American Automobile Association, succeeding George C. Diehl, who recently became president of that organization.

## Engineering Societies

### Calendar

**Annual Meetings**

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind., and Chamberlain, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

**The Cleveland Engineering Society** at its meeting, Oct. 11, will be addressed by D. C. Wills, chairman Board, Federal Reserve Bank, on "Prices—Past, Present and Future."

**The California Section, American Water-works Association,** will hold its annual convention in Los Angeles Oct. 1 and 2. The morning and afternoon of the first day, Saturday, will be devoted to papers and discussions. The annual dinner will be held Saturday night and will be followed by a paper by William Mulholland, chief engineer of the Los Angeles Water Department on "The Los Angeles Water Supply and Distribution." On Sunday there will be an all-day automobile trip to points of interest on the Los Angeles water system.

**The Oklahoma Section, Am. Soc. C. E.** will hold its annual meeting in Oklahoma City, Oct. 26-27, in connection with the annual meeting of the Oklahoma Society of Engineers and the [illegible] Engineering Council.

## Personal Notes

J. B. BENNETT, has been appointed county engineer, Pottawatomie County, Okla.

S. E. BRADT, superintendent of highways, Division of Highways of the Illinois Department of Public Works and Buildings has resigned after eight years' service. During this period the good roads movement has been put on a sound financial basis largely through the efforts of Mr. Bradt, who is a banker from DeKalb.

FRANK T. SHEETS, engineer of design, Illinois Division of Highways, has been made superintendent of highways, succeeding S. E. Bradt, resigned. Further details regarding Mr. Sheets' service with the department appear elsewhere in this issue.

OSCAR E. BRENOT, formerly with the engineering bureau, Pennsylvania Highway Department, has formed a partnership with Joseph Brenot, architect, Oil City, Pa.

F. W. ULLINS, JR., city engineer of Shorewood, Wis., has been appointed the third member of the Metropolitan Sewerage Commission of Milwaukee County. The other members are Charles B. Perry and George P. Miller.

SMITH & REYNOLDS, formerly Juul, Smith & Reynolds of Sheboygan, Wis., have opened an architectural and engineering office in Manitowoc, Wis. Edward A. Juul will continue the business formerly conducted by the firm in Sheboygan.

D. WALTER MUNN, head of the department of engineering at Royal Military College, Kingston, Ont., has resigned to become professor of engineering at Nova Scotia Technical College, Halifax, N. S.

GEERT BLAAUW has accepted a position with the Alabama Power Co., Birmingham, Ala., in connection with the design of a 120,000-hp. hydro-electric plant to be constructed on the Coosa River near Duncan Riffles.

A. M. OCKERBLAD, for the past two years professor of civil engineering in the New Mexico School of Mines, at Socorro, N. Mex., has been appointed assistant professor of civil engineering, University of Kansas, Lawrence, Kan.

JOSEPH M. SMOOT, formerly designer and draftsman in the construction department of the Stonega Coke & Coal Co., Big Stone Gap, Va., has been appointed aid with the U. S. Coast and Geodetic Survey and is now located in Wisconsin.

PITTMAN-SMITH ENGINEERING CO., Pittsburgh, Pa., was recently organized by E. W. Pittman and H. P. Smith to engage in the design of power plants, machinery layouts and all types of industrial buildings. Mr. Pittman and Mr. Smith were formerly general manager and chief engineer, respectively, for the engineering works department of the Dravo Contracting Co.

EDWARD C. SCHMIDT, associate professor of railway engineering at the University of Illinois for 11 years up to 1917, when he resigned to enter military service as major, Ordnance Department, has been appointed professor of railway engineering and head of that department. From 1919 to the present time he has been mechanical engineer for the North American Co.

HARRY G. COUTTS, formerly superintendent for John Griffiths & Son Co., Chicago, is now superintendent for the Longacre Engineering & Construction Co., Chicago, on the new Harris-Selwyn theaters, Chicago.

DANIEL L. TURNER, consulting engineer to the New York Transit Commission, formerly chief engineer of the Transit Construction Commission, New York, in charge of the design and construction of the subway system, and associated for 21 years with the development and construction of the New York subway system, has announced his intention of engaging in private consulting practice, specializing in city transit work, in addition to his present duties with the commission.

S. M. MERCIER, formerly engineer for the Columbus branch of the Building Products Co., has been given charge of the Dayton, Ohio, branch of this company.

E. E. TRUEBLOOD, for 15 years engineer with the Missouri Valley Bridge & Iron Co., has been appointed county engineer, Douglas County, Kan.

H. R. HOLMES, at one time engineer with the New York State Highway Commission, has been appointed city engineer of Lockport, N. Y.

H. B. TITCOMB has been elected president of the Southern Pacific R.R. of Mexico, succeeding the late Colonel Epes Randolph. For several years Mr. Titcomb has been in charge of the Pacific Electric Railway system in Los Angeles with the title of vice-president. Previous to that he was for many years in the engineering department of the Southern Pacific R.R. Co.

## Obituary

FRANK E. PATTON, secretary and treasurer of the T. J. Lane Equipment Co., Springfield, Ohio, since its organization, died Aug. 21.

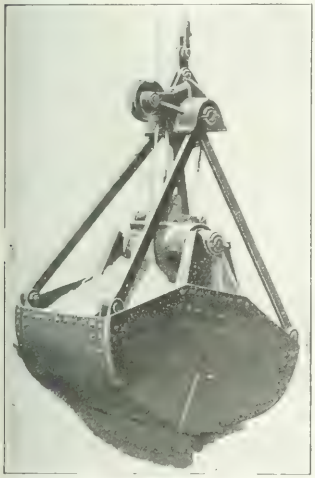
HENRY J. KIMMAN, since 1902 manager of the Cleveland plant of the Chicago Pneumatic Tool Co., died in Cleveland, Sept. 7. He was born in Harlem, Holland, in 1863, and went to Chicago in 1870. He served with the Adams-Westlake Co. and other manufacturing concerns in Chicago and the Far West. He designed and, in collaboration with his brother, built the first practical portable piston air drill

known as the Little Giant. Soon after engaging in the manufacture of air drills he became associated with E. N. Hurley and they formed the Standard Pneumatic Tool Co. in 1898. He became associated with the Chicago Pneumatic Tool Co. in the consolidation of pneumatic tool interests in 1901, at which time he became manager of the Cleveland plant and remained in charge of the plant until his death.

# EQUIPMENT AND MATERIALS

## New Clamshell Bucket

The Brown Hosting Machinery Co., of Cleveland, is putting on the market a line of clamshell buckets made in ¾, 1, 1½ and 2-yd. sizes. They are equipped with manganese steel digging edges

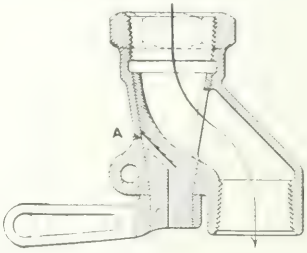


which can easily be replaced when worn. One of the features of the design is that it has few parts and that these are easily accessible so that repairs can be made on the job when necessary.

The company has for a great many years been building large capacity buckets, up to 15 to 20 tons capacity, for use in connection with ore-unloading machinery, bridge cranes, etc., and this experience has been called upon in the design of the new bucket.

## Pressure-Seated Air Valve

In this valve, made for general air service, two features are emphasized by the manufacturers: (1) The air does not come in contact with the valve seat—thus avoiding replacement of seat—while (2) the air pressure itself is used as a seating agent to hold the valve plug on its seat—thus eliminating packing, gaskets, stems, and spring. The valve parts are reduced to three—body, plug, and handle. The design is shown in the accompanying sketch. The plug is hollow and the air thus has an unobstructed passage. The air port *A*, when the valve is closed, allows the air trapped in the hose to escape, thus avoiding the blowing of grit or scale into the operator's eyes




when disconnecting the hose from the valve.

The manufacturers, the Cleveland Pneumatic Tool Co., of Cleveland, Ohio, report successful use in severe service under pressures as high as 500 lb.

## Power Stump Saw

This power stump saw has been developed for use chiefly in those sections where the value of the land is too low

to warrant the cost of blowing out the stumps or where the use of explosives is undesirable. It cuts close to the ground. The device is mounted on a sled frame, and the platform revolves so that the saw is readily fed through the stump. The machine is built by the Hamilton Stump Saw Co., of Harrisburg, Ark.

## New Four-Wheel Trailer Tracks Properly with Trucks

Unusually complete control, from the truck, of four-wheel trailers, is secured by the draw bar and steering arrangement illustrated. By means

of the long steering arm the trailer is kept always in the path of the truck. In addition, control in backing and turning is improved by providing for the attachment of the steering arrangement to the drawbar, when the trailer moves forward, and with the axle, in a locked central position, when it is backed up; also when backing up, the front wheels of the trailer are locked at right angles to the axle, while the drawbar is disconnected from the steering arrangement and receives nothing but the rearward push of the truck for the purpose of moving the trailer backward.

The trailer is manufactured by the Warner Manufacturing Co., of Beloit, Wis.

## Tram System for Window Washing

At the new Division St. pumping station of the Cleveland water-works a tram system is provided for safe and economical washing of the very large window area.

As is indicated in the illustration, a rail is carried around the building

under the cornice and on this is operated a light hand-propelled tram supporting a cage which can be raised and lowered by two small hand winches. The absence of heavy supports bracings, and rods renders the construction inconspicuous, so that it does not detract from the appearance of the building.

It is estimated that with this outfit three men can clean the windows in twelve days, two men being in the cage and the third bringing water and otherwise attending the window washers. At the rate of 60c. an hour the cost for the entire job would figure $172.80, whereas with the use of scaffolding it is estimated that the cost would be about $800.

The installation can also be used for painting window frames and spouting, and for other light exterior repair work.

The installation was put in by the Electric Tram Rail Division of the Cleveland Crane & Engineering Co., of Wickliffe, Ohio.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Public Bond Sales of July and August

To give a line on how much communities must pay for money for public improvements *Engineering News-Record* will publish regularly in the second issue of each month a representative list of bond sales throughout the United States. Just now, bond sales are exceptionally heavy, the total for July being $103,299,831, and for August $106,291,852, according to the *Chronicle*. Sales for August 1920 and 1913 were $59,684,048 and $19,822,191, respectively. The following partial list of actual sales sketches the general situation:

PUBLIC BOND SALES OF JULY AND AUGUST, 1921

| State | Purpose | Amount | Maturity Date | Rate | Sold for per Cent | Dated |
|---|---|---|---|---|---|---|
| Oregon | Highways | $2,000,000 | 1926–1946 | 5½ | $100 147 | Aug. 1, 1921 |
| Maine | Bridges and highways | 1,750,000 | $100,000 (1927–31) $125,000 (1932–41) | 5 | 98 147 | Aug. 1, 1921 |
| Wyoming | Highway | 1,800,000 | 1931–1941 | 5 | 100.00 | Sept. 1, 1921 |
| Michigan | Highways | 3,000,000 | 1922 | 6 | 100.00 | July 1, 1921 |
| Washington | Highways | 3,000,000 | 1926–1940 | 6 | 101.538 | July 6, 1921 |
| Delaware | Highway | 600,000 | 1961 | 4½ | $300,000 –90.00 300,000– 87.27 | Jan. 1, 1921 |
| County | | | | | | |
| Defiance, Ohio | Road | 292,000 | 1922–1930 | 6 | 100.00 | June 1, 1921 |
| Pennington, S. Dak. | Courthouse and jail | 500,000 | 1941 | 6 | 100.00 | July 1, 1921 |
| Polk, Neb. | Courthouse | 125,000 | 1926–1936 | 5½ | 99.148 | Jan. 1, 1921 |
| Lawrence, Pa. | Highway | 400,000 | 1922–1936 | 5½ | 100.419 | July 1, 1921 |
| St. Charles, Mo. | Road | 200,000 | | 5 | 95.23 | |
| San Joaquin, Cal. | Reclamation | 55,950 | | 6 | 97.50 | July 1, 1920 |
| Sumter, Ala. | Road and bridge | 75,000 | 1950 | 5 | 80.00 | Feb. 1, 1921 |
| Wyoming, N. Y. | Highway | 176,000 | 1923–1944 | 5½ | 100.683 | Aug. 1, 1921 |
| Columbia, Fla. | Road | 100,000 | 1922–1947 | 5 | 90.00 | Dec. 1, 1917 |
| Municipality | | | | | | |
| Akron, Ohio | Sewer | 500,000 | 1922–1951 | 6 | 101.78 | July 1, 1921 |
| Baltimore, Md. | City improvement | 2,348,000 | 1922–1935 | 5 | 96.51 | |
| | Water | 1,929,000 | 1929–1937 | 5 | 96.51 | |
| Camden, N. J. | Sewer | 224,000 | 1922–1959 | 5 | 100.922 | Aug. 1, 1921 |
| Cincinnati, Ohio | Street railways | 1,000,000 | 1942–1967 | 5½ | 101.177 | |
| Colorado Springs, Colo. | Paving | 200,000 | 1924–1936 | 5 | 93.816 | Apr. 1, 1921 |
| Hagerstown, Md. | Sewer | 360,000 | 1933–1947 | 5 | 95.0823 | July 5, 1921 |
| Huntington, N. Y. | Road improvement | 500,000 | 1925–1950 | 5½ | 103.03 | July 2, 1921 |
| Janesville, Wis. | Sewer | 100,000 | 1922–1941 | 6 | 102.295 | July 1, 1921 |
| Lansing, Mich. | Street, sewer and bridge repair | 500,000 | 1923–1932 | 5 | 94.31 | July 15, 1921 |
| Lynn, Mass. | School and public work | 403,000 | 1922–1951 | 5 | 100.30 | |
| Mt. Vernon, N. Y. | Refunding | 100,000 | 1922–1931 | 5½ | 100.641 | Aug. 1, 1921 |
| Newburgh, N. Y. | Highway | 40,000 | 1922–1936 | 5 | 100.00 | Aug. 1, 1921 |
| Port Chester, N. Y. | Street improvement | 200,000 | 1951 | 5 | 96.00 | Aug. 1, 1921 |
| Winston-Salem, N. C. | Street improvement, water and sewers | 325,000 | 1923–1932 | 6 | 100.00 | July 15, 1921 |

## Lockwood Housing Investigation Awaits Election

Though Samuel Untermyer, of counsel for the Lockwood joint legislative committee on housing which has been investigating building conditions in New York City, has returned from Europe, it is probable that a continuation of the hearings will not begin until after the municipal elections in November. In the meantime Mr. Untermyer is conferring with Senator Lockwood on methods to be pursued when a continuation is taken.

## West Coast Lumber Production

For the week ended Sept. 10, 101 mills reporting to the West Coast Lumbermen's Association reported a production of 52,500,000 ft. b.m., which is 30 per cent below a normal cut. New business totaled 43,000,000 ft. b.m.

## Cement Output Increases in August

According to recent information compiled and given out by the United States Geological Survey, the production and shipment of portland cement in the United States increased in August, 1921. The August production exceeded the average for August, 1917-1921, by about 15 per cent. Production for the first eight months of 1921 was about 99 per cent of the quantity produced during the corresponding period of 1920 and exceeded the average for the first eight months of 1917-1921 by about 8½ per cent.

The August shipments exceeded the production, and the total for the eight months just ended is equivalent to more than 99 per cent of the record quantity shipped in the first eight months of 1920. The average for the period during the five years 1917-1921 was exceeded during the past month by about 9½ per cent.

The total production of cement for the first eight months of 1921 is slightly in excess of 62,000,000 bbl.

## Cement Prices Lower

According to an announcement made Sept. 17 by the Universal Portland Cement Co., that company has reduced its selling prices on cement, effective Sept. 17 at its Chicago plant and 15c. per barrel at its Pittsburgh and Duluth plants. This is the second price reduction made by the Universal Co. within the year.

## Illinois Bridge Program for 1922 Is Large

Bids will be received up to Oct. 4, 1921, by the Illinois Department of Public Works and Buildings, Division of Highways, for state bond issue bridge work, a program which entails the construction of 61 bridges with 109 concrete spans and 8 steel spans. The bridges are scattered throughout the state in various counties and along various state routes. Only three of the 61 bridges are to be completed during the 1921 season, the remainder to be completed before the end of the 1922 construction season.

The concrete bridges range in span lengths from 8 to 50 ft., and the eight steel spans in lengths from 100 to 170 ft. Though most of the projects are small, there are three or four large bridges. The largest bridge to be constructed is that near the town of Goodfield and will have four 50-ft. concrete spans and a 170-ft. steel span. The roadway will be 20 ft. wide throughout. Another of the larger projects is the bridge near the town of Goldengate. This bridge will have five concrete spans of a 40-ft. length and a steel span of 125 ft.

Plans for the work may be examined at the office of the district engineer in which the work is located and proposal blanks may be obtained on application in writing from G. F. Sallee, Division of Highways, Springfield, Ill. Plans will not be sent to prospective bidders but upon making a deposit with the district engineer they may be obtained for temporary use while inspecting conditions attending the work in question.

The notice to contractors which has been circulated is full of details regarding the work. Not only are the general data concerning each project given, but the conditions as to availability of local materials, delivery of materials, existing structures, water conditions, depth of excavation, etc., are noted.

## Chicago Building Situation Still Unsettled

The Chicago building situation is still in a decidedly unsettled condition. While the decision of Judge Landis has been accepted by some of the unions and they have gone back to work, pending a rehearing over the wage figures set by him, nevertheless the men have not, in several cases, permitted the use of non-union carpenters, a trade that was not in the arbitration, regardless of the fact that the decision explicitly provided that non-union men might be employed under just these conditions. In the meanwhile much work is being held up and some violence is reported.

The various building material inter-

ests that have been under fire from the Dailey investigating committee (some of them indicted) have been promised speedy trials by the states attorney. Representatives of the cement manufacturers and Portland Cement Association have appeared before the commission during the past week, and the usual reports of "plenty of evidence" have been given out by the commission.

## Drop Noted in Number of Bad Order Freight Cars

A further decrease of 17,312 in the number of freight cars idle on September 8, compared with the total on August 31, was shown by reports just received by the car service division of the American Railway Association. The total on the later date was 450,803, of which 237,972 represented serviceable freight cars while 212,831 were in need of repairs.

Tabulations show, however, a decrease of 8,768 in the number of surplus serviceable freight cars in approximately a week, and a decrease within two weeks of 8,541 in the number of bad order cars. This is the first decrease that has been reported in the number of freight cars in need of repairs since last August and would seem to indicate that the rail carriers of the country are making progress in their efforts to get their equipment into shape in order to meet increased demands for transportation facilities.

## Standardization of Lumber Is Aim of Conference

At the direct request of one of the regional associations of lumber manufacturers and of a number of associations of retail lumber dealers, including the National Retail Lumber Dealers Association, a meeting to discuss the matter of standardizing lumber sizes and molding patterns will be held in Chicago, at the Congress Hotel, on Oct. 18, immediately prior to the annual meeting of the National Retail Lumber Dealers Association. The United States Forest Service has announced its purpose to engage in lumber standardization of specifications for the purpose of promoting standardization in size of patterns, and representatives of the U. S. Forest Products laboratory will attend the conference.

## Employment in Industries

According to a bulletin recently issued by the United States Department of Labor it is found that, comparing figures of August, 1921, with those of identical establishments for August, 1920, in six of fourteen selected industries there were increases in the number of persons employed, while in eight there were decreases. The largest increase—114 per cent—was recorded in the woolen industry. The most important decreases are 43.1 per cent in iron and steel, 36.1 per cent in car-building and repairing, 35.8 per cent in automobiles, and 33.8 per cent in paper.

## Queens Borough Has Busy Building Month

During the month of August 1,502 applications for new buildings estimated to cost $8,146,210 were filed with the Bureau of Buildings of Queens Borough New York City. The record for the corresponding month of last year was 628 applications of an estimated cost of $3,125,333. The month of August, therefore, has been the busiest month in the history of the bureau since its organization within the Greater City of New York. Acording to a statement issued by Commissioner of Buildings Moore, the first half of September is keeping up with the August record.

Even more remarkable than the high valuation of the total permits granted is the fact that in 90 per cent of the applications granted construction follows almost immediately.

## New Hydraulic Plant Put in Service in California

The Kern Canyon power plant, just completed for the San Joaquin Light & Power Corp. at the mouth of Kern Canyon, 18 miles southeast of Bakersfield, Cal., was put in service Sept. 17. The plant has a capacity of 12,000 hp. and operates under a static head of 260 ft. Water is diverted from Kern River and passes through an 8,300-ft. tunnel to the top of the penstock.

This is the fourth addition to the power system of this company to be completed in the last fifteen months and brings the total amount of energy added in that time to 100,000 hp. The first was a 17,000-hp. unit installed in the Bakersfield steam plant in June, 1920; the Kerckhoff hydro-electric plant on the San Joaquin River, 40 miles from Fresno, with a capacity of 54,000 hp. was completed in August, 1920; and the Midway steam plant, generating 17,000 hp. was placed in operation at Buttonwillow in June, 1921.

## Retail Food Prices Increase

The U. S. Department of Labor, through the Bureau of Labor Statistics, has completed compilations showing changes in the retail cost of food in August, in 15 principal cities of the United States. During the month from July 15 to Aug. 15, 1921, there were the following increases in all of these cities: Rochester, 8 per cent; Buffalo, 7 per cent; Baltimore and New York, 6 per cent; Milwaukee, Newark, and Norfolk, 5 per cent; Charleston, S. C., Louisville, Manchester, and Portland, Me., 4 per cent; Houston, 3 per cent; Butte and Dallas, 2 per cent; and Minneapolis, 1 per cent.

For the year period Aug. 15, 1920, to Aug. 15, 1921, there were decreases ranging from 30 per cent in Butte to 22 per cent in New York. As compared with the year 1913, the retail cost of food on Aug. 15, 1921, showed a maximum increase of 62 per cent in Manchester and a minimum of 43 per cent in Louisville.

## Jurisdictional Dispute Halts Work on Biltmore Clubhouse

Workmen employed on the new Biltmore Clubhouse, Rye, N. Y., with the exception of carpenters, have been idle for more than a week due to a jurisdictional dispute between the sheet metal workers and carpenters over which craft should do the work of hanging metal doors and window frames. Twelve crafts have gone out, part of them in sympathy with the sheet metal workers and part being forced out by the stopping of engines needed to hoist materials to the upper floors. The international union of the sheet metal workers ordered the men out as a result of the installation of the doors by carpenters and invoking as justification a decision given by the National Board for Jurisdictional Awards in the building industry dated Dec. 4, 1920. This decision gave to sheet metal workers the hanging of hollow metal doors and trim, except sliding doors, in the event that the metal is of 10 gage or lighter. Another decision gave all metal trim work to iron workers in the event that the metal is heavier than 10 gage.

## Pennsylvania Builds 520 Miles of Road

Up to and including September 22 the Pennsylvania State Highway Department had completed 520 miles of roadway into which concrete entered in some form. With what mileage remains yet to be put under contract during the present construction season, the total will probably approximate 650 miles for 1921. The state highway department of Pennsylvania believes that to date it has laid more pavement of a durable nature than has ever been recorded by any state highway department.

## Civil Service Commission To Appoint Statistician

The United States Civil Service Commission has announced an open competitive examination for statistician. A vacancy in the position of statistical analyst in the Interstate Commerce Commission at a salary of from $3,600 to $5,000 a year and vacancies in positions requiring similar qualifications at these or higher or lower salaries will be filled from this examination. The duties of the position require special training in statistical methods, together with familiarity with railroad statistics. The appointee will be required to assist in the analysis of the financial and operating reports filed by carriers and must be capable of conducting independent research. Graduation from a college or university of recognized standing and three years' graduate work in economics, statistics, or transportation are prerequisites.

Applicants should at once apply for form 2118, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C., or to

the Secretary of the United States Civil Service Board in any of the designated cities.

### New Funds Needed to Continue Pennsylvania's Road Program

At the close of the year 1922, according to a bulletin just issued by the Associated Pennsylvania Highway Contractors, Pennsylvania will have entirely exhausted all funds available for road construction unless the voters of the state, in the primary election of Sept. 20, authorize a constitutional convention which will incorporate in a new state constitution provisions to enable the commonwealth to issue additional bonds for highway construction. If the vote is favorable delegates will be elected in November and the convention will convene early next year, finish its work and submit its findings in November, 1922, when the new convention will be submitted for ratification to popular vote. Unless this course of procedure is followed the Associated Pennsylvania Highway Contractors predict that highway construction at the present rate will be halted at the end of the year 1922.

### Contracts Total $123,000,000

Contracts let during the past week, as reported in *Engineering News-Record*, amount to more than $22,000,000, a high figure for this time of year. This brings the total for the month of September to about $123,000,000.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving correct prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 1, the next on October 6

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.88 | $4.00 | $4.00 | $2.88 | $3.16 | $4.00 | $3.70 | $3.75 | $4.00 |
| Structural rivets, 100 lb. | 3.70 | 5.25 | 5.50 | 3.68 | 4.15 | 4.25 | 5.50 | 5.00 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.78 | —3.20 | 3.50 | 2.78 | 3.18 | 3.57½ | 2.35 | 3.75 | 3.75 |
| Steel pipe, black, 2½ to 6 in. lap, discount | 51% | 52 6⅔–5% | 45% | 65⅔% | 58.9–5% | 38% | —51.8% | 55% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 47.30 | 40.50 | +53.50 | 45.60 | 47.80 | 52.00 | 60.00 | 55.00 | 70.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | 2.50 | 2.69 | 2.80 | 1.97 | 2.26 | 3.10 | 2.89 | 3.10 | 3.10 |
| Gravel, ¾ in., cu.yd | —2.00 | 2.13 | 3.00 | 1.65 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.50 | 1.65 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 2.80 | 1.75 | 2.25 | 3.50 | 2.25 | 3.50 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 45.00 | 35.00 | 35.00 | 46.00 | 34.00 | 49.00 | 28.00 | 21.50 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 25.40 | 24.00 | 21.00 |
| Lime common, lump, per bbl | 3.69 | 1.60 | 2.75 | —1.40 | 1.40 | 2.95 | 2.25 | 2.75 | 15.00 |
| Common brick, delivered, 1,000. | 18.40@19.40 | 10.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .124 | 0821 | .092 | .09 | .12½ | .11 | .15 |
| Hollow partition tile 4x12x12, block | .11370 | .14 | .124 | .0657 | 092 | .10 | .14½ | .12 | ... |
| Linseed oil, raw, 5 bbl. lots, gal. | .80 | +.86 | .98 | .87 | —.86 | .98 | .91 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 72½ | .50 | .50@.55 | .81¼ | .75 | .... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45 6⅔ means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand, gravel and crushed stone are quoted alongside docks. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.15 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton, cushed stone f.o.b. cars. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

### Changes Since Last Week

Mill quotations on structural steel shapes and plates prevail at $1.60@1.70; with bars at $1.65@1.70 per 100 lb., in small tonnages. Mill shipments, New York, of structural shapes and plates are quoted at $1.98@203; with bars at $1.88@1.98 per 100 lb. Dallas quotes mill shipments of reinforcing bars at $3.05. Shipments of steel shapes from the mill via all rail to Minneapolis are quoted at $2.45; by lake and rail, $2.51 per 100 lb. Steel warehouse prices have shown considerable firmness throughout the week, with the exception of reinforcing bars, which are quoted in Atlanta at $3.20 as against $3.25 per 100 lb. San Francisco reports an increase of 5 per cent in discount on black steel pipe. An advance of 20c. per ton is quoted on cast-iron pipe in Dallas.

The market for concreting materials has remained firm; with marked increase in volume of business, particularly in crushed stone. New York, however, quotes gravel at $2 as against $2.25 per cu.yd., alongside dock.

Common lump lime is quoted in Chicago at $1.40 as compared with $1.50 per bbl. previously. This price applies to 180 pounds net.

Linseed oil is quoted at 86c. per gal. (5 bbl. lots) in Minneapolis and Atlanta.

Reports from Oakland, Cal., state that a gradual increase in construction work is noticeable, particularly in the Bay region. A strike of seven thousand five hundred oil workers in the producing sections of California threatens to creat a serious situation all along the coast unless speedily settled.

Minneapolis reports that at least 20 per cent of the skilled mechanics in the building trades are out of employment at present. There appears to be still greater unemployment among unskilled laborers in this vicinity. No unemployment, however, is reported among plasterers.

With the opening up of sixty-five steel and tin mills in the Ohio district alone, employment will be furnished for several thousand men. Some of these industries have not been in operation since the first of the year.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, OCTOBER 6, 1921 — Number 14

## A Different Kind of Conference

A FAVORITE American sport is the holding of conferences. We are constantly seeking subjects for desultory discussion by large groups. So often do such conferences prove fruitless, except to gratify the ambition of the limelight seekers, that as result-producers they are generally discredited. Consequently when the President announced the Unemployment Conference there were many who expected a meeting of the standard rambling, unproductive variety. Happily, they have been disappointed. The conference was composed of people having contact with the subject from a variety of angles. Upon convening if found ready all the necessary machinery—stenographers, clerks, statistical experts, etc.—for efficient functioning. In addition—and what is far more important—it found prepared for its consideration a large amount of well co-ordinated statistical data, summaries of conditions in previous unemployment periods, and suggestions for relief—all of which had been collected in advance by an advisory committee of statisticians and economists. The conferees, therefore, had something to work on, material stimulative of thought and discussion, yet of a kind that helps to hold the considerations down to the thesis of the meeting. This excellent organization and preparation, for which credit must be given to the inspiration of Mr. Hoover and the intelligent work of his able lieutenants, is without doubt responsible for the brass-tack character of the suggestions for emergency relief. The conference certainly was "different," which, however, is just what the country has learned to expect from Herbert Hoover.

## Ignorance About Construction Costs

REFERENCE is made in the comment on the Unemployment Conference to the favorable price situation. How necessary it is to bring this to the attention of public officials is shown by the recent action of a board of county commissioners. Steps were taken some months ago to get under way the work of replacing an old bridge, an improvement which public men and organizations of the county describe as urgently needed. Legal questions blocked progress at the time and nothing has been done. Now, when the commissioners are urged to resume the work, it is stated that they are disposed to postpone the improvement for a year or two in the hope of getting much lower prices. Apparently these officials are blind to what is happening in the construction field. It is apparent that engineers or their societies can do much in the present circumstances to set public officials straight on the price situation. No one is in a position to guarantee the future costs, but the indications in present bids and the prospect of stabilization of material prices warrant the recommendation that necessary work be proceeded with at once.

## Campaigns Win Wars

WARS are not won by single battles; campaigns are the agents of victory—which is only another way of saying that "keeping at it brings success." The Unemployment Conference—or the part of it concerned with emergency measures—has been held. It has sent out its recommendations. It is the first national battle against unemployment, but if it is the only battle, the war against unemployment is lost. There must be a campaign, a constant drive until the winter's peak is over. There must be hammering until every community organizes efficiently, and then new and continual hammering to insure the vigorous prosecution of the relief work. Every reader of *Engineering News-Record* has a duty as a citizen to help in the hammering, and to function on the working committees. In fact, he has a duty greater than that of any other class of citizen, for it is his industry, chiefly, which is looked to for relief. His societies, engineering as well as contracting, need to get on the firing line and by their expert advice to aid their communities to get the present strong picture of attractive prices and construction opportunities. Every community council or committee will welcome the expert aid of engineers and contractors collectively and individually. The societies should at once appoint committees and have them get busy.

## Highway Safety and a Railroad Analogy

A THROUGH-TRUSS highway bridge was knocked down last week by an automobile truck which ran into one of the trusses and destroyed some of the web members. Almost at the same moment a train out in Indiana knocked down a railroad bridge in precisely the same way, wrecking two spans. The coincidence points at a new condition that has been developing almost unnoticed. Modern road traffic brings with it risks of accident not much different from those affecting railways and this is true on the road itself as well as on bridges, though the present case calls specific attention to the latter. The fact is that our highway system, with the traffic it carries, is quite similar to a railway track network carrying high-speed trains—but one over which the trains runs at the pleasure of the enginemen, without control by block signals, interlocking derails or the other safeguards that have been introduced into railway practice. This uncontrolled operation is already seen to be unsafe, and we think is sure to prove more unsafe as traffic grows. The railroad analogy of the particular highway bridge accident reported is particularly apparent. In that accident a truck and a passenger car were trying to pass in the single-way width of the Little Patuxent crossing of the main Washington-Baltimore road, although warning signs at the bridge approaches told that the bridge was too narrow for vehicles to pass; they collided and were thrown against the truss members,

wrecking them and bringing the bridge down. Thus the accident is directly chargeable to the fact that the drivers ignored warning signs, just as neglect of signals by enginemen has caused many a railway wreck. The experience gained in railway service can find very useful application in the development of our highway transportation systm. Whether or not mechanical safeguards at dangerous crossings, junctions, and passing points are needed or are practicable is not now the question; if the danger points are recognized and the nature and seriousness of the risks which they involve come to be understood, the discovery of the most suitable means for protection will follow.

### Collision Resistance in Bridges

THERE are more perplexing questions in the Little Patuxent bridge accident than appear on the surface. If highway engineers are content to build their bridges so light that a swerving motor truck can knock them down—or if cost limitations compel them to build this way—the situation is serious. For some years past progressive highway departments have recognized the desirability of making bridge railings and balustrades strong enough to resist the impact of vehicles that might run against them, and several states now regularly build hand rails of this robust type even where there is a roadway curb and a sidewalk. All the reasons that argue for such construction apply with multiplied force to protection for the web system of a through-truss bridge. Few existing truss bridges are of such heavy construction that the web members would survive the impact of a colliding truck; and, of course, destruction of either a post or a diagonal is practically certain to wreck the whole structure. Not many such accidents have occurred hitherto, fortunately, but this in itself is not very reassuring, in view of the continuous expansion of fast motor-truck traffic that seems to be in sight. The Little Patuxent wreck raises the question very directly whether it should not be made standard practice to build through-truss highway bridges strong enough to resist truck collision, or whether, if this is not practicable, fender curbs should be provided as a protection.

### Railway System Consolidations

AN OUTSTANDING event in engineering interest last week was Prof. Ripley's report on the consolidation of the railway systems of the country. Such a study, under the auspices of the Interstate Commerce Commission, was a necessary precedent to the consolidation action looked for in the Transportation Act. Necessarily, Prof. Ripley's plan is but the start of hearings and discussions in which its merits and demerits will undoubtedly be adequately handled. Out of that, then, should flow the framework, at least, of the consolidated systems which, all students of the question generally agree, must come. Only by absorption of the weaker lines into stronger systems can the transportation industry of the country be put into a healthy condition. The National Association of Owners of Railroads Securities is also having consolidations studied by its Board of Economics and Engineering, which is now at work. It will have a viewpoint that should be well worth considering. The operating officials, too, will have views so that we many shortly expect a thorough airing of the entire subject.

## Overemphasizing the Corps of Engineers

A COMPLETE reading of the arguments on the proposed Department of Public Works, which in condensed but comprehensive abstract appear on another page, confirms a growing impression that the status of the Corps of Engineers and its control of the river and harbor work is playing much too large a part in the campaign for a revision of the engineering functions of the government. Most of the arguments in the Engineer Department circular are palpably background for the defense of the Corps of Engineers, which would maintain its status quo, admitted by its own members to be unsatisfactory in many ways, for fear of its complete disintegration under a Department of Public Works. On the other hand, the A.A.E. arguments, while apparently more sincere, concentrate on the antagonism to the Corps as an institution and register confirmed opposition to any scheme which does not relegate the Corps to the position of a subordinate military unit.

This is decided overemphasis of only one phase of an important and many-sided question. The overlapping of government engineering activities is manifestly inefficient and expensive and their proper co-ordination a step toward the reduction of the cost of government. If, however, the legislators at Washington, who must order the reorganization, get it into their heads that this is merely a military-civilian fight inside the engineering profession, they will wash their hands of the whole affair. Fair-minded advocates of the Public Works Department idea will do well to recognize this situation.

The Corps of Engineers' stand is quite explainable. In all published schemes for the new department the Corps is relieved of its present important civilian duties and thrust into a nebulous state, where part of the time its members are subordinates of civilians and part of the time subordinates of line officers. Its natural opposition would be partly relieved or the cause partly removed if the advocates of the new department freely admitted that war is a possibility, that military engineers are something more than civilian engineers in uniform and that responsible charge of large works is a necessary peace-time preparation for responsibility in war. At the same time the Corps might as well recognize that the day of military aristocracy is passing and that the horizontal demarcation between the civilian engineers and the army officers in the Engineer Department can not long be tolerated. The position of the United States Assistant Engineers is in large part responsible for the feeling among engineers against the Corps. It is un-American that there should be any branch of our government in which competent, trained men should be barred from promotion by the existence of officials of life tenure or where such men should automatically be in subordination to men of lesser age, training and capacity. Such a system, with all its implications, goes against the American grain. Some way must be found whereby the civilian engineer is made something more than the perpetual and enforced subordinate.

Meanwhile the Public Works Department idea must not be killed by the elevation of what really is a minor controversy to the position of a critical issue. Sooner or later some rational scheme will be proposed whereby the Corps of Engineers can get proper and equal train-

ing in both military engineering and civilian responsibility and at the same time will not be given autocratic control of an important government civilian activity. Such a scheme has yet been put forward and until it is no lasting harm would be done by the establishment of a Public Works Department, embracing all the other engineering functions of the government and leaving for the future the solution of the Corps of Engineers' tangle.

## Price Situation Justifies Unemployment Conference Recommendations

IT WAS not to be expected that the Unemployment Conference would produce a panacea or even novel ideas. The problem is too old to bring forth much of novelty. What the conference has done is to awaken the country to a sense of the seriousness of the problem, to make a dramatic mobilization of all sound means for increasing employment and to mark the inception of educational propaganda to get each community to put to work every agency that can have an influence on the situation. Fortunately, too, the price situation places a stamp of approval on the major recommendations of the conference.

The salient feature of the recommendations is that they relate to means of *increasing employment* and not to measures for charitable relief. The soundness of that method of solution need not be emphasized. Equally self-commendatory is the principle laid down that each community should organize within itself to handle the situation. The responsibility for functioning is put on the mayors, and the governors are appealed to to unite and activate such state agencies as can aid the efforts of the mayors' organizations.

Our own field, that of construction, offers, in the judgment of the conference, the largest area for increased employment, a statement indisputably correct. There are plentiful signs, too, of increasing construction activity and for that there is a very excellent basis. Prices have come down and though they are still 80 per cent above what they were in 1913, as shown by *Engineering News-Record's* construction-cost index number, there are indications that contracts will be taken much lower.

In both Iowa and Minnesota bids were submitted last week for earth work on road jobs at 22 cents per cubic yard, which is down to pre-war prices and as low as it is good to have work go; below that figure is loss, inefficiency, and defaulted contracts. In steel, two recent lettings tell a significant story. At Pittsburgh a steel arch bridge has been let on a bid just over $100 per ton, including the fabrication and rather difficult erection over a river. In New York the steel framework of the Federal Reserve Bank Building has been let at about $70, erected. These prices are so near the lowest obtainable in pre-war years as to be startling, especially when it is considered that wages in many trades are still high and that freight and various miscellaneous costs remain abnormal. It is apparent, therefore, that some contractors feel that prices will go lower and are bidding lower than today's quotations in some cases warrant.

There are, also, indications that material price stabilization is at hand. Steel sheets have gone up, so has brick, and lumber prices are generally conceded to be too low.

Taking these various facts into consideration, it is safe to say that, compared to the war peak, we are in bargain days for construction work. The facts quoted are an unanswerable argument for getting underway every bit of necessary private and public construction work. The Unemployment Conference's recommendations, therefore, on construction are fully justified by the facts. It is "up to" every engineer and contractor to bring these facts home hard to the mayor and the unemployment committee of his city.

This is the time to go ahead with needed work. The prices warrant it, the unemployment situation demands it.

## New York's Transit Situation

IN COMMON with all other municipalities, New York has had its transit troubles. Even before the war came to make them particularly acute, its surface lines had fallen on evil days. With the advent of war the entire system, including the elevated and underground lines, felt the stress. As a consequence there has been continuous discussion for the last four years, the companies pleading for relief, the municipal authorities standing fast for the maintenance of the five-cent fare. Withal it is generally recognized that only by a courageous procedure can the situation be righted.

Acting under mandate from the state legislature, the Transit Commission has recently rendered a preliminary report which will have interest for all concerned with municipal activities. It provides that all physical properties be taken over by the municipality upon a fair valuation, and that the companies be paid in bonds. The stock of the present companies would be wiped out. The operating companies would be given a lease, and out of the revenues would be paid the operating expenses, a 5 per cent interest return on the bonds, with an additional 1 per cent set aside to amortize the securities, while the bonds would be further secured by provision in the contract for the maintenance of a rate of fare automatically determined to meet at all times the cost of operation, bond interest, and the 1 per cent for amortization.

In addition to this an incentive to efficient and economical management would be offered in the form of an additional 1½ per cent on the face value of the bonds. Control of the properties would be in the hands of a board of control of seven members, three to be appointed by the operating companies, three by the city, and the seventh to be selected by the other six.

While the plan is tentative and open for discussion between the interested parties, it is plain that the largest city in the country is tending toward a basis in which the municipality will have a larger direct connection with the operation of its transit facilities, a direction in which other cities have already shown the lead. The sum and substance of the significance to municipal engineers is that in these transit rearrangements the municipal engineer is bound more and more to be drawn into the questions rising out of the operation of transit facilities.

The discussion and disposition of the New York plan, therefore, will be of much interest to readers of *Engineering News-Record*.

# Minnesota Swamp Land Reclaimed for Farm Use

## Company Drains Land, Makes Soil Studies and Lays Out Roads and Farms—Ditch and Tile Drainage—Rainfall Record—Large Ditching Machines Work on Soft Ground

By Merlin H. Dappert
[illegible] Albert Lea, Minn.

A LAND drainage, reclamation and settlement project of exceptional interest which is now being carried out in Minnesota is that of the Albert Lea Farms Co., near Albert Lea, Minn., this 15,000-acre project including not only ditch and tile drainage of swamp land, but also roads, bridges, wells, farm buildings and farming operations. In addition to the engineering and agricultural work, soil and hydraulic investigations and crop studies are being made on this tract by the University of Minnesota, as the results are applicable to large areas of wet and swamp land in that part of the state.

About fifteen years ago a drainage district was organized in Freeborn and Mower counties for the purpose of draining Rice Lake, Mud Lake and Sargossa Lake and the swamp land surrounding them. As the estimated cost of reclamation exceeded the existing value of the land, much opposition was encountered, with the result that only a main outlet ditch and nine lateral ditches were constructed, at a total cost of approximately $170,000. The excavation of these first ditches caused a remarkable change in the character of lands. Lakes were converted into marsh lands, and marsh lands into good hay and pasture land. But the landowners, limited by meager capital and not fully realizing the possibilities of complete drainage by the addition of smaller open ditches and tile systems, were satisfied to use the land for pasture, occasionally cutting hay from the marsh lands.

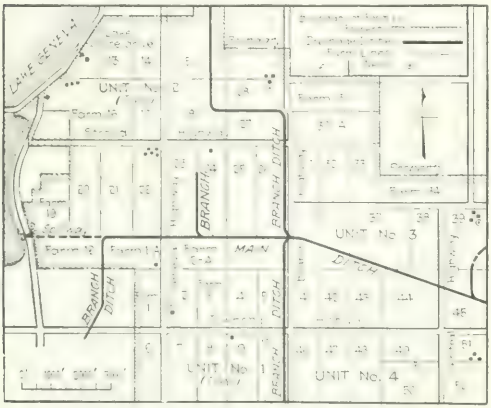



FIG. 1. PORTION OF ALBERT LEA FARMS AND DRAINAGE PROJECT

Within the center of the drainage area of 90,000 acres was the Barber Marsh, a basin comprising 15,000 acres of land which would be very productive if thorough drainage was accomplished. In 1918, the Payne Investment Co., Omaha, Neb., made an exhaustive examination of this marsh to determine the possibilities of reclamation. Borings were made and soil samples taken and analyzed. Surveys were made to determine the engineering problems of drainage. Other investigations included market facilities, transportation, agricultural requirements and probable cost of reclamation. The feasibility of the project being established, the Albert Lea Farms Co. was organized to purchase and develop the land, under the supervision and management of the Payne Investment Co. The climate is favorable for the raising of small grains, corn, hay and truck, as the counties mentioned are in the southern part of the state, and climatic conditions are similar to those of northern Iowa.

Rainfall records show an average annual precipitation of 27 in., distributed as follows: Winter, 2.71 in.; spring, 6.89 in.; summer, 10.94 in.; autumn, 6.48 in., December being considered as the first month of winter. As to rainfall intensities, records for 29 years show only one rain of 2.2 in. within one hour, two storms of 2 in. in one hour, and 15 storms where between 1 in. and 2 in. of rain fell in one hour. The maximum rainfall for a six-day period is 9.4 in. In several storms 7 in. of rainfall has occurred in a two-day period.

The topography is such as to facilitate drainage, there being a fall of from 2 to 4 ft. per mile from the edges of the marsh to its center. In the direction of the main outlet, the fall is 5 ft. per mile in the upper marsh area, flat through the central portion and 2 ft. per mile below the marsh area. The main ditch is 18 miles long, commencing at the east side of Lake Geneva and running southeast to Turtle Creek at a point three miles above its junction with the Cedar River. This ditch has a fall of 19.4 ft. or a little more than 1 ft. per mile. The total fall from the head of the ditch to the Cedar River is 32 ft. in a distance of 21 miles. Lake Geneva bounds the west side of the tract, acting as a storage reservoir for a watershed of 20,000 acres of rolling land lying west of the lake.

Uplands 5 to 60 ft. higher than the basin surround the marsh area. In these uplands, the divides are well marked; the valleys are wet and need outlets for tile drainage. In the basin area, the soil varies from muck, well decomposed peat and peat-loam to clay loam, 2 to 16 ft. deep, underlaid by sand, silt, clay-loam, and clay sub-soil. The upland soil varies from a black loam underlaid by clay to a more clayey soil, not so rich in fertility as the lower lands. Only several hundred acres of timber existed on the tract. Most of this has been divided into wood-lots and is being preserved for future use.

Prior to development, the tract was sparsely settled and almost inaccessible. The few existing roads were little better than trails, being impassable during the wetter seasons. Interior development was commenced in the spring of 1919, about 300 acres of land being seeded. During the summer and fall 15 miles of small open ditches were dug and 2,500 acres of land were plowed, ready for cropping in 1920. The old system of open ditches has greatly deteriorated from lack of

maintenance. Willows and cotton-woods have grown upon the spoil banks and sides of the ditches. Fence crossings, fords for cattle and carelessly constructed openings through the spoil banks, have caused the formation of bars, resulting in a filling of from 2 to 4 ft. by sedimentation.

Soon after work on the project was commenced, steps were taken to organize a drainage district to permit of cleaning out all existing ditches and extending them where necessary to reach sub-areas. The organization of Judicial Ditch No. 4, Freeborn and Mower counties, has been completed and the ditch established in court proceedings. Some modifications of plans are now being made, and the district work will be advertised and contracts awarded in the near future. Approximately 36 miles of open ditches with base widths of from 8 to 50 ft. will be constructed. Besides the open ditch work, there will be seven miles of tile drains, a large spillway and many surface water inlets and catch basins.

Capacities of the ditches are being made large enough to care for 50% more than the quantities of run-off obtained by the Elliot formula: $q = \frac{20}{\sqrt{M}} + 3.63$, in which $q$ equals second feet per square mile and $M$ equals area in square miles, which latter was considered applicable to the upper Mississippi Valley for absorptive and easily drained soils. In determining velocities and capacities on open ditch work, values of the co-efficient of roughness used with the Kutter formula are being taken as $n = 0.0225$ to 0.030. The normal low water flow will be from 3 to 5 ft. below tile outlets. High-water flow will be 2 ft. below natural surface in the lowest area (the bed of old Rice Lake), and from 2 to 5 ft. below the natural surface of the balance of marsh land making up most of the site.

Culverts through spoil banks are a special feature, these culverts being of corrugated pipes with concrete protection, inlets or catch basins and flap valves. No openings will be left in the spoil banks for admission of surface water. The estimated cost of the drainage district work approximates $263,000. On account of numerous delays in the organization and establishment of this drainage district, the Albert Lea Farms Co. decided to go ahead with the work of interior development rather than to wait for the cleaning of the open ditches.

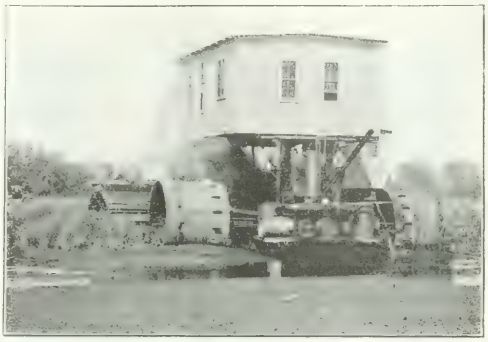


FIG. 3. EXCAVATOR CROSSING OLD CREEK BED

In this interior development the general plan of procedure is as follows: The tract has been subdivided into eight units of from 1,000 to 3,000 acres each. Roads are laid out and the units subdivided into farms of from 40 to 240 acres, each farm being given a number. Most of the farms comprise 80 to 120 acres of land. A typical portion of the layout of four units is shown in Fig. 1. Topographical maps with 1-ft. contour intervals are prepared for each unit prior to drainage, and soil surveys are made as soon as the surface ditching has been completed. The importance of topographical and soil surveys, not only for drainage plans, but for planning location of building sites and size and division of the farms, cannot be too strongly emphasized. The soil survey was made only in a general way on the first work, but is now being made very carefully. For draining a unit, the first step is the construction of small open ditches to remove the surface water. A 90-ton, 120 hp. ditching and roadbuilding machine used for this purpose is mounted on two wheels and two continuous bearing crawlers, the width of bearing being increased by heavy planks bolted to the crawlers and the wheel rims. This machine is shown in Figs. 2 and 3. A revolving wheel cuts the ditch to its finished shape, and a conveyor belt carries the material 20 ft. from the line of ditch, depositing it in a single spoil bank. The ditches are 12 ft. wide on top and 6 ft. deep with a rounded base, the excavation running about 1½ cu.yd. per lin.ft. With one crew of five men, a ½-mile run is an average for a 10-hr. day. Where roads are to be built, a ditch 7 ft. deep is dug and the spoil bank is cut down by tractors with road graders, as

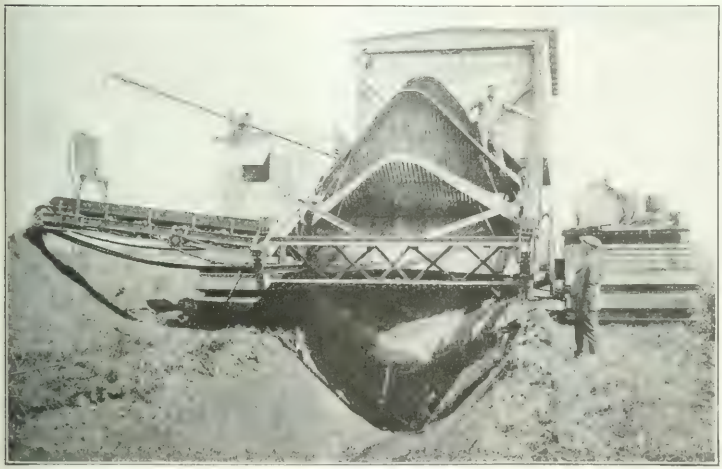


FIG. 2. WHEEL EXCAVATOR CUTTING DRAINAGE DITCHES 12x6 FT.

shown in Fig. 4. Where the soil is not heavy enough for road-building purposes, clay is hauled in and used as topping. As soon as this roadbed becomes compacted, a heavy surfacing of gravel is applied, the gravel being obtained from numerous hillocks in the marsh area.

Tile drains are laid in the open ditches as soon as the water table recedes enough to allow the hauling of tile. The sides of the ditches are then thrown in to cover the tile, this work being done with a blade or grader machine drawn by a tractor, as in Fig. 4. A wide, shallow depression, such as can be readily crossed in farming, is left over the main tile drain to carry off surface water in early spring when snow is melting

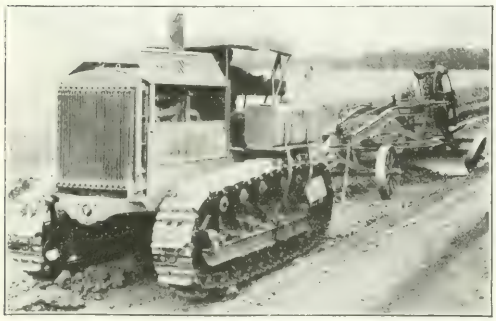


FIG. 4. TRACTOR AND GRADER MAKING ROADBED AND FILLING TILED DITCH

and ground is frozen (see *Engineering News-Record*, July 7, 1921, p. 28).

After the main drains have been laid, sub-mains and laterals are added to complete the drainage. The spacing of laterals varies from 80 to 300 ft., depending upon conditions, lateral tiles being omitted where sandy subsoil allows complete drainage with only main tile drains. Capacities of tile drains vary from $\frac{1}{4}$ to $\frac{3}{8}$ in. Laterals are laid from 3.5 to 4.5 ft. deep. The question of laying lateral tile 5 ft. deep in the more peaty soils is being considered, and experiments are being made to determine the effect of deeper drainage. Both concrete and red clay tile are used, a thorough test for presence of alkaline salts in soil and drain water having shown it to be perfectly safe to use concrete tile.

Drainage is followed closely by farming operations, 15 tractors, 130 horses and from 90 to 150 men being used for this work. Several complete sets of modern farm buildings have been constructed. Sites are selected for future use, and more farm buildings will be built next year. Artesian wells are being driven on many of the farms, a good flow of water being secured at a depth of 120 ft. Temporary bridges built where new roads cross dredge ditches will be replaced with steel structures when the work of dredging is completed.

Of this 15,000-acre tract, 4,000 acres have been thoroughly tiled and tiling is progressing on another 2,000 acres. Nearly 6,000 acres are in cultivation and 3,000 acres more are in the first stages of development. Approximately 6,000 acres will be left for reclamation in 1922 and 1923. Of 15 miles of roads constructed, 11 miles are now gravelled. Over 100 miles of tile drains have been laid.

The principal crops being raised are flax, buckwheat, oats, barley, rye, corn, sudan grass, clover, timothy, sugar beets, potatoes and various kinds of truck. On account of the immense amount of hand-labor required for sugar beets and truck, only small acreages have been planted to these crops. Yields have been very good, considering that the land is new. The first crop of flax on 2,000 acres averaged 13 bushels to the acre. Last year the yields per acre from different fields were as high as follows: oats, 68 bu.; flax, 20 bu.; potatoes, 264 bu.; and sugar beets, 17 tons.

Experiments with many varieties of seed, with and without fertilization, are being conducted by the University of Minnesota, which has also established a substation for drainage investigation. A thorough study of groundwater conditions, run-off and spacing of laterals is being made. In May, 1921, the thoroughness of the drainage system was proved when 7.38 in. of rain fell during the month, 6.08 in. falling within a period of 12 days and 2 in. in two hours. Not an acre of crop was injured where tiling was completed, and the tile drains were of adequate capacity to meet all requirements for rapid removal of excess water.

This development work is under the supervision of Geo. H. Payne, president of the Payne Investment Co., and T. F. Stroud, of Omaha, Neb. R. F. Payne is general manager. J. W. Dappert, Taylorville, Ill., who has been the consulting engineer, has recently been appointed engineer for the drainage district. The drainage of the tract is under the supervision of the writer. Among the agricultural advisors are Dr. T. J. Alway, of the University of Minnesota, and Prof. Ezra Levin, of the University of Michigan, both experienced in peat and muck soil farming. Drainage investigations are being conducted by G. R. B. Elliott, of the University of Minnesota, and Sven Norling, of the University of Upsala, Sweden.

## Unit Costs of Railroad Track Work

In studying to carry on track maintenance work at minimum cost in relation to effective work, it is necessary to have uniform records of cost units. Further the records must be published so that each railroad or division may know what the items of work cost on other roads and divisions. These views were expressed in an address before the Roadmasters and Maintenance of Way Association at Chicago, by Charles A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry. His remarks are abstracted below:

One of the first things necessary is to agree on a classification of the different portions of a railroad. The cost of laying rail on a track having 20 trains over it in working hours will be much in excess of the cost on a piece of road having but 10 trains. The cost of inserting ties will vary with the class of ballast, and between ties put in without raising the track and those put in while liftng the track out of face for a new lift of ballast. Track work in large yards and on passing tracks and side tracks should be shown separately. Classes of ballast should be made, so that work on unballasted track and on lines having similar classes of ballast could be compared.

A few of the important items might be listed to start with and others added from time to time. For instance, the cost per mile for relaying rail, divided to show the cost of the different items of work, including surfacing the new rail, unloading the new material and loading the old material. Labor force is allowed usually on the basis of so many men to the mile of main line, regardless of sidings and turnouts. Some roads have a method of track equation by which track is equalized as to different classes of work that take extra labor. All roads should do this in order to distribute forces equally.

# New Machine Completes Tunnel in One Operation

## Shield Carries Cutter Head—Rotating Tail Ring Sets Lining Blocks and Advances Shield

A TUNNEL shield, with a boring head and a rotating tail attachment by means of which the lining is placed, is operating successfully in an experimental tunnel in Philadelphia, Pa. In this tunnel, which is through schist and has a 5-ft. bore, the machine has advanced at the rate of 5½ ft. per hour. Eight men operated the outfit. This is the only measure of performance which is now available, but it is expected that the machine will soon be installed on actual tunnel work for the city of Philadelphia when more comprehensive records will be secured.

FIG. 1. COMPLETED LINING BEHIND MACHINE

In its combination of a boring head, a protecting shield and a rotating tail-cam or helix for placing the lining and advancing the shield, the machine illustrated differs from other tunneling machines.

As indicated by Fig. 3, one motor drives the boring head and the rotating helix. The head is so arranged that its center may be moved up and down or right and left by means of a lever actuating eccentric cams connected with the movable teeth at the ends of the revolving arms. This makes it possible to change the line or grade of the tunnel. Four adjustable external fins at the quarter points of the shield also aid in changing its alignment.

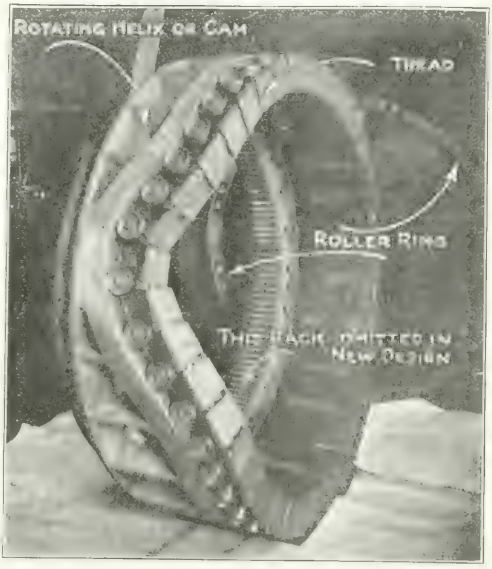



FIG. 2. ROTATING HELIX, CRAWLER TREAD AND ROLLER RING

The rotating helix ring is installed inside the tail of the shield and bears against a roller ring set between a rib in the shell and a rib on the helix. On the front edge of the helix is a rack by which the gear train effects its rotation. On the rear edge rides a crawler ring whose feet bear against the edge of the lining in place. The helix ring, roller ring and crawler tread are shown by Fig. 2.

As the helix rotates it produces in the caterpillar tread an advancing gap for inserting the concrete lining blocks one at a time around the bore. The blocks are set in spiral courses so that as the helix revolves it forces the shield ahead by screw action. The same thrusting action closes up the lining joints and expands the lining ring to fill the space occupied by the shell of the shield. This expansion is aided by the shape of the blocks.

Several hundred feet of experimental tunnel have been constructed without trouble. An inside view, after the lining had been plastered, is presented by Fig. 1. Observation of the machine in operation indicated an unusually orderly and simple procedure even in the restricted space of a 5-ft. bore. The machine was invent-

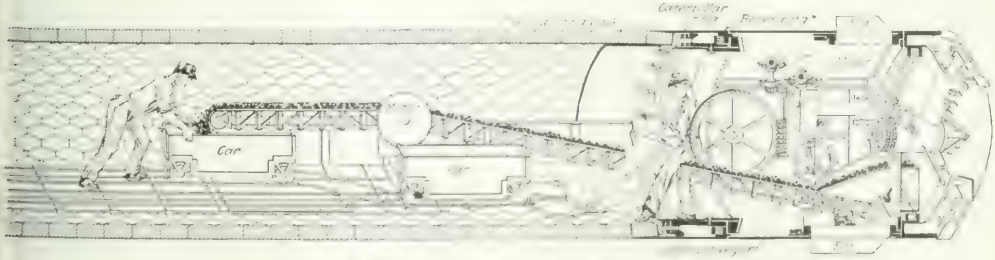



FIG. 3. TUNNELING MACHINE IN OPERATION

ed and patented by M. Roy and Earl Shean, of Philadelphia. Raymond Thomas, electrical engineer, Arthur M. Barnes, mechanical engineer, and A. Sanford Craven, civil engineer, were engaged in the final development. We are indebted to these gentlemen of the Tunnel Machine Manufacturing and Engineering Co. for information and an opportunity to study the machine in operation.

## Selection of Pipe for Water-Works

By J. W. Ledoux
Consulting Engineer, Philadelphia, Penn.

*Abstract of a paper before the New England Water Works Association, September, 1921.*

FOR water-works pipe 24 in. in diameter and above and under pressures of more than 50 lb., a consideration of the various materials available is advisable. Some designers consider cast-iron pipe so far superior to other kinds as to leave no room for argument. In a large part of the United States, especially in the districts yielding hard [alkaline rather than acid] waters, where the soil conditions are favorable, this position could not be seriously criticised because the initial leakage should be immaterial, the cost of maintenance nominal, the lasting quality indefinite, and cast-iron pipe can be obtained readily in the competitive market throughout the East and Middle West. For the soft waters of New England and other states, the mountain regions and the colored waters of the Atlantic Coast, cast-iron supply mains will lose a large part of their carrying capacity within a very few years. Instances of small sizes losing 60 and large sizes 30 per cent of their original capacity within twenty years are common. It is true the pipe can be cleaned and the original discharging capacity restored, but sometimes within a year after cleaning, the results are as bad as before.

Coatings or paints for cast-iron pipe have all been tried without permanent success. Cement lining is expensive and materially reduces the discharging capacity. Cement lining is best when applied to wrought-iron or steel pipe, as has been proved by over thirty years' experience. The only difficulties were with the joints, the tapping and the competition with cast-iron pipe. But this kind of pipe became discredited due to certain pipe contractors, who tried to reduce the cost by cheap workmanship, and the use of lean mortar.

For low head and large sizes reinforced-concrete is practical and successful, particularly since good and economical expansion joints have been designed. For high heads it will in all probability be necessary to use a thin sheet steel tube within the reinforced concrete. Some firms are now ready to furnish, install and guarantee this class of pipe for almost any conditions and pressure. It has the great advantage that it can be fabricated complete in large quantities at or near the site of the installation, which is impracticable with any form of metal pipe.

Wood pipe has for many years been exploited and used as a substitute for wrought-iron pipe. Where the material, design and construction have been good and the conditions suitable these pipe installations have been satisfactory for pressures below 150 lb. per square inch.

[The author next described the various types of wood-stave pipe—sectional and continuous—and pointed out some of the factors governing their satisfactory use. A considerable part of the paper related to the leaks in and satisfactory repairs of the sectional, machine-bound wood-stave pipe line at Norfolk, Va., described at greater length in *Engineering News-Record*, Sept. 8, p. 396. An article by Mr. Ledoux giving detailed cost estimates for cast-iron and wood-stave pipe for a pumping main, taking carrying capacities into account, appeared in *Engineering News-Record*, Nov. 11, 1920, p. 932—Editor.]

*Discussion*—A variety of opinions as to the pressure wood-stave pipe will stand were expressed. Allen Hazen declared that under very heavy pressure wood-pipe is sure to leak.

## Some Dams of the Ancients

### Earliest Masonry Dams Had Base Four Times the Height, But With Improved Methods the Romans Reduced This Ratio to Three to One

By Charles Prelini
Civil Engineer, New York City

DAMS are probably the least known structures of past ages. All that is generally known of them comes to us because they have been mentioned by some historian, or slightly hinted at in the reports of different explorers. Unfortunately the explorers have never paid much attention to engineering structures as such, and in most instances only the length and height of the dams have been recorded, and not the base. Consequently we are unable to determine any rule followed by the ancients in the design of these interesting structures.

One of the most ancient dams on record is the Marduk dam erected across the river Tigris to regulate the waters of that troublesome river. Built in prehistoric times it survived the Chaldean, Assyrian, Persian, Greek, Roman, and Sassian dominations, and it was breached and fell in ruins at the time of the Mongol invasion towards the end of the 13th or the beginning of the 14th century of our era. This magnificent dam, according to a description found in a clay tablet, was built by Marduk (the Nimrod of the Bible), and was recorded in the following manner:

Flowing wide like a sea was the river, when Eridu was made, when E-Sagil was built:

E-Sagil in the midst of the fresh water deep, where the God of the glorious abode dwells.

Marduk laid reeds in the face of the waters:

He piled up the earth banks sheltered by the reeds; that he might cause the Gods to swell in the place of their heart's desire.

To this day the immense barrage across the ancient bed of the Tigris above Opis is called Marduk dam, which fully confirms the description of the clay tablet. The reeds mentioned as part of the construction of the earth embankment, probably were not simple reeds, but strong and resistent timbers laid in the "face of the waters" to arrest their course, and consequently a kind of cofferdam protecting the construction of the embankment. The fact that this timber work was erected to facilitate the construction of the embankment is clearly indicated in the clay tablet with the words: "He (Marduk) piled up the earth banks sheltered by the reeds." Marduk may have left this timber work within the embankment to consolidate the structure to give a stronger foundation, decreasing the chances of its being washed out and carried away during the freshets. It has been a common practice with the nations of antiquity to consolidate even the masonry walls with timber works, as found in Asia Minor, Greece, France and Scotland.

The most ancient masonry dam of which we have a record was built by Menes, the first king of the first Egyptian dynasty, over 4,000 years B. C. It was built at Kosheish about 12 miles south of Memphis, to intercept the course of the Nile river so as to lead it into a canal, diverting the river from the locality where Menes built the city of Memphis. It was built of cut stone masonry, as recorded by Herodotus and attested by its ruins, which are still in existence. We do not know the dimensions of this important structure but

from the width and depth of the river and height of the banks and annual inundations, it must have been no less than 1,500 ft. long and 50 ft. high. The dam built by king Menes was kept in perfect condition under the Egyptians, Persians, Greeks and Roman rulers or for a period of more than 45 centuries, but it was neglected and ruined during the Caliph's domination, when the lower part of the city of Memphis was flooded again by the periodical inundations, and most of the ancient monuments were destroyed, or buried in the muddy deposits of the river.

### Largest Dam in Arabia

The largest masonry dam ever built in the world was erected in connection with the irrigation works in Yemen, Arabia. Only a few explorers have visited the ruins of this interesting structure, and unfortunately they were not technical men. Some of these explorers, however, have given the height and base of the dam, which enables us to learn something concerning the rule followed by the ancient engineers in designing such construction. Lokman, king of the Sabeans about the year 1700 B. C., built a very large reservoir for irrigation and water-supply purposes. This was formed by intercepting with a very large masonry dam the course of the Wadi Shibwan at a point about 6 miles from the city of Saba. The dam was 2 miles long, 120 ft. high and 500 ft. wide at the base. It lasted for nearly 2,000 years, collapsing at the beginning of the 3rd century of our era, causing a disastrous flood, which is still recorded in the Arabian literature. Before the total collapse, the dam must have given some indications of its dangerous condition, since Arabian history mentions the fact that the owners of the irrigated lands, some time before the disaster, sold their properties and emigrated. The immensity of this dam can be deducted from the enormous amount of stone masonry required in its construction, estimated at not less than 15 million cu.yd. The proportion of base to height of the Saba dam was 4 to 1.

Maspero claims that the great fertility of the Fayoum in Egypt was not due to the existence of the famous Lake Moeris as described by historians and geographers of the antiquity, but to numerous artificial lakes formed by impounding the waters of the different ravines that entered the Fayoum. In support of his theory he mentions a dam across the Wadi Gezzaweh discovered by Dr. Schweinfurt in 1885. The learned archeologist has not given all the necessary dimensions of this important engineering structure, but he says the ravine is about 240 ft. wide and the banks 40 and 50 ft. high. The dam is 143 ft. wide at the base and was formed of three different materials. The lower portion is composed of irregular stones of not large size embedded in clay; the next layer is formed of irregular limestone blocks piled up as is our riprap work and the upper portion of the dam is composed of cut stones laid in horizontal courses and forming a series of steps, the upper course always receding from the one below it. The central part of this structure was carried away by the force of the torrent, but close to the abutments the original structure is still standing for almost one-fourth of its width. In the absence of the height of the dam, which is not given, we may suppose that it was somewhat lower than the banks and consequently it must have been about 36 ft. high. Comparing the base with the height these are in the exact proportion of 4 to 1.

The Romans built many dams, some of which have entirely disappeared, while the ruins of others are still in existence. Yet no one has investigated the dimensions and methods of construction of these important structures. The only thing we know is that they were composed of massive masonry of great resistance and longevity. The one built by Emperor Nero at Subiaco lasted 13 centuries, as attested by a document recording the data of its collapse. A study of the Roman dams could be made by an inspection of the ruins of those built in the African provinces in connection with irrigation. The Romans certainly built dams which were watertight, and were strongly built of regular cut stones laid in lime mortar, and probably they reduced the thickness of the base of the dam to three times the height. Such a practice must have been continued all through the Middle Ages, since we find the early Elche dam in Spain, built by Moors in the year 913 under the reign of Abderraman III, was 52 ft. high and 159 ft. thick at the base; that is, a base three times the height.

### Cross Sections Not Known

If we lack information about the dimensions of the dams built by the ancients, we know less concerning the cross sections of these structures. Considering, however, that the masonry dams were the successors of the embankments, they must have been constructed with the main characteristic features of the former structures. A masonry dam was probably designed with a level top, and the front and back faces sloping in the opposite directions, resulting in what we call today a trapezoidal profile. The sloping faces were not formed with an even surface but in a series of steps of small height as seen in the Egyptian dams, a feature which has been preserved for many centuries, since it was used also by the Moors in the middle section of the Almanza dam. Most of the ancient reservoirs were deprived of spillways, the series of steps on the downstream face of the dam greatly facilitated the fall of water overflowing from the top during the freshets. The steps prevented the water from acquiring great velocity, which would have been disastrous to the structure, undermining its foundations. The different materials employed in the construction of the Wadi Gezzaweh dam were probably laid with different slopes, thus giving a profile composed of lines of various inclinations, after the manner used by the French engineers in designing dams.

It would be very important to know what kind of binding material was employed to connect the stones in the construction of the ancient dams. Clay, asphalt and lime mortars have been employed by the nations of antiquity in the construction of walls. In Egypt, lime mortar was used since pre-historic times, while in Chaldea, as far as we know, it was employed only at the time of King Nebuchadnezzar. Such a fact may lead to the discovery whether the Atheim and Dyalek dams were really built at the time of the great improvement on the Tigris River, or are of more recent construction, replacing those previously built which were destroyed. It will also indicate if the Saba dam was built either by Egyptians or Chaldean engineers and consequently indirectly prove the rule detected in the design of the ancient structures, whether it was the practice of only one country, or a general rule followed by all the engineers of antiquity to make the base four times the height.

# City Surveys of Rivers and Harbor at Milwaukee

## Triangulation on River Channels to Establish Dock Lines—Hydrographic Work in Lake—Organization and Equipment—Field Work and Mapping

A RECENT triangulation survey of the harbor and waterways of the city of Milwaukee, covering approximately 23 miles of dock frontage or 11½ miles of rivers and canals, has been made for the purpose of definitely establishing dock lines, correctly mapping the existing water front and providing a base for future surveys for harbor and water-front improvements. The harbor includes a natural outer harbor on Lake Michigan, protected on the north and south by large points of land, and an inland harbor composed of rivers and canals which afford dockage and transportation facilities for industries. In 1874 the City Council established dock lines along the Milwaukee, Menomonee and Kinnickinnic rivers, but in later years these lines were ignored more or less and encroachments into the water were made when many of the docks were built.

The Harbor Commission, an honorary body appointed by the mayor in 1913 to protect the city's interests from private encroachments, found that maps and data in the city's possession were not up to date and were not reliable. Harbor limit lines had been established by the U. S. Engineers in 1906, and it became necessary for the city to see that no encroachments were made over them. These limiting lines had been laid down from a triangulation survey but had not been referenced to city street corners in a sufficient number of places to make it practical to use the lines for construction purposes.

In order to determine the conditions, the City Council, in October, 1915, authorized a triangulation survey to be made from which the co-ordinates of all street corners and monument stones in the vicinity of the river could be found and also the location of all improvements along the river. Buildings, docks, railway tracks and street lines were to be drawn on large scale maps and the Government's limiting lines and the old-established city dock lines then projected upon these maps. With these data new dock lines could be laid out and permanently established which would be tied in to all street corner stones by means of co-ordinates. Fig. 1 shows the area and waterways included in the survey.

### Survey Work and Equipment

The triangulation survey consisted of quadrilaterals spanning the rivers and linked to one another. The precision necessary to obtain the desired accuracy of maps was decided to be not less than 1 in 20,000, and in order to secure this result the steel tapes were standardized, using a 20-lb. pull with an ordinary spring balance. It was found necessary to standardize the tapes about once a month, owing to variation in length All measurements were made using a spring balance and plumb bobs. Thermometers were used, the temperature being recorded and the proper correction made to the measured distance. In each quadrilateral, twelve angles were read, as shown in Fig. 2, each angle being read by repetition six times, three direct and three reverse.

A system of azimuth control lines was run for each river, these lines being connected with a line of every third or fourth quadrilateral, as shown in Fig. 3. These control systems were started at the upper end of the river from lines whose azimuth was found by reading twelve angles to Polaris and checking in the same way. All angles in the control system were read twelve times, six direct and six reverse, and were checked by reading to complement in the same manner.

As the work progressed down the river, side traverses were run from the quadrilaterals down the adjacent streets, so that all street corners and permanent points could be located from stations. It should be understood that nearly all of the quadrilateral stations were not permanent, as it was found that monuments placed near the dock front would shift out of position. Existing docks

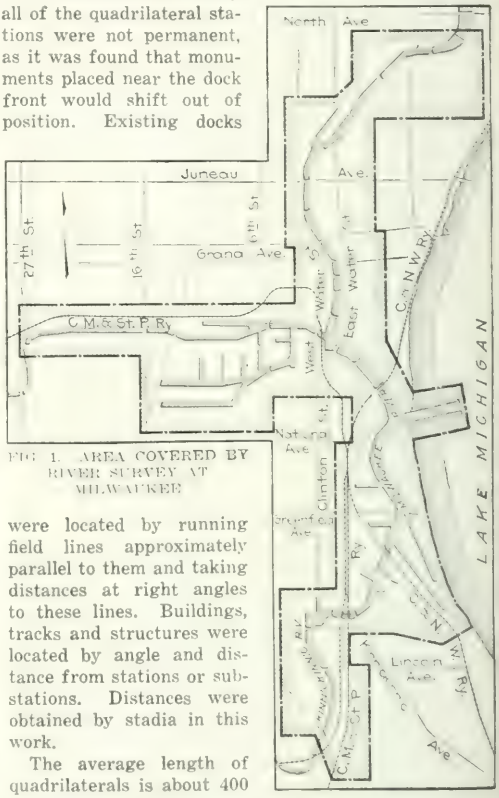



FIG. 1. AREA COVERED BY RIVER SURVEY AT MILWAUKEE

were located by running field lines approximately parallel to them and taking distances at right angles to these lines. Buildings, tracks and structures were located by angle and distance from stations or substations. Distances were obtained by stadia in this work.

The average length of quadrilaterals is about 400 to 500 ft., being the distance from bridge to bridge, but this length varied with the width of the river, as wherever possible the angles in the quadrilaterals were kept larger than 20 deg. In order to do this the quadrilaterals in the sections where the river was narrow were much shorter than in those sections where the river was wide.

*Equipment*—The principal equipment of the field party included the following: Transit with 7-in. horizontal circle marked with two rows of figures, reading 0 deg. to 360 deg. both ways and having two double verniers exactly opposite, reading to one minute; Philadelphia rods for stadia work; wood octagonal range poles, 6, 8 and 10 ft. long; steel octagonal range poles, 6 and 8 ft. long; 100- and 200-ft. wire-ribbon tapes;

50-ft. steel and 50- and 100-ft. cloth pocket tapes; plumb bobs, 8, 12 and 16 oz. and 4 lb.; 40-lb. sportsman's spring scale, steel pins and a heavy tripod from an old camera converted for holding a range pole.

### Organization of River Survey Party

Only one party has been engaged on the field work and this party normally consisted of the chief of party, an instrumentman, a notekeeper and two rodmen. When certain parts of the work, such as the hydrographic

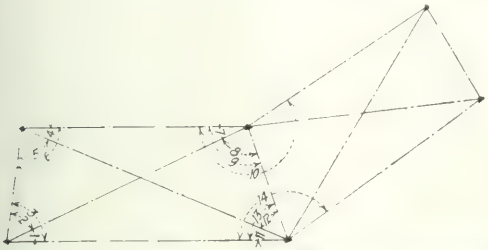


FIG. 2. CONSECUTIVE READING OF ANGLES IN SURVEY

survey, required more men, they were taken from other parties in the city engineer's department.

The chief of party kept ahead with a reconnoissance survey approximately locating quadrilateral stations, laying out traverses, looking up street corner stones and office data. It was his duty to see that all street corners needed by the river survey were surveyed and located by the city's division engineers and to see that they set stones at these corners if possible. He generally started the field party each day by giving instructions for the work to be done and then he went out on reconnoissance or laying out advance work, returning to the field party to decide any questions which might have arisen. The chief of party also supervised the draftsmen and explained points not quite clear in the notes. During the winter months he had charge of the compiling of the computations.

The instrumentman had charge of the field party in the absence of the chief of party. He read all angles and did all the instrument work; taking the head end of tape on all chaining while a rodman gave line. Wherever possible all distances were taped and checked, so as to have several measured base lines from which to compute unknown sides. Three men did the taping. Two men had plumb-bobs and set the distances by means of pins, while the third man applied the correct pull by means of a spring balance hooked to the end of the tape. The tape was never laid on the ground or supported in the center, but always hung free from the ends.

The notekeeper kept all notes and made all field sketches. As the reading of angles in quadrilaterals required a large amount of time, he would often go ahead and make sketches of tracks, buildings or docks while the instrumentman kept his own notes of the angles read, which he would give to the notekeeper later in the day. This saved considerable time. It has been found that attempting to speed up the work in the field by taking notes and sketches which are not neat and well drawn is wasteful. When plotting such notes during the winter, more time will be lost in deciphering them than was saved by the speed in the field, and it may be necessary to go back and relocate some of the questionable points. It is considered that the notekeeper is the last man to be crowded for speed.

The rodmen held range poles over the stations, carried the stadia rod, and helped in the taping and all other incidental work. With the tripod already mentioned, a range pole could be plumbed over a point that was to be used for a long time as a sight. When

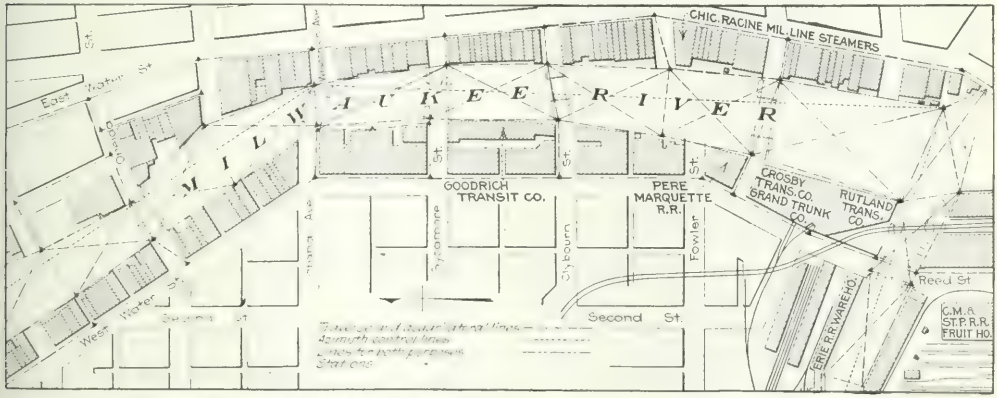



FIG. 3. RIVER SURVEY MAP SHOWING TRIANGULATION AND CONTROL LINES

using this stationary rodman or fixed sight, the rodmen could give sights at other points and thus save time.

### Stadia Work and Obstruction

Buildings and tracks near the docks were located wherever possible by taking right-angle distances from stations on temporary survey lines run parallel to the dock. Buildings and tracks at some distance from the river, which would not enter into the direct solution of laying out new dock lines, were located by stadia. As stations and sub-stations were close to each other it was seldom necessary to take longer sights than 300 ft. in this stadia work. Only the main corners of the buildings were located by stadia, as the buildings were then measured up with a cloth tape and the distances shown on the sketches.

In some cases where obstructions came in the line

of sight it was necessary to build cantilever platforms from the docks, over the water, upon which to set up the instrument. Such a set-up is shown in Fig. 4. When such stations were used all the necessary field work from them was completed as quickly as possible so that the platforms would have little time to shift out of place before all sights were taken to and from them. Other stations were located on the roofs of low buildings. In general the stations were located approximately at the same level so that no instrumental errors due to the vertical angles entered into the readings of the horizontal angles.

*Recording and Marking Stations*—Stations were set usually on more or less permanent structures such as

FIG. 4. A SURVEY STATION FOR RIVER TRIANGULATION ON A CANTILEVER PLATFORM PROJECTING FROM DOCK WALL.

bridge abutments and concrete walks, but where this could not be done sub-stations were set on some permanent structure or on stones and tied in with the main stations. On all such permanent structures crosses were chiseled at the station points, and these were tied-in to arrow marks cut in buildings or structures of a permanent nature. Should any of these stations be destroyed they can can be reset from the tie-in arrows in most cases. The arrows may be used also to locate stations covered by snow, ice or piles of materials. The tie-in points are used also to check stations, to determine whether they have shifted before using them for running dock lines.

Stations were numbered from No. 1 on each river. The sub-stations were followed by letters, as 15-A or 17-A and 17-B, if two sub-stations were set from Station 17. No numbers were chisled near the stations in the field as it was found that the care and time necessary to do good work in cutting these numbers was too great for the advantage gained.

Stones were set wherever possible on street corners that were used in the river survey, but in the downtown districts this was impossible on acount of buildings. In such cases offset points were set from both the intersecting street lines and the point was chiseled and co-ordinated.

### Lake-Front Hydrographic Survey

The city has a line of survey stones about 500 ft apart in a line parallel to the shore along the lake front, for which the co-ordinates are on record. In order to get soudings in the bay, a base line of 1,500 ft. was run between two of these stones and stakes 100 ft. apart were set on this line. The party for the hydrographic survey consisted of two instrumentmen and two notekeepers on shore, with two oarsmen, a sounder and a notekeeper in the boat. The notekeepers had their watches set alike. The sounder had an 18-ft. sounding pole and a red flag. The idle oarsman held the stadia rod. One of the shore instrumentmen had a white flag. To take soundings at right angles to the line of stakes at every 100 ft. stake the following method was used:

Let the shore instrumentman with a white flag be "A" and the other shore instrumentman, "B." When "A" set up his instrument over stake No 1, where the work was to start, "B" set up his instrument over stake No. 10, 1,000 ft. away. Both "A" and "B" sighted at each other and "A" turned off a 90-deg. angle and started the boat out on this line. When the boat was on line the sounder would wave his red flag and sound. All notekeepers would read the time and "A" shore instrumentman, would read stadia distance and angle if the boat had drifted off the 90 deg. line. The "B" instrumentman would only read the horizontal angle. Both "A" and "B" used the stadia rod for target.

The boat would then be rowed further out in the lake, getting line from the "A" instrumentman who was set on 90 deg. again. The distance rowed out would be dependent upon the variation of the lake bottom. The sounder would wave the red flag again and the operations would be repeated.

This would be continued until the boat had sounded out to the distance wanted, which was 1,200 ft. from the shore. After the boat was out some distance, "A" instrumentman would have some difficulty in reading stadia and would mark shots he was not sure of. After the line was completed from stake No. 1, "A" instrumentman moved to stake No. 2, "B" instrumentman staying at stake No. 10. After getting a sight on "B" again, "A" would turn off 90 deg. and line in the boat, which would work towards shore, the method of taking sounding being as described. In this manner four or five lines were sounded and then "B" would move down to stake No. 15 until the soundings were complete to stake No. 10 and "B" would move to stake No. 5.

From this method of getting the field data very few if any shots were lost, as there were several checks. Each notekeeper numbered the shots that were taken, so that with the time recorded and a check by stadia distance, one of the instrumentmen might miss a sounding without getting the whole of the notes confused. The plotting of the first soundings taken without changing the "A" instrument from stake to stake and turning off right angles to line in the boat, showed that in some

cases the boat had drifted out of line so much that the soundings were 200 to 300 ft. apart instead of 100 ft., while in other cases there was a repetition of soundings at the same point.

### Computation and Office Work

All quadrilaterals on the rivers were adjusted separately and connected, after which preliminary co-ordinates were computed. Having the location of all docks and co-ordinates for all street corners, monument stones and stations near them, both planing and construction of river improvements and river front work can be laid out from these points. This work is now being completed, and the ordinances are being revised to cover the proper dock lines. It has been found desirable to change some of the U. S. Government limiting lines and when the work is complete the new dock lines will be submitted to the U. S. District Engineer to be sent to Washington to be sanctioned by the Chief of Engineers, U. S. Army.

The detail maps, to a scale of 1 in. to 30 ft., are drawn on sheets 42 x 72 in. The index maps are on a scale of 1 in. to 100 ft. The co-ordinates of stations and the directions and distances of survey lines have been kept in loose-leaf books, in which they are filed at present. It is proposed to show these on the map tracings after the office work has been completed and the U. S. Engineers have sanctioned the new dock lines.

The advantages in using triangulation from co-ordinated street intersections and stones over other methods of survey has been established during the four years' work. Along the river in business sections of the city where obstructions are such that it is nearly impossible to see through with the old method of survey, it has been found very simple to use the co-ordinated points of the triangulation system. This has also eliminated the carrying of lines for several blocks by angle and distance in order to stake out a small piece of dock. Bridges have been staked out in much less time and greater accuracy than by the old way.

The greatest advantage of the co-ordinate system is that in planning work in the office for new bridge or dock frontage, the exact location of such work can be determined from the maps without extensive preliminary surveys, and the work as planned can be located in the field from the co-ordinated stations.

Dock lines were given formerly by the city's division engineers and were described by distances from streets parallel to the docks. But these distances were given only at angle points. When lines had to be given for the construction of a short piece of dock or wharf halfway between the tie-in lines or distances it was necessary to make a field survey to find all angles in street lines and between the intersections of street lines before any computations could be made for staking out the work by going through an alley or between the buildings. This often took two or three weeks to give dock lines that can be staked out now in a day or two by using the triangulation stations as base lines.

This river survey has been made under the direction of the city engineer, Geo. F. Staal, but has been interrupted at times in order to use the party on another large survey for the harbor development plan. The work was stopped entirely for two years during the World War. Beginning with Jan. 1, 1921, the work is being done directly under the Harbor Commission, but previously the Commission turned over a part of its funds to the city engineer, who had a party engaged on the work. The field work is completed, but there are still some maps to be drawn and numerous tracings to be made. As the money has to be furnished from the Harbor Commission fund the work cannot be pushed by engaging a number of draftsmen but must be carried out by the one party which is doing all other engineering work desired by the Commission. This survey was in charge of Ralph Cahill in 1915 and C. S. Gruetzmacher during 1916, but since Jan. 1, 1917 it has been in charge of Herbert C. Schmitt, assistant harbor engineer, who has furnished the material on which this article is based.

---

# Handling Breaks in Irrigation Canal Embankments

## Emergency Outfits Stored in Lockers—Questionnaires and Information Needed Regarding Breaks Posted Near Canal

By R. M. Adams
Civil Engineer, Rocky Ford, Col.

THE procedure of getting quickly to a break in a canal bank has been given too little attention by the irrigation managers of the inter-mountain country. Although the writer has worked on several of the large projects he has yet to find one which has an efficient system worked out for meeting quickly any and all contingencies that arise at times of washouts in large canals.

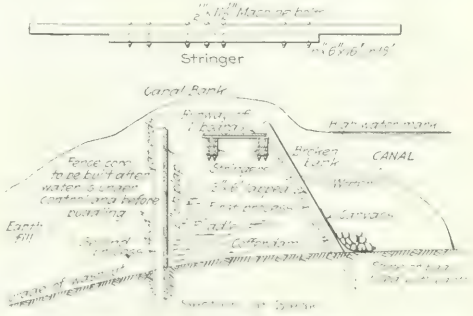



FIG. 1. FENCE CORE METHOD FOR SMALL BREAKS

While superintendent of construction of one of the largest irrigation systems in the country he proposed a system that would make it possible to get breaks repaired quickly and for small overhead expense. A list of the repair materials and tools suggested is listed below. It is incomplete, but will be corrected when time shows up its deficiencies. There was not installed, however, what the writer considers a most important procedure of any recommended, i. e., the posting of a questionnaire to which anyone who first locates a break may refer for the information most needed at headquarters.

In any emergency the operating force must be under instructions and know the prearranged plan if the efforts of the construction and repair gangs are to be quickly and efficiently of use. All openings in canal

banks found by an employee of the canal company and not immediately repaired by him should be reported by the quickest means available to headquarters. The following facts should be given in every instance: (1) The location of the opening with respect to some well-known structure, to a mile post, or with respect to the owner of the land immediately below the opening; (2) the best way of getting into the right-of-way of the canal, if the water has covered roads, and means of approach if the canal bank is cut off; (3) the width of the opening when last seen, the amount of water flowing and the rate at which the bank is disintegrating; (4) the opening of any spillway to relieve the canal of the head of water running at the break, and what, if

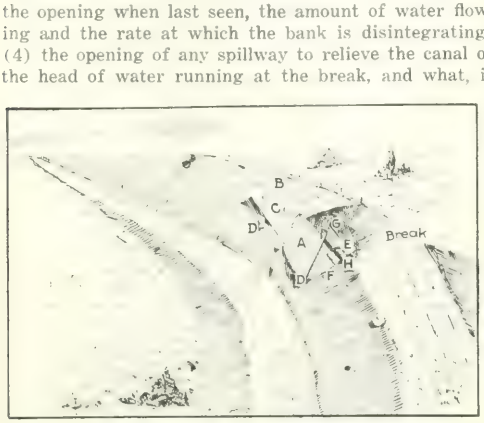



FIG. 2. HOG WIRE AND CANVAS FOR HOLES NOT OPEN TO TOP

A is hog wire, cut off at brook, held in place by iron pins B, C is canvas, cut away at opening. Both wire and canvas are supported by pole G. Sacks D hold down wire. Sacks E and F make first and second wall to hold puddle H.

anything, has been done to stop the water running out.

With these facts established, the construction superintendent at headquarters will be able to load out on trucks and automobiles such personnel and equipment as the case will demand. As a secondary precaution, such tools and materials as would be needed in the worst contingency that could result from a break at the place reported, are loaded ready to send on a moment's notice. Men and tools to repair a 4-ft. break may be loaded into a five-passenger Ford car and driven to the scene of operations at the rate of 30 miles an hour over good roads. For a break the width of which is over 10 ft. trucks may carry tools, materials and laborers, at a rate of from 15 to 30 miles an hour.

To assure small loss of time in attending a washout the four required statements concerning a break should be posted at the homes of all farmers, or others, who live immediately under the canal. A large percentage of the reports of trouble comes from people who live near the canal and it has been found that ordinarily the ideas conveyed to the headquarters office are misleading and erroneous. If the informants knew just what to look for in order to make a report, more definite action could be taken immediately.

If the methods described are used, in most cases the water need never be turned out of the spillways to relieve a section at a break. Only such breaks as are close to a spillway or to the upper end of the canal need have the water turned out for the efficient repair of the bank, unless the length of the opening is over 50 ft., or a somewhat lesser length when the banks are built of material that erodes quickly.

In addition to the list of tools, shown in the accompanying table there is appended a sketch of the process of repairing a small break. For a larger place most of this material would be out of place and too slow.

In repairing breaks which have not opened the top of the bank it is possible to replace the cofferdam of

EMERGENCY TOOLS FOR CANAL BREAKS

To be kept in lockers, securely locked

| | |
|---|---|
| 2 single-bitted chopping axes | 1 piece of canvas, 10x20 ft |
| 2 post mauls | 1 ball binding twine |
| 2 striking hammers, 3 lb. | 2 large sacking needles |
| 2 ripping hammers | 1 6-ft. crosscut saw |
| 2 hand axes | 1 pea'x |
| 2 doz. ¾x11½-in. machine bolts with washers and two nuts on each bolt | 1 42-in. duckbill timber carrier |
| | 2 pairs of heavy wading breeches |
| 1 keg 10d nails | 1 brace and set of bitts |
| 1 keg 30d nails | 2 seven-point hand saws |
| 1 keg 60d nails | 1 steel carpenter's square |

To be kept in bundles, and used only in emergency

| | |
|---|---|
| 3 picks with handles | 3 grub hoes with handles fitted |
| 6 l.h.r.p. shovels | 1 logging chain with hooks |
| 2 saw trestles with 30-in. legs | 2 bundles (100 ea.) cement sacks |
| 100 ft. ¾-in. manilla rope | 1 diaphragm pump |

To be kept in bulk and used only in emergency

| | |
|---|---|
| 3 pcs. 6x6 in.—18 ft. | 6 pcs. 4x4 in.—16 ft. |
| 3 pcs. 6x6 in.—16 ft. | 20 pcs. 2x4 in.—any length |
| 10 pcs. 2x6 in.—16 ft. | 300 lin.ft. 2x6 in.—any length |
| 2 two-horse fresnoes | 30 pcs. shiplap, 2x10 in.—length unimportant |
| 6 slip scrapers | |

the sketch, Fig. 1, with an obstruction made of hogwire pinned down to the slope of the bank on either side of the opening by 4-ft. iron pins. The pins should preferably be placed at some distance from the edge of the break, and if carried back far enough may all be above the water, as at *B*, Fig. 2. Canvas may then be placed over the hogwire and weighted with sacks of earth on the outer and lower edge. The last process of tightening up is then done by throwing earth from the bank onto the small leaks remaining under the canvas. To prevent too much sag the hogwire is generally reinforced by one or two posts fixed as at *G* after the water, is cut off. Then a row of half-filled sacks is placed as at *E* and a second row at *F*, some 6 ft. from that at *E*. Puddle is then put in between the two rows of sacks. This construction takes the place of the fence core in Fig. 1. In an actual case the water was cut off in 20 min. after the materials arrived at the break. Three men did the work and the whole repair was made in 3½ hours.

The total cost of the tools and equipment, not including the timber and the lumber as given in the list above is about $250. This figure includes wrenches to screw up the nuts as given in the list, also hogwire, canvas, a pair of 12-in. side-biting lineman's pliers, 300 ft. of soft core cable, Crosby clips, a snatch block, 100 ft. of ¾-in. sash cord for casting and a crowbar or two.

Whether the method as shown in Fig. 1 is used or one similar to that shown in Fig. 2, the water will be in the lower reaches of the ditch long before it would were the water cut off to repair the break. If the latter process is used slip scrapers can be used on each broken end of the bank as soon as the line of sacks is built up under the bank end whether or not the middle portion of the breech has been walled up with sacks. There is no other way that backfilling can be done until the space between the fence core and the cofferdam is entirely filled with puddle to the height of the dirt outside the fence core. The fence is a rectangular, square-cornered thing, and a trench just the right dimensions must be made for it. In the sack wall method, any shape will be fitted by the sacks of earth snugly and solidly.

# Rival Arguments on the Public Works Department

## American Association of Engineers Replies to Statement Against Department Ascribed to Chief of Engineers

UNDER the title "Reorganization of the Government Departments" the American Association of Engineers has just issued a pamphlet of 25 pp. which not only contains a "suggestive plan for grouping engineering activities to effect economies" in the government departments, but also answers in some detail a statement entitled "Proposed Department of Public Works" which the A. A. E. pamphlet assumes to have been issued by the Chief of Engineers, U. S. Army, to his officers and assistants. While this assumption is doubtless correct, it should be stated that the document in question, in one form a folio typewritten manuscript of 19 pp., is anonymous and is not openly acknowledged by the office of the Chief of Engineers.

The manuscript statement, "Proposed Department of Public Works," is an argument against the adoption of such a department. It starts off with the assertion that the engineering work of the different departments of the government is only incidental to the primary functions of these departments, and cites the Indian Service, which requires lawyers, engineers, teachers, doctors, and ministers of the gospel. The argument continues "It is plain that efficiency would not be promoted if all the legal work of this service were intrusted to the Department of Justice, its engineering work given to the proposed Department of Public Works, its teachers placed in the Bureau of Education, its doctors in the Public Health Service, and its ministers in the Chaplains Corps."

The argument next refers to the referendum of the Chamber of Commerce of the United States, which was against the Public Works Department. It follows with a claim that the proposal to limit the President to an engineer for appointment as secretary of the department is unwise and probably illegal and contrary to the spirit of our institutions. It claims that such departments in other countries and in states have no wholesale collecting together of large and diverse bureaus, but only a few separate engineering functions, such as, for example, roads, bridges, and canals. "No country has actually tried to place all kinds of engineering work in a single department."

### Military Construction by Army

In consideration of the bill proposed for a department of public works, the argument says that "the provision transferring military construction to the War Department would certainly lead to lack of co-ordination and to the waste of public funds in times of peace, and to worse results in times of war; while the provision transferring the river and harbor activities from the War Department would sensibly diminish the resources available to the country for national defense, and in normal times produce increased expense rather than economy." The argument then proceeds to analyze the functions of the various branches of the government which are to be included under the proposed department, prefacing the analysis with a claim that the activities which the bill proposes to transfer are essentially independent lines of work, and argues that one would not expect a great firm of architects to undertake the wholesale construction of inexpensive dwelling houses; or engage dredging contractors to build a reservoir in the hills.

In the analysis of the river and harbor improvement work, the argument emphasizes the highly specialized character of this work, the difficulties in training men to understand it, and the necessity for long experience before responsibility can be placed. It is stated that the problems of the Reclamation Service, for instance, are in general directly opposite to the problems met in river and harbor improvement, with the consequent deduction that there is no reason why the experience of the one should be of help in the other. It is insisted that the administration of the laws of navigable waters is one of the most important duties under the River and Harbor Act.

Continuing the analysis of the various departments, it is stated it is a mistake to think that the same preparation is needed for the land surveys of the Geological Survey and for the hydrographic work done by the Coast Survey. There is an apparent overlapping of the map work done by the Geological Survey, the Coast and Geodetic Survey, and the Corps of Engineers, but this overlapping is small, since each of the services makes full use of the work done by the others. It is argued that the Bureau of Standards, the Bureau of Public Roads, and the Forest Service are all of such special character that it would be better to have them independent and that there is nothing to be gained by interchangeability of personnel, although it is added that "as a part of its duties as military engineers, the Corps of Engineers of the Army must be familiar with highway work, and has performed important work of that character in the past."

### Defense of the Corps of Engineers

Following paragraphs argue against the transfer of army construction from under the War Department and of the taking of the river and harbor work from the Corps of Engineers. The latter arguments take up practically all of the rest of the document and are the most elaborate of the whole statement. It in effect is a defense of the Corps of Engineers both in its peace-time and its war-time activities. Certain sentences will be quoted at random to indicate the trend of the argument.

It is idle to elaborate on the fundamental principle that the defense of the country is the first duty of the government. Wherever the military resources of the country can be increased without undue cost, the necessary measures to that end are desirable. But when the test of war has just proved that a certain organization of the government adds material military resources for the defense of the country, without cost to the United States, it is folly to entertain the idea of its destruction. . . . The engineer troops of the United States forces . . . were organized and equipped with a minimum of friction or delay. . . . While other bureaus may have been swamped by demands incident to the war, the Engineering Department successfully expanded without any fundamental reorganization. . . . It thus fell to the small nucleus of regular officers of the Corps of Engineers to supervise and operate an organization more than twice as large as our pre-war army, and engaged in work which involved every conceivable form of engineering practiced by the profession in the United States. . . . It would have been impossible had not the Chief of Engineers had at his disposal a group of officers who were acquainted with the personnel and practice of the engineering profession, and competent to

direct members of that profession; and who at the same time, by virtue of being commissioned officers of the army, were able to co-ordinate the work done with military exigencies. This combined training in civilian and military practice has been attained only by the existence in time of peace of a group of officers engaged with profit to the nation in river and harbor improvement, but with the military training and experience to mold, train, and direct the mass of engineer material which in time of war is so hastily summoned. . . . In time of peace the Engineer Reserve Corps looks to the regular officers of the Corps of Engineers for such training and organization as is given them. . . . To take away from the Corps of Engineers its peace-time training in practical engineering is largely to destroy its ability to control and operate this splendid reserve from civilian life. . . .

The Engineer Department labors under no delusion that its performance during the past war was perfect. There were failures of individuals, not confined to those who entered for the period of the emergency. The failure of individuals to measure up to the demands of war is as unavoidable as are casualties from hostile fire or from disease. It can be met only in the same manner, by replacement of the individual. It in no way affects the organization as a whole. It is a fact that a considerable number of engineers were placed in positions where their abilities were not fully utilized. Such waste is, however, but an incidental feature of the wasteful business of war. It was far less than would have been the case had the regular officers of the Engineer Corps not been in a position in which they enjoy that extensive acquaintance with engineers in civil practice.

### Department Discourages Preparedness

The statement then argues against the theory that temporary duty under the Department of Public Works would succeed in giving the officers of the Corps of Engineers proper instructions, training, and experience because they would not have under the department proper responsibility. It is responsibility that they need in their peace-time activities. Furthermore, there is a danger that if the Corps were separated from its peace-time work and kept only on fortification work and military duties, it would become extremely difficult to justify the maintenance of a considerable number of engineer officers and the Corps would dwindle below the necessary strength as a protection against possible war. It is then stated that the Corps of Engineers have very much lower salaries than would be given to civilians on the same kind of work, so that money is saved to the government by the present arrangement. The conclusion is that the object of the bill and its effect if enacted into law is to relegate the officers of the Corps of Engineers in time of peace to study without practice, to deprive them of the possibilty of acquaintanceship with the profession which is necessary in war-time when it is their duty to so place civil engineers who come in as temporary officers as to obtain the greatest value of their services.

The final paragraphs state there is no widespread and well-founded public demand for the measure, but that it is merely a criticism of a policy of Congress; that the new department will merely provide an organization precisely similar to the Corps of Engineers, except that the men entering the new service would not have received the training traditional with the Military Academy.

After the argument against the department there are some pages devoted to a suggestion that the War Department would be glad to co-operate with other governmental agencies having duties allied to those of river and harbor improvement, and that the Chief of Engineers would be glad to join a conference for the purpose of formulating a program for any further co-operation that may prove to be practicable either as to expenditure of public funds or the more advantageous use of personnel and information now available. It is suggested finally that Interior Department has a number of its own bureaus which would bear consolidation and that such consolidation should take place before the general consolidation or reorganization of the government departments.

### A. A. E. Favors New Department

The A. A. E. pamphlet says that it has been prepared by some of its members to "serve as an answer to the circular recently issued by the Chief of Engineers of the United States Army to his officers, giving his reasons for opposing the reorganization of the engineering activities of the government." It starts off with an accusation that the Corps of Engineers realizes that if it were once to lose its river and harbor and other civil works, it would never regain them and that it is now making a desperate effort to hold the civil works which it still has. It denies that public works are incidental to the primary functions of the various departments. It states, on the contrary, that "the great bulk of our public works, other than those pertaining to national defense, rarely bear a close relationship with the departments under which they are at present." It contends, in opposition to the circular, that an architect would certainly be better fitted for the management of a large survey than a military commander or a collector of internal revenue; that he would be better able to undertake the wholesale construction of inexpensive dwelling houses, than would officials who had no technical knowledge of architecture. It asks the question, "Would not the ordinary general medical practitioner be better fitted to perform a surgical operation than the best lawyer at the bar?" It states that the proposed department would have experts in all lines, and the executive could always select a man who would be specially suited for any work. In addition to an interchangeability of personnel, there would result a corresponding interchangeability of plant and equipment.

It states that co-operation alone would not be sufficient and cites the case of the Board of Surveys and Maps which has been trying to co-operate for two years but which has reached no practical results.

The report denies the extreme technicality of the laws affecting navigable waters and doubts whether they could not be readily learned by a new group of men. It charges that the Corps of Engineers has not been particularly successful in the administration of the laws.

### War Experience of Engineer Corps

The argument then reverts to the war experience of the Corps, and states that the schooling of the army engineers on civil work was no real help to the engineering organization in France. "There are many regular army engineers whose work in France is entitled to the highest praise, but that in all fairness to the individuals concerned, there is much which indicates that the regular engineering organization, so far as that organization functioned in this matter, was as often an obstacle to the work in France as it was an aid in its execution. Much of the success achieved by many of the regular army engineers who were in France was due much more to their ability to get favorable action

at headquarters where they knew the ropes and could obtain a hearing, than to any previous schooling which these men had had with civil works." It is claimed that much of the most important engineering work, for instance, the railroad service, the chemical warfare service, the purchasing department, the construction and operation of the ports, the construction of many of the cantonments, hospitals, etc., had to be taken from under the Chief Engineer and placed with a temporary officer, generally a civilian at its head. "The Corps of Engineers as an organization by no means has the right to claim any major part of the credit for such engineering successes as were achieved in France, and cannot properly use such an argument in favor of its retention of civil works which are in no way incident to the primary functions of the army."

In opposing the control of civil works by army engineers, it is claimed that there are equally good engineers in the government service and that the army engineers only have control of it because of precedent; that conditions now are somewhat different than in the early days, in that the General Staff of the army has now control over the Corps of Engineers, and that the General Staff is not made up of engineers. It concerns itself solely with the efficient management of the army as a fighting machine, and so may possibly destroy the efficiency of the engineers in administering civil work. Instances of this are the frequent changes of station of the engineers, with the result that responsibility on work cannot be fixed, the man who makes the estimates very frequently not being the man who has to carry out the execution of the work.

It is stated that the army, outside of the Corps of Engineers, approves the separation of the Corps from civilian work. It is also stated that in no other country are the army engineers engaged in civil activities.

### Assistant Engineers' Status

Opposition to the ability of the Corps is made in a claim that the United States Military Academy is not an engineering school and that the men selected for the Corps because of their being at the head of their class are generally those of high mathematical ability, and that mathematical ability does not necessarily mean engineering ability. The lack of practical engineering training, such as the ordinary civilian engineer gets, is emphasized.

Several pages are devoted to the civil engineer's lowly position under the Corps of Engineers, and the un-American situation whereby there is a horizontal demarcation above which the lower grade men cannot possibly rise. It is also charged that on account of the enormous multiplication of paper work, in reality the clerks in Washington and in the various engineer stations control the activities of the Engineering Department.

The final pages disclaim any intention on the part of the writers of the report, at least, of forcing the actual construction work of the War or Navy Department into the proposed department. It is stated that all of those engineering functions necessary to those departments should be performed by themselves. The remainder of the report is devoted to an analysis of the proposed department not very different from analyses which have been made before. It includes in that statement that it is believed that the fortification and other engineering activities left with the army, together with the command and management of engineer troops therein, will offer all of the engineering schooling needed by these regular officers, will increase their usefulness for the army itself and will not entail so many delays and so much wastefulness as do the present methods."

## Airplane Shed With Special Roof and Door Construction

### Truss Sections With Interlocking Joints—Overhead Kneebracing—Counterbalanced Pivoted Door 21 x 100 Feet

IN THE construction of a shed for mail airplanes at Reno, Nev., a quick erection form of steel roof truss framing was adopted by the engineer, J. B. Strauss, of Chicago, and an adaptation of Mr. Strauss' well known form of bascule bridge counter-weighting was applied to the pivoted door which forms one entire end of the shed.

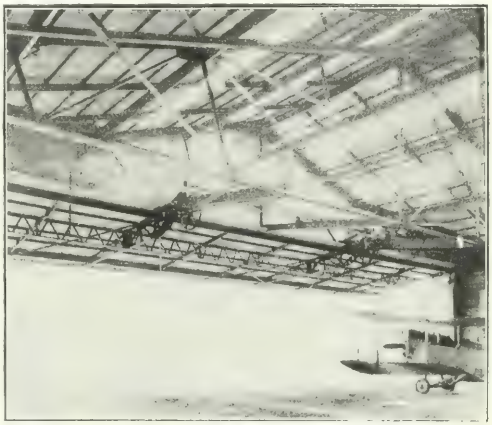


FIG. 1. RENO AERIAL MAIL HANGAR, SWINGING DOOR OPENED

This door, 21 ft. high and 100 ft. long, trunnioned at the top of the door jamb, can be opened in 20 sec. Its counterweight consists of a concrete mass supported by and inclosed in a latticed steel framing, of total weight 37,500 lb. It is held in vertical position, whatever the position of the door, by a counterweight connected to the roof truss. The door itself is covered with asbestos corrugated sheathing. A 5-hp. motor through a train of gears operates two pinions engaging cast-iron racks bolted to the door girders.

Eight De Haviland 4B airplanes can be accommodated in the shed, and in addition there is a complete workshop for building and repairing planes. The dimensions of the structure are 105 x 105 ft. overall with a clear vertical headroom of 18 ft. The roof trusses are carried by wide latticed steel side columns, and to avoid reduction of clearance at the corners by kneebraces are braced to the column above the sloping roof line by horizontal struts attached to extensions of the columns above the heel of the truss.

Quick assembly joint construction was developed by the designer to simplify the erection. Each truss was shop assembled in two triangular sections, leaving the center portion of the bottom chord, the middle hangar,

and kneebraces separate shipping pieces. To seat the heel of the truss at the column a shelf bracket was provided, the peak joint of the two half sections was developed as a butt joint, and the middle section of the bottom chord was fitted with lug plates at each end adapted to hook over and engage similar lug plates attached to the splice and bottom lateral plates attached to the truss section. It was therefore necessary only to lift the two truss halves into position and set the bottom chord section in place to engage, whereupon the truss was self-supporting and could be bolted up at leisure. The middle hangar and the kneebraces have ordinary bolted joints without lugs for quick placing.

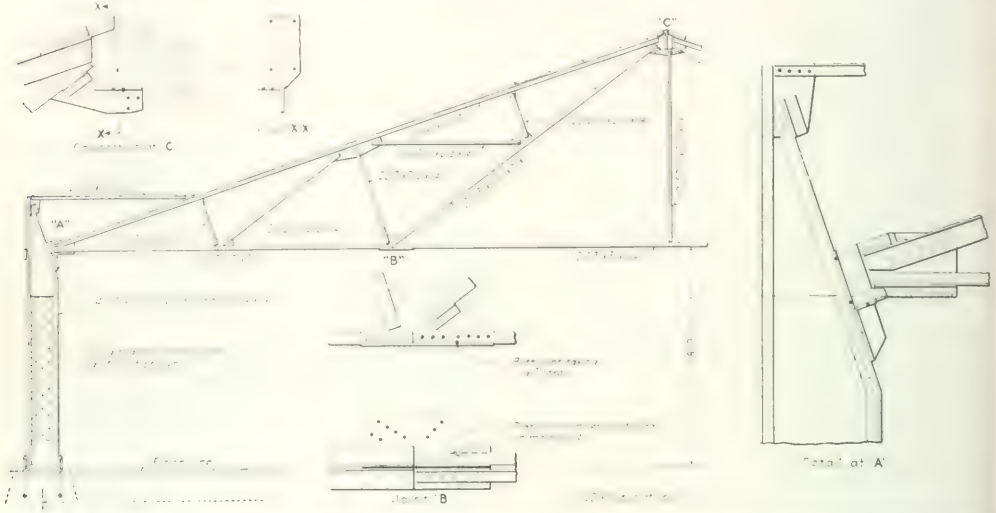



FIG. 2. ROOF DETAILS OF RENO AIRPLANE SHED WITH INTERLOCKING JOINTS AND OVERHEAD KNEEBRACING

The shed was built for the city of Reno and the county of Washoe. Patents are pending on the roof construction. S. H. Newton of Reno was the erection contractor.

### Plan to Revise Building Code at Indianapolis

A number of important changes in the building code are embodied in an ordinance prepared for the city council by a committee of the Chamber of Commerce of Indianapolis in co-operation with Walter B. Stern, city building commissioner, and representatives of the various interests affected. Eight-inch brick walls for two-story construction are to be allowed where now 12-in. walls are required in the first story of a two-story dwelling. Frame buildings less than 4 ft. from the property line would be required to have 4 in. fireproof filling in the spaces between the studs, and no frame building would be allowed to come within 2 ft. of the property line. Steel lumber floor construction would be permitted in first-class buildings, the requirement for hollow tile or concrete fireproofing now imposed being rescinded for this purpose. A further proposal that has been made, but is yet under consideration, is to provide that all wood shingle roofs must replaced by fireproof roofs within a fixed period of years, and that the replacement of wood shingle roofs that have been damaged be further restricted. The present code requires that when 50 per cent or more replacement is necessary fireproof material be used. The proposed limit is 20 per cent.

## Quick Hardening Cement Developed By the French

### New Fused Product of High Alumina Content Should Prove of Value in Many Kinds of Construction

By Edwin C. Eckel
Consulting Engineer, Washington, D. C.

IN THE course of the World War a cement of very remarkable type and properties was put into use by the French for special military purposes. Its high technical value, in certain limited fields, is such as to make it advisable to briefly discuss its characteristics. As an introductory summary we may say that it is a lime aluminate, differing from normal portland cement in the almost total absence of silica; that it is prepared by actual fusion, not by mere clinkering; that it is almost white in color; and that it will harden with such rapidity as to make a good heavy-gun platform within 24 hours. It will be seen that it offers certain possibilities for other than military uses; and that products of this general type may become of interest both to American cement manufacturers and to American engineers.

Of course it is well known here that, a decade or more ago, Messrs. Lazell and Spackman began investigating the possibilities of high-alumina cements, and took out a series of patents in connection with them. Some of the processes then developed have come into use, particularly in connection with the lime industry, where it was found that the addition of a lime aluminate aided greatly in giving a more rapid hardening to limes and lime plasters. But so far as I know, none of the products made for that purpose were ever, commercially, real aluminates of lime. They were made in the majority of cases from a furnace slag which carried abnormally high alumina, because it came from furnaces running on the brown iron ores from the north coast of Cuba.

What is less commonly known, however, is that

parallel series of investigations were being carried on in France, at about the same time, and that these have resulted in an entirely different series of commercial products. The French patents were taken out in 1908 by the well-known firm of J. & A. Pavin de Lafarge, who are among the largest French manufacturers of both portland cement and hydraulic lime. During the war the A. E. F. operated some of the Lafarge plants, and while in charge of that work it was possible to observe the manufacture and characteristics of the fused aluminous cement which was being made at a neighboring plant for artillery mounts. Such notes on the subject as seem of general interest are presented here.

### Lafarge Fused Cement

The Lafarge quick-hardening aluminous cement was marketed as *ciment fondu* or fused cement, and for the sake of brevity that term will be used hereafter in this article.

The fused cement is made in a small blast furnace, which is charged with coke, limestone and bauxite. When the furnace is in steady operation it turns out from ten to fifteen metric tons a day of fused slag or clinker. This slag, cooled and ground, is the Lafarge fused cement. In composition it does not vary greatly from

| | |
|---|---|
| Lime | 50 per cent |
| Alumina | 40 per cent |
| Silica, etc. | 10 per cent |

The silica noted comes in chiefly from the impurities of the coke, but in lesser part from the bauxite, and to a very slight extent from the limestone used. The fused cement, as will be seen from the above note, is far lower in lime than the normal portland cements, a characteristic which it shares with the high-iron cements occasionally made and used.

So far as cost of manufacture is concerned, the fused cement can obviously be made at least as cheaply as a normal portland. Its uses will be determined then, not by cost, but by its special characteristics, which give it value in certain fields of work, but limit its use in other lines. We may note briefly some of these characteristics.

### Setting, Hardening and Strength

The fused cement has a normal setting time, falling in this regard within ordinary portland cement specifications. It can therefore be mixed and worked without taking any extraordinary precautions.

Its hardening, however, takes place with far greater rapidity than does that of a normal portland cement, so that a 24-hr. test will give results for the fused cement which are rarely obtainable with portlands under 28 days. In saying this it must be kept in mind that I am speaking of French cements used in French climate. The average American portland, used in the United States, will both set and harden faster than the usual European portland employed abroad.

Laboratory tests on the fused cement gave the following results, the briquettes and cubes being made up of a 1:3 mixture of cement and sand.

RESISTANCE IN KILOGRAMS PER SQUARE CENTIMETRE

| Age | Tension | Compression |
|---|---|---|
| 1 day | 29 kg | 352 kg |
| 2 days | 34 kg | 387 kg |
| 3 days | 34 kg | 400 kg |
| 7 days | 35 kg | 451 kg |
| 28 days | 47 kg | 475 kg |

Obviously there are great advantages in the use of a quick-hardening cement of this type under special conditions. For marine work which is to be completed between two tides we have available a satisfactory material, and as will be seen later it is also a cement resistant to marine action.

### Resistance to Decomposition

Considering the composition of the fused cement, its most remarkable property perhaps is its resistance to the decomposing effects of sea-water and similar solutions, for until the Lafarge cement was introduced there was a tendency to ascribe the breaking up of portland cement in sea water to its content of alumina, and to search for cements low in alumina. Yet here we have a cement with a very abnormal alumina content which seems to be perfectly resistant to marine action.

The Paris-Lyons-Méditerranée R.R. used fused cement on a portion of its line along the Mediterranean, where normal cements are badly affected by exposure to sea air and salt water; and the fused cement is reported to have stood the exposure admirably.

In laboratory tests, for which records of nine years' standing are now available, the fused cement has been kept in three solutions: (1) Sea water, (2) water saturated with lime sulphate and (3) water carrying 1.2 per cent magnesium sulphate. The cubes kept for nine years under these three very trying conditions are absolutely intact.

Briquets of neat cement, composed of fused cement to which gypsum was added in all proportions up to 50 per cent, have been kept in water since 1908 without the least signs of disintegration.

In view of these facts it seems evident that we must broaden our ideas as to the possible modes of securing protection of cement against the action of sea water and of other strong solutions. I was not able to secure data regarding the resistance of the fused cement against highly alkaline or acid solutions, a matter which is yearly becoming of greater industrial importance. It is to be hoped that some laboratory which has the facilities for carrying out such tests may take up the matter in proper detail.

To sum up the matter, we are dealing with a cement of entirely new type, which seems to be well worthy the consideration of American engineers and chemists. None of the Lafarge fused cement has ever been shipped into this country; and no cement of that type has, so far as I know, ever been made here by anyone else. In view of the history of the Spackman and the Lafarge patents, it is questionable as to how far any patent rights can now cover the product above described in the United States. The commercial side of the matter is therefore uncertain; but as a technical affair it is certainly worth more attention than has been given to it heretofore.

## Mineral Production

According to statistics compiled by the United States Geological Survey, in co-operation with the Census Bureau, the gold, silver, copper, lead, and zinc mines in the United States, exclusive of Alaska, produced during 1919 approximately 61,839,000 net tons of ore containing 1,833,309 fine oz. of gold, 51,224,300 fine oz. of silver, 582,500 net tons of copper, 443,000 net tons of lead, and 549,000 net tons of recoverable zinc. The placer mines yielded approximately 474,000 fine oz. of gold, 45,400 fine oz. of silver, and 800 oz. of crude platinum.

# Heavy Narrow-Gage Locomotives on Concrete Road Work

## Twenty-Ton Engine Hauls Five 22-Ft. Cars Carrying 25-Batch Boxes—Three Trains Serve Five-Bag Paving Mixer

By B. H. Piepmeier
Assistant Engineer of Construction, Illinois Division of Highways, Springfield, Ill.

TWENTY-TON, narrow-gage locomotives received by the Illinois Division of Highways in the distribution of surplus war equipment, are being successfully used this season for dry batch haulage in concrete road construction. The size of the locomotives made their economic service doubtful and to determine the facts it was decided to give them a trial in day-labor construction where their use could be controlled by the state engineers. There were three 20-ton, 24-in. gage, Vulcan steam locomotives and several miles of 25-lb. rail received from the War Department. The work selected was a 7½-mile, 18-ft. concrete road between Dwight and Odell in Livingston county.

TWENTY-TON ENGINE AND FLAT CARS EACH CARRYING FIVE 5-BAG BATCH BOXES

Sectional track was not adopted. The 25-lb. rails, varying in length from 12 to 30 ft., were spiked to 4 x 8-in. x 4-ft. wood ties with ⅝ x 3½-in. spikes. All joints were fastened by standard four-bolt fishplates. The ties were spaced 22 to 24-in. on centers and the track was partially ballasted with earth. Its center line was placed 5 ft. from the edge of the proposed line of the 18-ft. pavement, to permit the cars and locomotives to clear the finishing machine.

Three locomotives and thirty-six cars were installed. The locomotives have three drivers on each side and front and rear trailers. They normally pull from five to eight flat cars, each of which is loaded with five, 5-bag batch boxes. The cars are about 6 ft. wide and 22 ft. long and have a double truck under each end, the dead weight being about 4 tons each. The locomotives have sufficient power to pull from ten to twelve loaded cars over the road, which has less than 2 per cent grades. Since the track is not made up in sections, switches cannot readily be installed, therefore, the line is provided with a permanent switch about every mile.

The first loaded train in the morning and the first after the noon hour, pushes out five extra cars, or twenty-five batches, and leaves them on the track in advance of the mixer. One locomotive is kept at the mixer to spot the batch boxes for the mixer, and when the train is emptied it couples onto the five cars held in reserve and pulls them back to the mixer for use while the approaching loaded train pulls out the empties and puts the loaded train in reserve. The locomotive at the mixer then couples onto the train that has been spotted at the mixer. In this way, the twenty-five batches kept in reserve supply the mixer during the time the loaded train is being switched into place.

A 21-E paving mixer, with boom and bucket delivery and a loading derrick with a reach of 14 ft., is used. A 10-ton roller, a subgrader and a finishing machine make up the equipment around the mixer. From June 15 to Aug. 13, the mixer had operated 44 days, and had laid 3.04 miles, or an average of 365 ft. per day. This record, considering the equipment and the entirely new gang that had to be organized, met all estimates and expectations. It is hoped that the 7½-mile section will be completed this season.

At the central proportioning plant there is a 60-ft. stiff-leg derrick with a 1-cu.yd. clamshell. Small bins are used for sand and stone, each bin having a capacity of about one carload. The cement shed has a capacity of about eight carloads. Sand and stone are brought in by rail. Water is supplied by a 2-in. main from Dwight or Odell, with a large steam pump to boost the pressure. The plant is located about ¾ mile from one end of the 7½-mile section. It is expected that the three locomotives with the 140 batch boxes will supply ample material to the mixer even on this long haul.

H. W. Hartmann is superintendent in direct charge of the work, and C. S. McArdle is general superintendent for the department.

## Standardization of Brass Goods for Water-Works

THREE committees recently appointed by as many associations to draw up a scheme for the standardization of brass goods for water-works met at Bridgeport, Conn., during the recent convention of the New England Water-Works Association and unanimously adopted a report to be submitted to their respective organizations. The associations and their representatives are: New England Water-Works Association, David A. Heffernan, Milton, Mass.; American Water-Works Association, W. R. Edwards, Paterson, N. J., and J. Walter Ackerman, Watertown, N. Y.; National Association of Brass Manufacturers, Fred Mueller, H. Mueller Mfg. Co., Decatur, Ill.; and Fred Schulder, United Brass Co., Boston, Mass. The committee decided that for all brass goods to go underground the metal mixture should be standardized, with a specification of definite "limits of tolerance for each ingredient," and "that all essential dimensions be standardized and minimum weights specified." It was decided to ask the American Association of Brass Manufacturers to submit suitable specifications to cover the metal mixture and the dimensions and weights.

The following eliminations from corporation cocks were decided on: (a) The ⅜-in. size; (b) all round bodies; (c) female threaded outlet; (d) hex plug recess; (e) Mueller coupling thread; (f) quarter-bend coupling; (g) increasing size lead flange cocks; (h) lead flange cocks for 1-A lead; (i) on the sizes smaller than 1½-in. to eliminate squares and hexes; and also to discourage the use of the ¾ and the ⅝-in. sizes. Many recommendations for corporation cocks, for curb cocks, and for couplings were also agreed upon.

Presumably the full report of the committee will be published in early issues of the journals of the two water-works associations.

# Railroad Line Change in the Tehachapi Pass

## Two Troublesome Tunnels Eliminated at Less Than Concreting Costs—Portal Collapses as Bench Cut Is Substituted

THE single track railroad over the Tehachapi Pass in California presents operating difficulties far out of proportion to the mileage because of the grades, curves and tunnels that are combined there. Numerous studies have been made in the endeavor to find means of increasing the capacity of the line, in an operating sense, and decreasing the danger of blockades, particularly those due to trouble in the tunnels. Ten of the eighteen Tehachapi tunnels have been lined with concrete and concreting is being carried on continuously. Two of the tunnels, 12 and 13, that have been particularly troublesome have recently been eliminated by a line relocation that was carried out at a cost less than that of enlarging the tunnels to the company's present standard size and lining them with concrete. Despite a difficult situation that arose where the new location cut into the portal of tunnel 13, the new line was put into service practically without interruption to traffic.

In studying the line change on paper and on the ground, it was decided that 2,700 ft. of new roadbed could be located so as to substitute open cuts for tunnels 12 and 13 by excavating a total of 90,000 cu.yd. This involved one through and one bench cut and two fills.

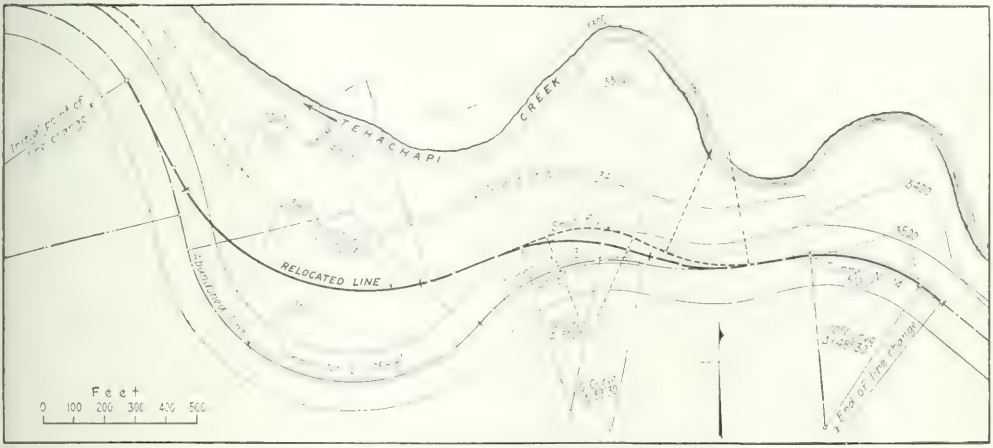
The Tehachapi grade, as a whole, is located on an uncompensated grade of 2.2 per cent which brings the equivalent compensated gradient up to 2.6 per cent on curves. The relocated line has a gradient of 2.5 per cent compensated or a slight improvement over the previous gradient. In addition to the 2,700 ft. of relocated line a length of 1,175 ft. of existing line at the west end was reballasted and the track raised to gain a 1.4-ft. grade rise.

The most serious problem was to get safely by the portal of tunnel 13 at the east end of the deep cut without any interruption to traffic. Here the bench cut would take away the material on one side of the tunnel timbering in heavy ground and hence was expected to threaten the stability of the tunnel. Excavation was started at this end of the line but with the first operation of the steam shovel along-side the portal, the tunnel timbers moved outward 1 inch. Work was promptly stopped and begun at the other end, the entire cut being made by advancing from that direction. This cut has a maximum depth of 75 ft. on the center line and 125 ft. at the upper edge of the slope.

As the cut approached the critical point opposite the portal, the excavated material was all used to widen the new bench at this point to make room for a temporary shoo-fly which was to be used pending the completion of the cut to final location. In widening the roadbed here the material had to build up a height of 125 ft. from the bottom of the existing slope, hence a large quantity of material was required to increase the roadbed width sufficiently. Material that might have been dumped elsewhere was taken to this point so as to insure having a bench wide enough for the shoo-fly at as early a stage of the work as possible in case an emergency should require its early use.

When the cut came near enough to the tunnel timbers so that they began to move, excavation was continued cautiously, rushing the filling where the shoo-fly was to be laid and making hourly observations on the tunnel timbers so as to have warning of danger to trains. When the timber movement was sufficient to impair clearance the tunnel was pronounced unsafe for trains, the line was closed to traffic, rails in the tunnel portal were taken up and the steam shovel in the cut was then worked at maximum speed, regardless of effect on the tunnel itself.

Within 5 hours after traffic through the tunnel had been stopped, the portal had collapsed and the shoo-fly had been opened to traffic. The collapse of the portal was a slow movement better described as a crushing down of the timbers. At the end of several days the timbering in the abandoned tunnel had caved in for a distance of about 100 ft. back from the portal.




RELOCATION OF RAILROAD LINE IN TEHACHAPI PASS

# Overflow Channels Proposed for Pueblo Flood Protection

### Plan Involves Diversion of River to Bluff Side, an Overflow Channel, and Use of Railroad Yards for Extreme Flow

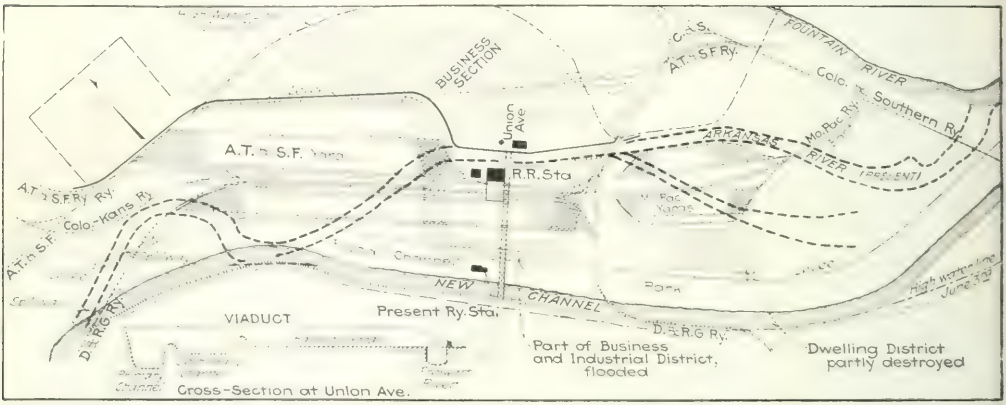
A NOTEWORTHY proposal for the control of the Arkansas River at Pueblo, Colo., to prevent recurrence of floods like that of the first week of June, has been put forward by Edward F. Rizer, civil engineer, of Pueblo. It depends upon provision of an overflow channel alongside the normal river channel, normally utilized as a park. This channel would make the capacity equal to the estimated flow of the 1921 flood. To provide for still higher floods, 50 per cent greater than that of June, a wide belt of level ground, adjoining the overflow channel and in the plan assigned to railroad yard use, is made to serve as a secondary overflow channel, carrying water 4½ ft. deep in extreme floods. Levees provided with suitable spillways separate the river and the overflow channels from each other.

In applying this flood control system to the Pueblo conditions, Mr. Rizer makes a relocation of the Arkansas River through the entire length of the city, shifting it from its present location (about the middle of the valley bottom) to the southerly edge, along the bluff. Complete revision of the railroad yards now occupying the south half of the valley bottom, would be required, as well as elimination of a business and industrial district lying between the present river and the Union Depot, and a housing district. In the accompanying plan of the project, the present river channel is indicated by dash lines. A section across the valley shows the proposed channels and the railroad yard district in profile.

Pueblo's physical location will continue to invite flood disasters, says Mr. Rizer in explaining his proposal, on account of the size, arrangement and steep slope of its drainage area, which make the river flashy. Three extreme floods have occurred within a 30-year period, in each case doing large damage. By moving the river south against the bluff, one bank is secured; the bluff is of blue shale and will not require revetment. Taking the ordinary flood volume at 65,000 cu.ft. proposed new channel is planned to be able t. carry this flow. The "flood channel park," about 400 ft. wide, along the north bank of the new river channel, would receive water over a spillway at a point near where the river enters the city, increasing the capacity to 115,000 sec.-ft. The area north of this channel, to the present river, would be devoted wholly to railroad yards and would be kept available for peak flood flow, giving a total flow width of about 2,200 ft. The main part of the city to the north would be separated from the railroad yards by a retaining wall. Communication between this part of the city and the district lying on the south bluffs would be by viaducts like the one shown for Union Avenue.

This plan was developed on the assumption that Pueblo alone would have to finance the flood-protection work, and correspondingly it gives protection to the city only. Should the Arkansas Valley as a whole be included in the project, a detention reservoir would have to be added to the local channel improvement. This would, roughly, double the cost, it is stated.

Enlargement of the channel at its present location, Mr. Rizer says, would destroy more property value than the diversion project. That part of the plan involving rearrangement of the railroad yards is also logical as the present yards are poorly arranged and of inadequate capacity.




OVERFLOW CHANNELS FOR PROTECTION AGAINST ARKANSAS RIVER FLOODS AT PUEBLO
Railroad yards to serve as secondary flood channel

## Roadmen's Wages in Britain

The wages of men employed on roadwork in and about London average just over £4 per week. In some boroughs reductions are taking place, notably in Southwark, where a 3s. 9d. bonus has been withdrawn on account of the decreased cost of living. This brings the wages of roadmen and scavengers down from £4 11s. 11d. to £4 8s. 2d. per week. Men employed on improvement works have had an additional reduction of 2d. per hour.

| | Wages per Hour | |
|---|---|---|
| | 1920 | 1921 |
| [illegible] | [illegible] | 9d. to 1s. 2d. |
| [illegible] | 8d. | 7d. |
| [illegible] | 9d. | 9d. |
| [illegible] | 1s. | 10d. |
| Scotland | 11d. | 10d. |

The wages paid to the same class of laborers in the north of Scotland work out as given in the table.

# Removal of Colloids from Sewage: Theory and Practice

By Waldo S. Coulter
Consulting Engineer, New York City

Ever since Dr. William Owen Travis formulated his "Hampton doctrine," in which unusual emphasis was laid upon the part played by physical operations in the treatment of sewage, a more or less sustained interest has been shown by engineers in the removal of colloids. One does not have to accept the Hampton doctrine in toto to admit the importance of colloids and the desirability of removing them, even in part, if this can be accomplished in an economical manner.

Dr. Wolfgang Ostwald, defining colloids, says: "The colloids differ from the coarse dispersions in that they cannot be analyzed microscopically and in that they pass through ordinary filters. The colloids differ from molecularly dispersed systems in that they do not diffuse and do not dialyze, which molecular solutions do." Ostwald attempts to set limiting sizes for coarse dispersions, colloids and molecular dispersoids. For the purposes of this article, however, it will be sufficient to define colloids in sewage as matter in an extremely fine state of subdivision, down to the border line of solution. Such matter is practically unaffected by sedimentation, within any reasonable period, although probably reduced somewhat in septic tanks and to a larger degree by chemical precipitation.

Metcalf and Eddy illustrate its amount in a general way by a hypothetical effluent from a sedimentation tank, as follows:

| | |
|---|---|
| Settleable solids | 15 parts per million |
| Suspended colloids | 150 parts per million |
| Dissolved colloids | 50 parts per million |
| Total settleable and colloidal solids | 215 parts per million |

## Colloidal Coagulation

Dr. Travis observed that colloids were coagulated by surface attraction or adsorption, either upon the surfaces of the vessel containing the sewage, or upon rods, etc., immersed in the latter. He states: "The value of presenting a larger extent of surface to the liquid cannot be exaggerated, for it not only causes increased deposition, but also shortens, in inverse ratio to the areas of the surfaces, the period during which the phenomena described are observable." Or, to again quote Ostwald, "We may regard adsorption as that change in concentration which colloids and other dispersed systems suffer at the surfaces where they come in contact with other bodies. . . . In cases of positive adsorption there commonly occurs a fixation of the colloid or of the dispersed material upon the

INCREASE IN SURFACE OF A CUBE WHEN DECIMALLY DIVIDED

| Length of the Edge | Number of Cubes | Total Surface |
|---|---|---|
| 1 cm. | 1 | 6 sq. cm. |
| 1 mm. | 100 | 60 sq. cm. |
| 1 mm. | 1,000 | 600 sq. cm. |
| 1 mm. | 10,000 | 6,000 sq. cm. |

*Table carried out by Ostwald. Table and data from "Colloid Chemistry," by W. S. C.

. . adsorbing surface. Under such circumstances, the rest of the dispersed system may be poured off without carrying away with it the dispersed material that is collected in the surface." Referring to the use of powders of carbon, Fuller's earth, etc., in adsorption experiments, Ostwald says: "The enormity of the adsorbing surfaces in such dispersed systems is not generally appreciated, nor how these may grow with increase in the division of the particles. To illustrate the matter I append the table given herewith which shows the surface increase of one cubic centimeter when undergoing decimal division."

To illustrate the adsorptive action of coarse suspended matters, he continues (Lecture on The Changes in State of Colloids):

> I want now to show you the wide distribution of these adsorption phenomena (demonstration). I have here a number of flasks filled with differently colored colloid and molecularly dispersed liquids; picric acid, iron chlorid, fuchsin, berlin blue, congo red, colloid silver, colloid gold, and colloid graphite. Standing opposite is an equal number of flasks, each containing a spoonful or two of bone charcoal (bone black). I pour upon the bone black in each of the flasks the contents of the flask opposite it and for a moment shake every mixture vigorously. I next pour all the mixtures, along with their bone black, one after the other into this large filter-lined funnel. In spite of the fact that I have carried out this whole procedure as rapidly as possible, you see that the filtrate runs through entirely clear. Adsorption has, in other words, occurred with extraordinary rapidity in all these cases and is practically complete.

To demonstrate that not only colored dispersoids and not only charcoal show such prompt adsorptive effects, he then proceeds to secure similar results with Fuller's earth and quinin solution. The same thing could have been done with sand in place of Fuller's earth, but the time would have been greatly prolonged, owing to the lesser aggregate adsorptive area of the sand particles.

In any practical application of this idea to the clarification of sewage, the time of contact and the aggregate area of the surfaces of adsorption, necessary for satisfactory results, must be within economical limits.

## Colloid Deposition Slow

The deposition of colloids upon the inside faces of a glass container is usually a slow process. By greatly increasing the area of the exposed surfaces, a point will be reached where a considerable removal can be effected in a reasonable length of time, say four or five hours.

To secure the necessary adsorption surface by a multiplication of artificial faces, as rods, slabs, laths and the like, and to further place these so that the accumulation on their faces will detach itself readily, and the whole act without interference from scum, gas bubbles, etc., is not a simple matter. Nor is that of cost. For these reasons, colloiders have received little attention from American engineers.

In 1911 I visited the 39th St. Sewage Testing Station of the Sanitary District of Chicago. Among the features of this station was a small upward-flow tank of the type installed at the experimental plant of the Massachusetts Institute of Technology by Winslow and Phelps, known as the Boston biolytic tank. This is simply a Dortmund tank, with a steeply sloping hopper-shaped bottom and peripheral effluent gutter, but it differs from the Dortmund in that the influent pipe extends downward to a point just above the tank bottom, in such manner that the upward-moving sewage must pass through the sludge accumulation. If the

velocity of inflow is slight, or if the tank bottom is flat, flotation of the sludge accumulation may not take place. But with sufficient velocities in the lower portion of the tank the sewage will pass upward through a heavy flocculent mass of suspended sludge. The velocity in the upper part of the tank is, of course, reduced sufficiently to prevent the escape of sludge and suspended matters, except as this may occur through disturbances due to septic action. A scum baffle should be used.

The effluent of the tank at Chicago was remarkably clear. I had never seen anything from a clarification device that equaled it. Unfortunately it was heavily charged with hydrogen sulphide, and the vicinity of the tank was not a pleasant resting place. None of the other devices, handling similar sewage, showed this peculiarity. The remarkable clarity of the effluent from this biolytic tank attracted general attention. No satisfactory reason could, however, be assigned for it. Its predecessor at Boston had produced no such effluent; also, fortunately, no such gas.

Upon thinking the matter over afterward, it occurred to me that this extraordinary clarification might be due to a colloidor-like action of the sludge particles. The aggregate area of a mass of sludge particles must be enormous, much greater than it would be practical to provide by artificial surfaces. These particles were brought into intimate and prolonged contact with the colloids and, in comparison with the latter, the individual particles were massive. As for the tank at Boston, that was so large in comparison with the inflow that, at a point 2 ft. above the bottom, the mean velocity of upward flow was only slightly in excess of 2 ft. per hour. Under these conditions, it is not probable that any appreciable flotation of the sludge took place. Of course the designers had no colloidor action in mind when the tank was designed, and I do not mean to impute faulty arrangement.

Such tanks have since been constructed at activated-sludge plants to clarify the effluent from aëration tanks. In such cases the colloidor effect would not be noticeable, since colloids are pretty thoroughly removed in the aëration unit.

### Early Use of Sludge Mixing

The commingling of sludge with inflowing sewage to secure a better clarification is an old idea. The Candy upward flow tank was in use in England before any attention was given to colloids by engineers. I have no information concerning the results secured with this tank, but they could not have been at all unusual, as the bottom of the tank was flat, and the sewage admitted from the side radially across the floor. Sludge was removed by a rotating arm delivering to a sludge pipe at the center.

A more intelligent application of the idea was the introduction of fresh sewage into a fill-and-draw tank containing old sludge. The whole was then agitated by compressed air, which dispersed the sludge throughout the liquid. This agitation was maintained for an hour or so. As chemicals were used, the process was chemical precipitation, with preliminary agitation. There is nothing to indicate what might have been the effect had the chemicals been omitted. It is said that the process showed little or no improvement over straight chemical precipitation with adequate preliminary mixing in baffled channels. It is interesting to note how closely this old Mather & Platt process unwittingly approached the activated-sludge process.

The adsorption surfaces presented by the media of contact beds and sprinkling filters no doubt act as colloidors, especially in the case of contact beds, where the sewage is retained for a longer period.

Finally the action of the dispersed sludge particles in the aëration tank of an activated-sludge plant have, in my opinion, much to do with the excellent clarification secured, their action being a physical one. I am not, of course, denying the oxygenic work of bacteria.

The scrubbing or straining action of the sludge in biolytic tanks following aëration chambers is sometimes referred to. I am convinced that where it is used elsewhere, as it has been, I understand, by Robert Spurr Weston, for certain industrial wastes, it acts to a marked degree as a colloidor.

If this is correct, we are able to secure a colloidor, to some degree at least, without resorting to chemicals or pulverized materials, or to costly and difficult arrangements of artificial surfaces.

### Practical Applications

I have installed two plants along these lines. One treats the waste from a millboard factory and the other an institutional sewage. Considerable colloidal matter remains in the effluent from the former, but the clarification is good, with a very important removal of colloids. Quiescent sedimentation of the raw waste in a tall beaker glass has no effect upon a large part of the finely divided solids, unless prolonged to an impractical period. The test plant which preceded the operative installation showed an average removal of 60 to 80 per cent of suspended solids. This does not appear at all remarkable until the effluent is compared with a sample subjected to quiescent sedimentation for a like period. As regards the institutional plant, only a few persons have as yet been served by the tank, so that the retention period is abnormally long and the velocities in the lower portion of the tank correspondingly low. While the effluent is excellent, it has not as yet been any better than the effluent from any good tank might be.

The instances alluded to above do not, in themselves, make a case, I admit. Nevertheless they do, in connection with the other facts referred to, indicate, I believe, a probability that the particles of sludge accumulation may be made to act as colloidors if the tank is properly designed. The presence of excessive quantities of hydrogen sulphide in the effluent from the Chigo tank may perhaps be taken to confirm Dunbar's suggestion that most of the sulphur compounds in sewage are in the colloidal matter, and that the removal and reduction of the latter under other than aërobic conditions will be offensive. This may, upon more extended practice, prove to be the case, but I think that most authorities in colloid chemistry are agreed that there is no selective action in the formation of colloids, based upon chemical composition, but that, as Von Weimarn says, "The colloid state is a universally possible state of matter." As regards varying consistency of sewage matters, it is doubtless true that some are more readily macerated and dispersed than others, yet I think it remains to be demonstrated that sulphur compounds predominate in such matters.

The retention period should not be long enough to

permit too vigorous septic action. The incoming sewage generally contains some oxygen as it passes into the sludge.

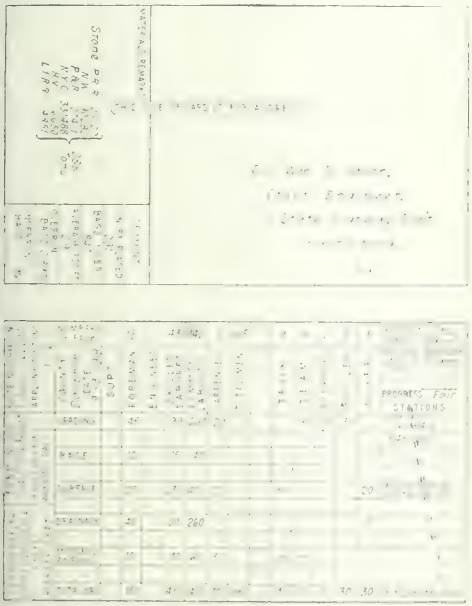
The digestive action of tanks of this type is good, but the sludge has a high moisture content, which is a drawback. This last difficulty might be overcome by a separate digestion tank.

The upward-flow tank will unload to a greater degree, perhaps, than any other single-story tank, despite any combination of baffles. I have found that a short-period two-story tank, following the colloidor, will redeposit and retain most of the matter unloaded, if the colloidor effluent flows over a weir or is otherwise somewhat agitated to release entrained gases.

## Daily Road Construction Report Card, Pennsylvania

INSPECTORS of highway construction in Pennsylvania make daily reports of progress on the convenient post-card form shown by the accompanying drawing. Two copies of this card are mailed, one to the chief engineer and one to the district engineer of the state highway department. The illustration indicates the information reported.

In making these reports the inspectors are required to exercise great care in charging all time to the item



INSPECTORS' DAILY REPORT POSTCARD IN USE BY PENNSYLVANIA HIGHWAY DEPT.

to which the cost ultimately applies. In general, accuracy is demanded in all information reported and entries under the head "miscellaneous" are rigidly restricted. The cards are filled out from the inspector's note book, which is kept in a prescribed form and with great accuracy, since it becomes, when finished, an original record in the files of the Pennsylvania State Highway Department.

## Engine Driver Describes First Trip of Passenger Train in 1831

OPERATION of the first passenger train locomotive in the United States and a brief account of contemporary locomotive building is contained in a letter to C. C. Hopkins, consulting engineer, Rochester, N. Y., written in 1890 by David Matthew, the engineer who drove the locomotive "DeWitt Clinton" on its first trip. Through the courtesy of Mr. Hopkins, Mr. Matthew's letter is printed herewith and is thought to be a matter of timely interest in view of the recent refitting and actual runs of the old "DeWitt Clinton" as reconstituted by the New York Central R.R. The letter is dated from San Francisco, Oct. 20, 1890, when the writer was about 90 years of age:

Yours of Oct. 4th, inst. was duly received and contents noted. You requested me, as engineer of the Locomotive Engine "Dewitt Clinton," to give an account of the running of the first passenger train, on the American continent.

As you have become educated to the locomotive engine as a big Iron Horse, of weight, varying from 30 to 50 tons or more, I must take you back to the days when the locomotive was a colt. His body was light, and the wheels were made of rods of iron, turned and finished and bright. The suspension wheels were braced by rods, similar to those of the wheels of the bicycle of today, equally as well finished. In fact the locomotive of that period was as like a thing of life and speed, compared with the present locomotive, as a grey hound is to the present horse or bull dog.

Every thing was light, neat, and made of the best material, like clock work. The weight did not exceed three and a half tons, without tender. The tender was not made at shop, but at Albany, after the engine was on the road. Here was the first application of the outside journals, on the railroad axles, which were put under the "Dewitt Clinton's" tender. The coaches had shafts with inside bearings and wheels outside of the frames, while the "Dewitt Clinton's" tender was outside. The stage coaches' bodies were mounted on light wheels, etc., everything being light, to keep down non paying weight.

The starting point of the first passenger train, was at the junction of the railroad and Cherry Valley turnpike, two miles from state house, of Albany, N. Y. Thousands of people had assembled to witness the starting. I had been there from the 27th of June to the 9th of August, fitting up and experimenting with fuel, etc. The road over which we were to pass, was good and smooth and straight for the greater part of the way. With our light smooth colt and cars, we were ready to take our load of passengers, and commence our flight with the birds, that wished to join us in our trip over broad miles to the Mohawk. Our engine wheels, springs, etc. were very bright, and when in motion, reflected the rays of the sun, like a mirror—which was very novel and interesting to me, at that time.

I am informed that a pair of the "Dewitt Clinton's" wheels are on exhibition at the Grand Central Station, New York City. The "Dewitt Clinton"—Locomotive Engine—that is, the boiler, cylinder, crank shaft with driving wheels, etc., was sold to a man who put them in a small boat to tow canal boats about Troy and Waterford, in 1833. Thus the back wheels and shaft, which were left, are to be found at the Grand Central Depot, N. Y. City. The diameter of the suspension wheels was 4½ feet. They were bright, had finished arms, and the hub was covered with brass plates, on which was engraved, W. P. F. Association [West Point Foundry Association]. So you can see what the Locomotive, or Iron Horse was when a colt. You have never seen the old mare run away from her colt.

*Note on Locomotives.* In May 1829 the "Strowbridge Lion" was landed at W. P. F. A. N. Y. City, and was there exhibited to thousands, under steam, blocked up, to allow her wheels to turn without the body moving.

In 1830, the Locomotive "Best Friend of Charleston" was built at W. P. F. A., N. Y. City, for South Carolina R.R. also the Locomotive "West Point" for the same road. Both

were exhibited under steam at the shop before shipping them to Carolina. No tender had been made for either of these. Next in turn, came the "Dewitt Clinton." The two preceding ones were used for the road construction, and running excursion trains, and not used in passenger traffic. So that makes the "Dewitt Clinton"' the Pioneer Locomotive on the passenger traffic, and I, the Man that had the head charge of building and exhibiting the three first Locomotives under steam, and of running the first passenger train on the American Continent. I have drawn out a home spun, illustrated History for my Boys, that they may have their own History.

Our Rail Road men are so taken up with foreign stock that they lose sight of their own country.

*Notes.*

J. T. Clark was the man that collected first passenger fare, on train drawn by locomotive engine, in America.

J. V. Jervis was orderer of the first Locomotive engine for America, for RailRoad service, 1828.

E. L. Miller orderer of "Best Friend"—1830.

H. Allen, orderer of "West Point" winter of 1830 and 31.

J. B. Jervis, orderer of "Dewitt Clinton"—1831, on road, June 1831. Three first to do business in America, on Rail Road, Wooden wheels on first three, "Strowbridge Lion," "Best Friend," and "West Point."

Mr. Hopkins says: "He [David Matthew] was an experienced mechanic, having served nearly five years as an apprentice in the steam engine factory of the West Point Foundry Association, and by a resolution of the board of directors of the Utica & Schenectady Railway Co., passed Sept. 23, 1835, was employed by that railroad as chief locomotive engineer and machinist, his employment commencing Jan. 1, 1836. He also worked in the U. S. Government workshops in the Navy Yard at Washington, D. C."

### Machines for Railway Track Work

That labor-saving machinery is coming into use more extensively in connection with track work was a view expressed emphatically by C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., in an address at the recent annual convention of the Roadmasters' and Maintenance of Way Association. The following is an abstract of his remarks on this point:

With labor-saving machinery coming into use more and more in connection with track work we need to keep in mind that it is purchased to save labor and money, and that with it our requirements for labor should be reduced. A man to the mile was the force that was considered necessary in the old days. If you ask roadmasters today how many men they needed to properly handle the work, nine out of ten would tell you they ought to average a man to the mile; this even on roads using treated ties where but half the number of ties have to be inserted per year and provided with ditching machines, modern steel spreaders, center dump ballast cars, air dump ditcher cars, motor cars with mowing machine and shoulder weed cleaners, tamping machines and various other labor-saving devices. What we need to do is to take account of stock and revise our ideas of the force necessary to maintain track, where machinery has been furnished.

As a word of advice: Have patience with any new device that is sent you. Your first tendency may be to say that it is no good, and to set it off the track and continue in your old methods. But remember that the machine would not have been furnished you if someone had not made a success in its use and shown that it would save money. So when you say you cannot use it to advantage you are admitting at once that you cannot do what some other man has done in the way of saving money in doing your work; in other words, that you are not as good a man as the other fellow. Therefore, have patience in learning how to operate a machine and if you cannot get results from it ask that someone be sent out to instruct you in its use.

# Testing and Calculating Aluminum Sulphate Solutions

By Charles H. Capen, Jr.
Assistant Sanitary Engineer, State Department of Health, Trenton, N. J.

A METHOD for readily checking the amount of aluminum sulphate applied to a given water supply has recently been devised, utilizing charts for the calculation in which specific gravity and rates of flow alone are used to compute the alum feed. So far as known no satisfactory field titration for alum solutions has yet been found. With the following procedure titration is unnecessary.

A sample of the alum solution is collected in a cylinder of known volume at a point as near as possible to the place of application, the length of time required to fill the cylinder being taken with a stop watch. At some plants where it is impossible to measure the rate of flow in this manner, the total amount of solution used per day may be found by measuring the volume of the solution tank and assuming the rate to be a constant throughout the day. A specific gravity hydrometer is then placed in the cylinder and after correcting the reading for temperature the per cent of alum in the solution can be determined from the curve made for that purpose. With these data and the rate of flow of the treated water, the alum dose in pounds per day and grains per gallon may be obtained from the chart.

The formulas from which the chart was plotted were developed as follows:

Let $T$ = temperature of alum solution in deg. F.;
$S$ = specific gravity hydrometer reading;
$S'$ = specific gravity corrected for temperature above or below 60 deg. F.;
$P$ = per cent (by weight) of alum in solution;
$A$ = alum flow (c.c. per sec. or cu.ft. per day);
$L$ = pounds of alum per day;
$F$ = water flow (million gallons per day);
$G$ = grains per gallon of alum applied to water;
$j$ and $k$ = constants.

By experiment (1) $S' = S + 0.0002\ (T - 60)$

(2) $P = 190\ (S' - 1)$

Then since the pounds of alum per day vary directly as the per cent and rate of flow of the solution

(3) $L = jAP = \frac{60 \quad 60 \quad 24 \quad 0.0022046}{100} AP$ $\therefore$ $j = 1.90477$.

Since the grains per gallon vary directly as the pounds of alum per day and inversely as the rate of flow of water receiving treatment

(4) $G = k \frac{L}{F} = \frac{1}{(8.345)\ (17.142)} \frac{L}{F}$ $\therefore$ $k = 0.0069906$

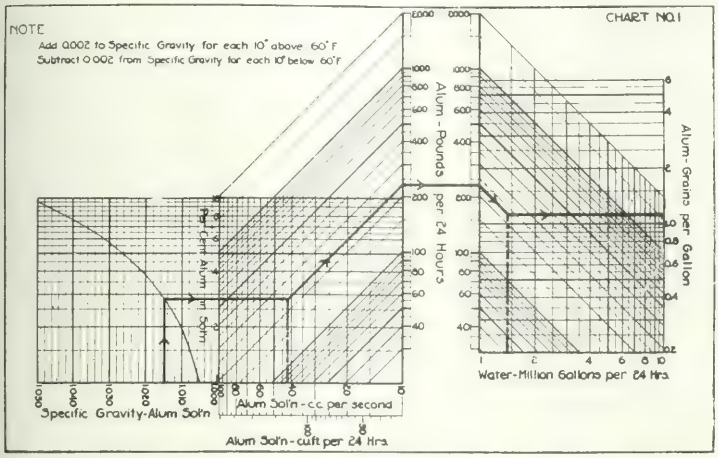
Place $L$ of (3) in (4) then (5) $G = jk \frac{AP}{F}$ $jk = 0.013315$

Place $P$ of (2) in (5) then (6) $G = 2.5294 \frac{A\ S'}{F} - \frac{A}{F}$

Alum solutions of various percentages of strength were made up from commercial alum and their specific gravities taken at a uniform temperature of 60 deg. F. The correction for variations in temperature was also determined. This correction is not absolutely constant for all hydrometers but the variation may be neglected.

An error is introduced into these computations by assuming in equation (3) for computing the value of

$f$ that the weight 1 c.c. of the alum solution is 1 gram or 0.0022046 lb. This error in per cent is measured by the equation $E' = 100\ (S' - 1)$. The normal range of this error has been found to be from 0.5 per cent to 2 per cent. This error may be disregarded for the reason that compensating errors are introduced in collecting the alum sample, reading the hydrometer, measuring the rate of water flow, etc. Example:


NOTE
Add 0.002 to Specific Gravity for each 10° above 60° F
Subtract 0.002 from Specific Gravity for each 10° below 60° F
CHART NO. 1
Alum - Pounds per 24 Hours
Alum - Grains per Gallon
Water - Million Gallons per 24 Hrs.
Specific Gravity - Alum Soln
Alum Soln - c.c. per second
Alum Soln - cu.ft per 24 Hrs.

ALUM FEED CHART BASED ON SPECIFIC GRAVITY AND SOLUTION FLOW PER SECOND

Given $S = 1.013$ $T = 70$ $A = 42$ $F = 1.4$
Find $P$, $L$ and $G$
Correcting for temperature $S' = 1.015$
From chart (1) (see heavy lines),
$P = 2.8$, $L = 230$, $G = 1.2$
From formulas (2, 3 and 6),
$P = 2.85$, $L = 228$, $G = 1.14$

Similar charts to obtain quickly the rates of hypo feed have been made up, utilizing the regular sodium thiosulphate titration for obtaining the strength of the solution. Some charts which involve portions of these principles are given in "Water Purification Plants and their Operation," by Milton F. Stein, and some parts of the formulas are given in the *Manual* of the American Steel Wire Co.'s "System of Water Purification," by C. Arthur Brown, but the computations are not reduced to a minimum in either case. The methods described in this article, together with small notebook sized copies of the charts, have actually been used in the field a great many times and have proved very satisfactory.

## Second Simplon Tunnel Nearing Completion

Completion of the second Simplon tunnel may be expected by early fall, according to progress reports just published. At the end of April the length of completed (and fully lined) tunnel was 19,408 m., out of a total length portal to portal of 19,825 m. Full-section excavation has proceeded about 150 m. farther. A monthly progress of about 100 m. is being recorded, so that September or October should see final completion of the enterprise. This second tunnel is an enlargement of the pioneer heading constructed at the time the first tunnel was built.

## Manganese Bronze for Water-Works Valve Stems

By William R. Conard
Inspecting Engineer, Burlington, N. J.

Of the thirteen or more parts in a water-works valve the stem is the most important, for upon it depends the proper opening and closing of the gate or gates and the operation of the wedging mechanism, which in turn controls the flow of water, and if the stem fails the rest of the mechanism is useless. In determining the diameter of the stem the area at the base of the thread should control and not the full diameter of the stem, and high factors of safety should be allowed to provide not only for these stresses but also for the human element, which always enters into the operation of a device of this kind.

After giving the matter extended study I have concluded that the best bronze for valve stems is that having a high yield or elastic limit, moderate ductility, and a high ultimate strength, but not more than 100 per cent higher than the yield point. Fortunately this can be done at practically no increase in cost. It is not particularly difficult to get a bronze that will have a yield point of not less than 40,000 lb. per square inch, an ultimate strength of 60,000 to 70,000 lb. per square inch, an elongation percentage of 10 in 2 in., and a reduced area percentage of 10. It may be noted in passing that the water-works official and the manufacturer usually base their calculations on the ultimate strength of the material, figuring that the usefulness of the stem is not gone until it actually fails, overlooking the importance of having the stem retain its original shape.

This harder, stronger metal is of course somewhat tougher and not quite so easily machined, but if the proper tools are used it does not appreciably increase the cost, and surely is better than increasing the size of the stem beyond the manufacturers standard to get the added strength.

The more frequent reasons for valve stem failures are that the necessary strength is mostly based on the full diameter of the stem; the tensile or ultimate strength of the metal, and not taking into account that metals of any kind unless especially treated for it do not have as great a strength in the center or core of the mass as near the surface, with the result that a stem has scarcely any greater strength at the bottom of the thread than the simple working stresses that are put on it, without taking into account added friction due to corrosion, sediment, etc., nor that in many cases the persons operating are likely to use tools that exert considerably greater leverage on the gears or operating nut than is intended or needed.

Test pieces should be cast attached to the actual stem where possible and where the small size of the stem will not permit this, then the test piece should be cast in the same heat and in the same flask as the stems. In the case of hammered or forged stems the test piece should be a prolongation of one end of the stem reduced to a cross-section that will show a close approximate of the metal in the stem itself.

Stems for valves 30 in. and more in size should be of forged manganese bronze. Forging adds very little to the cost and adds somewhat to the physical qualities, but its main value lies in making the metal homogeneous perfect for threads, free from the dangers due to the different cooling stresses common in the inner and outer portions of castings.

# Conference Suggests Plan for Unemployment Relief

## Private and Public-Works Construction Affords Greatest Field for Taking on Men Now Out of Work

CONSTRUCTION, both public and private, is held up by the President's Unemployment Conference as the greatest field for employment at the present time, and every interest concerned is urged to undertake such works. This forms one of the recommendations for emergency relief adopted by the conference previous to its adjournment Sept. 30 to meet again Oct. 10 to take up permanent measures to prevent the recurrence of unemployment periods.

The recommendations, twelve in number, lay down a standard procedure, urge in detail the resumption of certain classes of work and purpose measures for relief applicable to manufacturing establishments.

### Methods of Procedure

1. The Conference finds that there are, variously estimated from 3,500,000 to 5,500,000 unemployed, and there is a much greater number dependent upon them. There has been an improvement, but pending general trade revival this crisis in unemployment cannot be met without definite and positive organization of the country.

2. The problem of meeting the emergency of unemployment is primarily a community problem. The responsibility for leadership is with the mayor and should be immediately assumed by him.

3. The basis of organization should be an Emergency Committee representing the various elements in the community. This committee should develop and carry through a community plan for meeting the emergency, using existing agencies and local groups as far as practicable. One immediate step should be to co-ordinate and establish efficient public employment agencies and to register all those desiring work. It should co-ordinate the work of the various charitable institutions. Registration for relief should be entirely separate from that for employment.

4. The personnel of the employment agencies should be selected with consideration to fitness only and should be directed to find the right job for the right man and should actively canvass and organize the community for opportunities for employment. The registry for employment should be surrounded with safeguards and should give priority in employment to residents. Employers should give preference to the emergency employment agencies.

5. The emergency committees should regularly publish the numbers dependent upon them for employment and relief that the community may be appraised of its responsibility. Begging and unco-ordinated solicitation of funds should be prevented.

### Classes of Work Urged

6. Private houses, hotels, offices, etc., can contribute to the situation by doing their repairs, cleaning, and alterations during the winter instead of waiting until spring, when employment will be more plentiful.

7. Public construction is better than relief. The municipalities should expand their school, street, sewage, repair work and public buildings to the fullest possible volume compatible with the existing circumstances. That existing circumstances are favorable is indicated by the fact that over $700,000,000 of municipal bonds, the largest amount in history, have been sold in 1921. Of these, 106,000,000 were sold by 333 municipalities in August. Municipalities should give short time employment the same as other employers.

8. The governor should unite all state agencies for support of the mayors and, as the superior officer, should insist upon the responsibility of city officials; should do everything compatible with circumstances in expedition of construction of roads, state buildings, etc.

9. The federal authorities, including the Federal Reserve Banks, should expedite the construction of public buildings and public works covered by existing appropriations.

10. A congressional appropriation for roads, together with state appropriations amounting to many tens of millions of dollars already made in expectation of and dependence on federal aid, would make available a large amount of employment.

The conference under existing circumstances, notwithstanding various opinions as to the character of the legislation and the necessity for economy, recommends congressional action at the present session in order that work may go forward.

11. The greatest area for immediate relief of unemployment is in the construction industry, which has been artificially restricted during and since the war. We are short more than a million homes; all kinds of building and construction are far behind national necessity. The Senate Committee on Reconstruction and Production, in March of this year, estimated the total construction shortage in the country at between ten and twenty billion dollars. Considering all branches of the construction industries more than two million people could be employed if construction were resumed. Undue cost and malignant combinations have made proper expansion impossible and contributed largely to this unemployment situation. In some places these matters have been cleaned up. In other places they have not and are an affront to public decency. In some places these things have not existed. In others costs have been adjusted. Some materials have been reduced in prices as much as can be expected. Where conditions have been righted, construction should proceed, but there is still a need of community action in provision of capital on terms that will encourage home building. Where the costs are still above the other economic levels of the community there should be searching inquiry and action in the situation. We recommend that the governors summon representative committees, with the co-operation of the mayors or otherwise as they may determine, to (a) determine facts; (b) to organize community action in securing adjustments in cost, including removal of freight discriminations, and clean-out campaigns against combinations, restrictions of effort, and unsound practices where they exist to the end that building may be fully resumed.

12. Manufacturers can contribute to relieve the present acute unemployment situation by

(a) Part time work, through reduced time or rotation of jobs.

(b) As far as possible, manufacturing for stock.

(c) Taking advantage of the present opportunity to do as much plant construction, repairs, and cleaning up as is possible, with the consequent transfer of many employees to other than their regular work.

(d) Reduction of the number of hours of labor per day.

(e) The reduction of the work week to a lower number of days during the present period of industrial depression.

(f) That employees and employers co-operate in putting these recommendations into effect.

A large number of employers have already, in whole or in part, inaugurated the recommendations herein set forth, and for this they are to be commended, and it is earnestly urged upon those employers who have not done so to put same into use, wherever practicable, at the earliest possible opportunity.

(g) Specific methods for solution of our economic problems will be effective only in so far as they are applied in a spirit of patriotic patience on the part of all our people.

During the period of drastic economic readjustment, through which we are now passing, the continued efforts of anyone to profit beyond the requirements of safe business practice or economic consistency should be condemned. One of the important obstacles to a resumption of normal business activity will be removed as prices reach replacement values in terms of efficient producing and distributing cost plus reasonable profit.

We, therefore, strongly urge all manufacturers and

wholesalers who may not yet have adopted this policy to do so, but it is essential to the success of these measures when put into effect that retail prices shall promptly and fairly reflect the price adjustment of the producer, manufacturer, and the wholesaler.

When these principles have been recognized and the recommendations complied with, we are confident that the public will increase their purchases, thereby increasing the operations of the mills, factories and transportation companies, and consequently reducing the number of unemployed.

## Some Factors Affecting Zoning and Living Conditions

FACTORS affecting zoning and living conditions discussed by George B. Ford before the recent National City Planning Conference included an outline of observations on the distribution of industrial establishments and of business throughout a number of cities as observed by him and his associate, Ernest P. Goodrich, in their city planning studies; the number of stores to be allowed for a given population; the proportion of apartment houses and tenements found in various cities, and Mr. Ford's conception of the proper way of so controlling these as to serve the best interests of cities and their inhabitants. As to the latter phase of the subject, Mr. Ford urged that it was not so important to limit the number of families per acre as to control internal and external living conditions affecting the health, comfort and happiness of city dwellers. As to the distribution of industrial plants, Mr. Ford stated that in cities of 15,000 to 50,000 population industry is generally "concentrated in a rather small compact group"; in places of 75,000 to 150,000, industry is "spread in feelers along the railways and waterways"; while in larger cities the distribution of industry is generally quite irregular and haphazard, resulting in serious transportation and other problems.

### Business Houses and Apartments

As to business houses in towns of 10,000 or less, they are generally found "concentrated in a small area in the center of the town at a cross-roads or spread along a single street"; in places of from 10,000 to 50,000 business extends out from the center of the city along a number of streets, while here and there there are stores "at convenient corners in the residential districts"; as cities grow in size from 50,000 population and upwards, business extends out in "long feelers" on the principal traffic streets. The number of stores found in a half a dozen cities investigated have ranged from one to forty to each 125 inhabitants, the ratio being relatively larger in the smaller communities. Mr. Ford suggests that for places of 25,000 inhabitants or less there should be one store to each 50 or 75 inhabitants; in places of 25,000 to 100,000 one store to 75 to 100 people, and in communities of more than 100,000, with department stores, one store to 150 people. Even in large cities the outlying districts would have to have stores provided much the same as in smaller communities.

Other than one-family houses are rarely found in communities of less than 10,000 population and tenement houses are rarely numerous until a place has attained a population of some 20,000, while apartment houses are "rarely prevalent in cities of less than 50,000 inhabitants or in metropolitan residential suburbs of less than 25,000 inhabitants. In the East we find that there is one tenement or apartment house to every 100,000 inhabitants."

On the subject of zoning limitations designed to prevent congestion Mr. Ford says:

Aside from possibly esthetics there is little that is wrong with the two-family house, the tenement or the apartment, except the tendency to inadequate light and air, undue congestion, lack of privacy and of a place for the children to play. If these four features can be taken care of properly there is little that is harmful about congestion so-called.

The solution of these problems lies not in the policy, so difficult of enforcement, of limiting the number of families per acre, which is a palliative, imported from England, but rather by providing adequate yards and courts and a reasonable amount of open space in front of each window, front, rear, side and interior. If this is done properly, undue congestion will be taken care of effectively by indirection.

On the other hand, if room congestion is taken care of in a zoning ordinance it should be done frankly in the same way it is done in the tenement house laws by limiting the number of square or cubic feet of air per person in living and sleeping rooms.

We have found that we get vastly more satisfactory results in a much simpler and more direct way by specifically stating the minimum sizes of front yards, side yards, rear yards and courts which must be increased in size as the building goes up in height and as the lot increases in size. If done properly it makes wider lots desirable and a better business proposition.

### Provision For Yards

Similarly we find in practice that there is little or nothing gained by employing the cumbersome processes of limiting the percentage of lot occupied, for appropriate front, side and rear yard provisions solve the problems of securing adequate light and air and relieve over-crowding in a much simpler and more logical way.

Rather than limit the percentage of lot occupied we would recommend the more reasonable expedient which E. P. Goodrich has used in the Westfield, N. J., zoning ordinance where he made the front yards, the side yards and the rear yards each a certain minimum percentage of the area of the lot. We have applied this latter principle to at least 500 typical existing buildings and found that it works surprisingly well and causes no hardship.

In making city plans for Rheims, France, a place of 125,000 inhabitants before the war, which seemed destined to become an industrial center of 300,000 to 400,000 inhabitants, Mr. Ford provided for "an industrial sector along each of the five railways and three waterways radiating through the city." Alternating with these industrial sectors, the plan called for housing areas for wage-earners. On the southern hills provision was made for a high class residential development. The idea was that workingmen would be enabled to live near enough to their work so that they could walk to and from their homes morning, noon and night "without having to encumber the transit lines or to cross the center of the town." This plan also would give the workingmen quick access to "the outlying country, along a radial, without having to cross an industrial district."

Small playgrounds and parks attached to the schools were located in the dwelling sectors and larger recreational areas of the same sort were provided in outlying districts, together with market gardening areas. In the center of the city provision is made for the concentration of the general business and administration, while on the radial arteries and main cross thoroughfares in the residential sectors it is expected that local business houses will be established.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## World's Shaft Sinking Record

Sir—In the "Hints to Contractors" in your issue of Sept. 15 appears a paragraph on "Shaft Sinking Records." A new record has been set at the Water Lily shaft of the Chief Consolidated Mining Co., Eureka, Utah, where the Walter Fitch Jr. Co., the contractor, sunk 427½ ft. in 31 working days ending Aug. 15. This was described in *Engineering and Mining Journal*, Sept. 3. The equipment included four self-rotating hand-held air hammer drills.

Chicago, Sept. 19. SULLIVAN MACHINERY CO., S. B. KING.

[According to the *Engineering and Mining Journal* the shaft is vertical and has three compartments 4 ft. 4 in. x 4 ft. 6 in. Hoisting was done in two compartments by two small electric hoists with buckets of 17 cu.ft. capacity discharging by automatic dumps into cars of 18 cu.ft. capacity. The shaft timbers are 8 x 8 in. The first 367 ft. was in a porphyry formation which was favorable for mucking but offered difficulties in drilling on account of its sticky character. The last 60 ft. was in a moderately hard close-grained limestone. The sinking was done on a 3-shift basis with an average of 5.7 shaftmen per shift. Shaft sets were placed at the rate of 2.8 per day by an average of 4.8 lumbermen. The timber was installed from a suspended steel bulkhead which hung from the last set and made it possible to carry on timbering and mucking or drilling simultaneously. An average of 72.5 buckets of muck were hoisted each shift. For each round 23.9 holes were drilled, and the average powder consumption was 15¼ lb. of gelatine powder per foot. The average daily progress was 13.8 ft. During the 31-day period, shaft operations were delayed 13 hours on account of failure of powder and repairs to headframe. The men were paid the standard scale and a bonus which increased proportionately with the footage.—EDITOR.]

## Running Cultural and Technical Studies in Parallel for Six Years

Sir—Prof. Burr's paper on engineering education is so sound in the main that it does not need to be supported by unnecessary depreciation of the status of the engineer.

The intelligence tests of the United States Army during the war indicated that the engineer officers had a higher average intelligence than any other calling represented in the army. Medical men fell very far below. As to financial status I have read that just before the war the average annual income of a medical doctor in the United States was about $1,500. In working with civic groups in many communities I have found the medical doctor as a rule (there are many exceptions) to be so engrossed in his private affairs that he does not stand out as notable for assuming civic and social responsibility, as compared with merchants and business men, many of whom lack his equipment of cultural education. His liberal education has not entirely saved him from provincialism and selfishness. The fact that the engineer is habitually more dissatisfied with himself than is the doctor does not necessarily reflect discredit on the engineer.

The lawyer's profession is that of dealing with human relations. His experience in that field gives him a tremendous advantage, not all of which is due to his liberal education, as note the many great successes of lawyers who have been admitted to the bar after apprenticeship in lawyers' offices and without the help of college educations. It should be borne in mind that while the medical and legal professions have dignity, vested rights, and prestige acquired gradually since before the days of Hippocrates and Justinian, the engineering profession is scarce a century old.

But granting the above, I believe it remains true, as Prof. Burr states, that the most outstanding limitation of the engineer is his frequent lack of the broad foundation of a general cultural education and outlook. Without such a foundation he may lack that capacity for an appraisal of relative values, and for a comprehensive outlook, which is essential preparation for any large part in economic and civic affairs. The strictly technical education of some engineering schools may in fact tend to inhibit the normal development of civic and social interests which would occur if given a chance. The next most important weakness in engineering education is the tendency to confine preparation to theoretical and laboratory study, leaving out those contacts with real situations which develop self reliance and initiative, and help the engineering student to discover his own characteristics as related to real life.

There is another method of accomplishing these results besides the recommendation by Prof. Burr, of having a cultural course followed by a professional course. This other method consists of carrying the two lines of preparation at the same time, for the same period of six years. This latter method has two chief advantages. First, there is now a failure of cultural and professional schools to realize their close relationship and interdependence. This realization can be developed when the two lines are carried together, and there can be elimination of duplication, as in teaching English or Physics to those who are to become engineers. Second, if the two lines of work are carried together, the student's mind can be growing in *both* fields during the whole six years. Education is not alone a matter of hours spent in class, but also a matter of the increase of mental comprehension, and time is a vital element in that process.

At Antioch College we are endeavoring to accomplish these various ends by methods described sometime since in *Engineering News-Record* (see issue of Jan. 20, 1921, p. 108). During a six-year course the student spends half his time at school and half at work. Of his school time, approximately half is spent with cultural studies and half with technical courses. Some courses, as English, Psychology, Physics, Chemistry and Mathematics, relate to both cultural and technical education, so duplication is avoided. At the beginning of the course the work is mostly in the cultural field. The student may arrive at his decision of a vocation gradually, after conferences and assistance. He may be in college a year or two before any vocational choice is made. If by the second year he should have decided upon the general field of engineering, some of his courses would relate to that general field, and, for instance, be made to include advanced physics and mathematics. As the years pass he will define his calling more definitely, and will take more specifically technical courses, and less cultural work, though both elements persist throughout the course. Vocational decisions commonly are made prematurely and without proper consideration. Young men and women do not have easily determined "bents" to the extent commonly supposed. The final choice of a vocation may well be postponed until the later college years, but it cannot safely be ignored in the meantime, as generally is the case in liberal colleges. It is one of the big problems of college years, to be given serious and continuous consideration.

There is perhaps an assumption in Prof. Burr's paper to the effect that the engineer has a certain definite function for which he requires certain definite preparation. This is not the case. Engineering is an undefinable field, and the engineer's work takes innumerable forms and such a range of magnitude that no one standard of preparation will apply. For instance, at Antioch we aim to train for proprietorship or management as related to engineering, industry or other callings. Only a carefully selected group, high in initiative and native intelligence, is suitable for such training. Another school may well train for more definitely technical and much more specialized fields, and give the maximum of service to students who by type must always be employees working under direction. Some men should receive the broad cultural training necessary to prepare

them for high professional standing and large responsibility, while with others specific technical training is all that society properly can afford to furnish. There should be numerous types of engineering education, and diversity, rather than specific conformity, should be the outcome of the present instability described by Prof. Burr.

In order to compress into six years both a cultural and a technical education, especially where combined with actual experience as at Antioch, it is necessary completely to recast our ideas of a cultural education. At Antioch we take it to mean a general knowledge and view of the entire field of human interest and experience. With that aim in view there is provided a general course in which there are few if any electives except those earned by proven capacity.

There is a profound difference between a general view and a smattering. Take the subject of history, for instance. H. G. Wells in "An Outline of History" has given a general view of the whole period of human history; a mastery of which I believe is of far more cultural value than a similar time spent in some restricted historical period, as is the habit in many liberal colleges. Well's "Outline" is mentioned as a type, and not for its individual excellence. The fields of physical science, biology, and literature can be treated similarly, and the ground decently covered in the allotted time. In engineering subjects it will be necessary to spend the time largely on fundamentals, leaving specific applications to be secured during working periods or through seminars, or if necessary by advanced training in purely professional schools, as suggested by Prof. Burr. With the improvements in secondary education outlined by Prof. Burr, a student of "A-grade intelligence" could complete this entire program, including two years of specialized post-graduate study, by the time he is twenty-four.

Yellow Springs, Ohio, Sept. 20, 1921. ARTHUR E. MORGAN, President, Antioch College.

---

Sir—Prof. Burr's paper is timely and has opened for discussion a subject that has been given considerable attention by teachers and practicing engineers.

One point commonly overlooked is that the aim of our engineering schools and colleges (the name signifies little) in the undergraduate courses is largely to fit men for the business and industrial world. Those students who intend to follow engineering as a profession must either take graduate work or serve an apprenticeship under professional advice. Thus, engineering institutions are really trying to fit men for two types of life work, namely, that of the graduate who undertakes construction, drafting, sales, etc,. and that of the truly professional man who goes into design or consulting work. One course can not be made to meet both conditions. Our present system serves its purpose well with the exception that the courses are often too highly specialized. Unfortunately, as Prof. Burr points out, the student who intends to enter the profession of engineering is handicapped by lack of instruction necessary to place him on a par with men of the other profession. His endeavors must be confined to graduate study which in many instances consists in doing senior work in greater detail. In addition to the present curricula, there should be scheduled six-year courses for those who intend to enter the profession. Only institutions well equipped to undertake graduate work should attempt to install the long courses and some distinction in the degree granted must be made. The number of applicants will be admitted not because of financial inability nor lack of intelligence but because most of our students do not intend to enter the profession. Furthermore, the opportunities of the professional engineer are more limited in the amount of work to be done than are those of the lawyer or the physician.

The practice of lawyers and physicians is consulting work and when comparison is made with engineers such comparison should be limited to consulting engineers who represent the truly technical men. The standing of consulting engineers in a community is as high on the average as that of the members of any of the other professions.

F. W. GREVE,
Assoc. Prof. of Hydraulic Engineering Purdue University.
Lafayette, Ind., July 29, 1921.

## Credit for Sounding Rod Rig

Sir—In order to correct any impression that the writer or his company was the originator of the sounding rod detail described by the writer in *Engineering News-Record*, Sept. 29, p. 539, may I ask you to print that we first heard of the scheme from the Raymond Concrete Pile Co.

New York City, Oct. 1. GEORGE E. HORR.

---

## Problems in the Chlorination of Water

Sir—In the article on "Problems in the Chlorination of Water," *Engineering News-Record*, Sept. 8, p. 393, you have misquoted us or at least there has been an error in presenting what we intended to say. The answer to Question 2 read, "The public does not become accustomed to tastes and odors in chlorinated water," but it should have read: "The public does become accustomed." If you read the following sentence in the same paragraph you will see that this is what the writers intended in answering this question.

Baltimore, Sept. 10. A. E. WALDEN, S. T. POWELL.

---

## Henry Ford's Operation of the D., T. & I.

Sir—Your editorial in the issue of Sept. 1 on "Discounting Efficiency" is timely in calling attention to the fact that there has been an increase in operating efficiency on the Detroit, Toledo & Ironton Railroad, as well as in its traffic and financial standing.

But was due thought given to the efficiency which any organizer can put into a plant, railroad or industrial, by furnishing new capital for the necessary improvements which will permit greater economy of operation? Installation of modern equipment, strengthening of roadbed and bridges, mechanical devices for saving labor in stations and shops, cost money, and bankrupt, or semi-bankrupt, roads have knowingly to get along with obsolete material, at large expense for labor and maintenance.

Was allowance also made for the fact that a certain amount of new capital was put into the property by the Federal Administration, as a war measure, the benefit from which was beginning to accrue just at the time Ford took over the property?

There is also a psychological effect on efficiency when the workman realizes that he has good tools to work with.

In the past other railroads have used similar methods to improve their standing. Witness the coal roads, but political cries like "discrimination in rates" and "interlocking directorates" have had their effect in forcing a separation of interests. Is this not really a similar case, not legally, but morally? L. J. CARMALT,

New Haven, Conn., Sept. 7. Consulting Engineer.

---

## Long Howe-Truss Spans on Southern Pacific

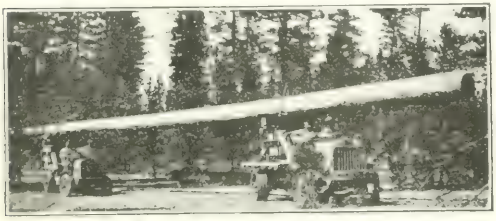
Sir — On page 452 of your issue of Sept. 15 you refer to the recently replaced 174 ft. 10 in. Howe-truss spans across the Allegheny River at Foxburg, Pa., as probably the longest railway Howe-truss spans on record. In their original construction, though long since replaced with steel, there were a number of Howe-truss spans on the Pacific System of the Southern Pacific R. R., that surpassed in length the spans referred to above. Among these were a 176-ft. span across Spring Creek, two 192-ft. spans across Salinas River, two 192-ft. spans across Kings River, one 192-ft. span across Sespe River, all in California, and two 200-ft. spans across Willamette River in Oregon. There is also a description in Johnson's "Modern Framed Structures" (7th Edition, page 356) of a 250-ft. Howe-truss built by this same company on its lines in Oregon.

JOSEPH JACOBS,
Powell & Jacobs, Consulting Civil Engineers.
Seattle, Wash., Sept. 21.

# HINTS FOR THE CONTRACTOR

## 90-Ft. Derrick Mast Hauled on Two Trucks

IN assembling construction equipment on the Pit River hydro-electric project in Northern California, timbers for use in the derricks were cut near the work and hauled in on trucks, as shown in the accompanying illustration. The method of fastening the timbers to the trucks was to build up a heavy timber bolster or cradle on each truck body so the timber would ride well above all parts of the truck, and fasten it there by means of a chain slung around timber and bolster and tightened with a jack. The bolsters were rigidly



MOVING 90-FT. DERRICK MAST IN THE WOODS

attached to the truck bodies, such play as was necessary being allowed by the single wrap of the chain.

## Batch Buckets Carried on Flat Cars Used in Building Retaining Wall

IN BUILDING a wall which is to retain a heavy fill between the Grove St. and East Orange, New Jersey, stations of the Delaware, Lackawanna & Western R.R., restricted right of way and inability to reach the work easily except from the railroad grade led to the use of heavy steel batch buckets carried on flat cars for the transportation of concrete from the mixer on one end of the fill to points along the concrete retaining wall.

The heavy steel batch buckets of 2-yd. capacity are placed on flat cars and hauled by a steam dinkey. The dinkey track is interlaid with the broad-gage track over which aggregate is hauled in railroad cars and stock-piled at one end of the fill. Approximately in the middle of the fill (which is about 300 ft. in length) is a stiff-leg derrick which handles the buckets from the flat car to where it is placed in the wall. One and a one-half cubic yards of concrete are carried in each bucket, being two batches from the ¾-yd. mixer being used. The mixer platform is built alongside the track so that the mixer can discharge directly into the batch buckets.

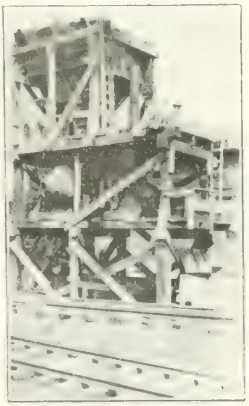


FIG. 1. CONCRETING PLANT

FIG 2. DINKEY TRAIN TRANSPORTING CONCRETE

This particular wall which forms part of the grade elimination work being done by the D. L. & W. and known as the East Orange Improvement, is being built by F. M. Talbot & Co., railroad contractors.

## Store Excavated Sand on Building Site

Sand and gravel excavated for the site of the Palace Theater at South Bend, Ind., was stored in a large pile at the center of the site for use in the concrete of the foundation and the mortar for the brickwork. This saved the expense of hauling the material away to a storage yard and bringing it back again as required. The lot is 108 x 165 ft., to be entirely covered by the building and having no storage space on either side. The material is an excellent grade of torpedo sand.

As the auditorium occupying the center of the site will be spanned by steel trusses there were no interior columns to be interfered with by the stock pile. Excavation of the foundation trenches and basement was done by teams and drag scrapers, the material being dumped to form a tall conical pile. The vertical face of the excavation was sheeted and the forms were braced against it, so that the pouring of concrete was being done at one point while excavation was proceeding at another point. Practically all of this sand will be used before the structure is ready for the trusses, so that there will be a clear and level space for the steel erection. The Ralph Sollitt & Sons Construction Co., Chicago, had the contract for this building.

### Wood Column Tests to Be Conducted at Madison

For the purpose of obtaining data on the effect of density and defects such as knots, checks and cross grain on the strength of structural columns of Southern pine and Douglas fir, a series of column tests covering a period of four years will soon be started at the Forest Products Laboratory at Madison, Wis. The tests will be carried out under the direction of J. A. Newlin, in charge of timber tests at the laboratory and Dr. D. F. Holtman, construction engineer, National Lumber Manufacturers' Association. The latter will furnish the material, which it is estimated will consist of 160 pieces of 12 x 12-in. x 24-ft. timbers.

# NEWS OF THE WEEK

New York, October 6, 1921

## N. Y. Transit Commission For City-Owned Lines

**Private Operation Recommended in New Body's First Report—Unified System Urged**

Valuation, consolidation and municipal ownership of all transportation facilities in New York City are favored in a report made public Sept. 29 by the N. Y. Transit Commission. The plan proposes the consolidation and municipal ownership of all surface, sub-surface and elevated lines, deemed by the commission to be useful and essential, and their inclusion in three new operating groups. Group 1 comprises the subway and elevated railroads now operated by the Interborough Rapid Transit Co., and leased by it from the city, and the Manhattan Railway Co. Group 2 includes the subway, elevated and surface railroads now or formerly operated in the Brooklyn rapid transit system; and Group 3 embraces the surface railroads of the boroughs of Manhattan and the Bronx.

The plan also proposes administration of all lines by a board of control of seven members. Operation is to be carried on by three operating corporate agencies to be created for the purpose. It is the commission's plan that the transportation lines be acquired without delay by the city, by amortizing out of earnings the valuation fixed by the Transit Commission. Existing securities would be replaced by an issue of bonds of a consolidated company representing a new physical valuation of the properties.

The rates of fare are to be based on actual cost and automatically determined by the amount of a contingent reserve or barometer fund. It is the Transit Commission's hope that the 5-cent fare may be retained, and that the charge for transfers can be abolished. New construction is provided for in the proposal by increasing the city's debt-incurring capacity. Participation by operating personnel as well as new security holders in surplus profits resulting from efficient management and operation is also a proposal in the readjustment plan.

The members of the Transit Commission making the report are George McAneny, John F. O'Ryan, and LeRoy T. Harkness.

## Traffic Doubles in 30 Months

Traffic over the highways of California is doubling every 30 months according to a report recently issued by the California Highway Commission and based on records from the 3,200 miles of highway which the commission has constructed and is maintaining.

## Engineers Urge Public Works Boom to Aid Unemployed

At their seventeenth annual convention held in Tacoma, Sept. 12-14, county engineers of the State of Washington adopted resolutions urging county boards, city commissioners, and state officials to proceed with all justified public improvements, as a means of reducing unemployment. A policy also was endorsed of having the various counties co-operate with the state in the purchase and use of devices for weighing loaded motor trucks on the main highways, to prevent overloading.

The association elected the following officers: E. A. White, president; J. L. Thayer, vice-president; Thomas Meads, secretary-treasurer. Next year's convention will be held at Walla Walla.

## May Defer Shadesville Bridge

No action has yet been taken by the county commissioners of Franklin County, Ohio, to readvertise the construction of the Scioto River bridge at Shadesville. The first contract, awarded on a bid approximating $400,000, was stopped by an injunction on application of the county prosecutor because of illegalities in the letting. While the Chamber of Commerce of Columbus has adopted resolutions asking that the construction of the bridge proceed, some of the commissioners are disposed to wait for further reduction in the cost of labor and materials, believing that a saving of $100,000 can be made if the project is held up a year or so.

## Federation Will Organize Paid Employment Service

**Decision Reached by Executive Board Last Week—Dean Cooley New President**

Approval was given by the executive board of the Federated American Engineering Societies at its meeting in Washington Sept. 30 to the plan of organizing a paid employment service for engineers. Dean Mortimer L. Cooley, of the colleges of engineering and architecture, University of Michigan, was elected president of the American Engineering Council to fill the vacancy created by the resignation of Herbert C. Hoover, made necessary by his appointment by President Harding as Secretary of Commerce. It is understood that Prof. Cooley has made arrangements which will enable him to give one-fourth of his time to active work for the organization.

The board adopted recommendations covering improvements in government contracts, endorsed the principle of a paid employment service for engineers referred to the committee on printing the proposal to publish a journal, authorized the secretary to form administrative committees in the states, abandoned the project for an engineering assembly in Washington at the time of the council's annual meeting in January, and recommitted the report of the committee on licensing of engineers.

Included in the approved recommendations of the committee on gov-

## Unemployment Conference Reports Emergency Measures

*THE President's unemployment conference completed on Sept. 30 the first part of its work—the consideration of measures for emergency relief of unemployment—and then adjourned to meet again Oct. 10 in order to consider measures for preventing or mitigating unemployment periods in the future.*

**Organization of the conference was effected Sept. 26 and the work divided among committees on statistics, employment agencies, emergency measures in public works, in manufacturing, in transportation, in construction, in mining, and in shipping. These committees immediately got to work and though it was not expected that they would be ready to report until Oct. 5, such progress was made that they presented their findings to the conference as a whole Sept. 30 and adopted recommendations with reference to emergency measures. These will be found elsewhere in this issue, while the editorial pages carry comment on the conference and its results.**

**The following men intimately connected with the construction industry were members of the conference:** *Winslow B. Ayer, president Eastern & Western Lumber Co., Portland, Ore.; C. M. Babcock, highway commissioner of Minnesota, St. Paul; John Donlin, president of the building trades department, American Federation of Labor; John H. Kirby, president Kirby Lumber Co., Houston, Tex.; Brig.-Gen. R. C. Marshall, Jr., general manager Associated General Contractors; Ernest T. Trigg, vice-president John Lucas & Co., and president of the Federation of Construction Industries; Sanford E. Thompson, consulting engineer, Boston.*

ernment contracts (A. P. Davis, chairman; Col. C. O. Sherrill, D. K. Boyd, Charles F. Ruffner, W. M. McFarland and Peter Junkersfeld) were the following:

1. Favoring unit-price, lump-sum or purchase-and-hire basis in preference to cost-plus.

2. Advocating appointment by the President of an inter-departmental board on standardization of contracts.

3. Urging promptness in making partial payments for work done.

4. Opposing boards of arbitration and giving contractor right of appeal up to bureau chief.

5. Endorsing principles of justice in making deductions for non-completion of work on time.

EMPLOYMENT SERVICE

More attention was given the report of the special commission on employment service, of which Morris L. Cooke is chairman, than to any other subject taken up by the board. From the discussion, a resolution grew which points out the pressing need for a unified employment service for engineers "national in scope, local in application and financed for adequate service." Since the constituent societies are not able to provide a free service, the executive board endorsed the principle of a paid employment service, but with reduced fees for members of the organizations that support it. The chairman of the executive board is to appoint a committee of five members, while each of the boards of the four founder societies is to designate one of its members so as to provide a committee of nine members on engineering employment. This joint committee is to organize the employment bureau.

The committee on finance was given broad powers to deal with financial arrangements with member societies. At the time the federation was formed the numerical strength of most engineering societies was at its peak. With the industrial depression, there have been losses of members and several suggestions to relieve the situation have been offered. Edwin Ludlow suggested that the American Institute of Mining and Metallurgical Engineers would like to revise the agreement so that payment of the contribution to the federated societies could be made on a basis of paying members. After some discussion, it was decided to adopt no rigid policy in the matter, but to give the finance committee authority to deal with the matter as it sees fit.

ENGINEERING ASSEMBLY ABANDONED

Authority was given to Secretary Wallace to form administrative committees in the several states.

The Engineering Assembly, which was being considered in connection with the annual meeting of the council in January, was abandoned. The feeling was that the business depression would militate against the success of a general meeting of engineers at that time.

After listening to the report of the committee on licensing the board agreed that further work must be done in perfecting the uniform licensing bill. The whole matter was recommitted to the committee.

Those in attendance at the executive board meeting were: G. S. Williams, Ann Arbor, Mich.; Lloyd B. Smith, Topeka; Arthur M. Greene, Jr., Troy, N. Y.; Wm. McClellan, Philadelphia; S. H. McCrory, Washington, D. C.; H. E. Howe, Washington, D. C.; Morris L. Cooke, Philadelphia; W. B. Powell, Buffalo; C. F. Scott, Yale University; W. W. Varney, Baltimore; L. P. Alford, New York City; P. N. Moore, St. Louis; W. E. Rolfe, St. Louis; Calvert Townley, New York City; Fred J. Miller, Stockton, N. Y.; Edwin Ludlow, New York City; Arthur S. Dwight, New York City; J. P. Channing, New York City; O. H. Koch, Dallas, Texas; D. S. Kimball, Ithaca, N. Y.

## Many Changes Made in Newark's Engineering Personnel

As a result of a reorganization of the Department of Streets and Public Improvements of Newark, N. J., effective this month, many changes in engineering personnel have been made. Morris R. Sherrerd has been replaced, as chief engineer, by John A. Foulks, formerly an assistant chief examiner of the Civil Service Commission, who will have charge of the city's new water supply division. Mr. Sherrerd, it is understood, will be called upon for consulting advice. In the reorganized service James W. Costello heads the division of works and Harrison R. Van Duyne will be chief of the division of surveys and accounting.

## Providence Awards Contract for Feeding Garbage to Hogs

A five-year contract for garbage collection and disposal by feeding to hogs, was awarded Sept. 30 by Providence, R. I., to Joseph J. Nugent. The average yearly contract price is $80,000, beginning at $100,000 for the first year and diminishing by $10,000 a year. The contractor will provide a loading station in Providence and will maintain a sufficient number of hogs to consume the garbage, which it is supposed will be about 6,000.

Although bidders were permitted to adopt either hog feeding, reduction or incineration as a means of disposal, the only formal bid received was for disposal by feeding. The highest bidder ($120,000 a year) offered to get rid of the garbage without a loading station in the city. A bidder at $107,000 conditioned his bid on the city providing a loading station, wagons and buildings for his horses and men; or as an alternative he proposed to do the work for $3,590 per year per team. All three of the bids mentioned were for five years. The fourth bidder offered to do the work for $90,000 a year on either a six-months, one-year or three-year contract. Dr. Charles V. Chapin is superintendent of health in Providence.

## Steel Bridge Wrecked by Auto Collision

### Truss Members Knocked out by 5-Ton Truck and Structure of 100-ft. Span Falls

A steel truss highway bridge of 100 ft. span, at Savage, Md., was completely wrecked Sept. 21 as the result of the grazing collision of two motor cars on the bridge. John N. Mackall, chairman and chief engineer of the State Roads Commission, gives details of the accident as follows:

"Over the Little Patuxent River on the Baltimore-Washington boulevard at Savage, there was a pin-connected, through-truss bridge of a span of 101 ft., with a clear roadway of 14 ft. The bridge was marked with signs of standard size placed 300 ft. from the ends, notifying the public that it was a one-way structure. A 5-ton truck loaded with asphalt approached the bridge from the north at the same time a light passenger car approached from the other side. Instead of one or both stopping, they rushed on the bridge and met at about the center. The truck and car side-swiped, doing little damage to the truck, but tearing the front and rear fenders and running board off the automobile. The impact caused both the truck and car to turn around on the bridge, and the truck knocked out several of the vertical and diagonal members, both compression and tension, as the result of which the entire bridge collapsed. The truck went down with the bridge.

"There are on the state road system in Maryland about 20 one-way bridges which are being replaced as rapidly as as funds are available. The inevitable result is failure of the structure whenever an accident of this kind occurs. The bridge was regularly inspected and was amply strong in every respect to carry any load which was likely to come on it. When the First Division was going to Washington for the Pershing parade in 1919, one of the army trucks knocked down a bridge at Conowingo over the Conowingo Creek in a similar manner. No injury was done to anyone at this time.

"A contract has been awarded for the rebuilding of this bridge, work has begun and we expect to have it completed within 30 days. A reinforced-concrete arch of a clear width of 24 ft. between curbs will replace the demolished steel structure."

## Health Exposition to Be Held in New York City

A health exposition of "approved articles of health value" by commercial houses and educational and philanthropic organizations will be held in the Grand Central Palace, New York City, November 14-19—the week of the fiftieth annual convention of the American Public Health Association.

Further information may be obtained from the association at 370 Fifth Ave., New York City.

## Three Triple-Expansion Pumping Engines for Milwaukee

Bids for one 25 and two 22-m.g.d. vertical triple-expansion pumping engines, erected in the Riverside pumping station, are wanted by Percy Braman, commissioner of public works, Milwaukee, Wis., up to 10:30 a.m., Oct. 24.

## Dean Cooley New President of Federated Societies

Dean Mortimer L. Cooley, of the University of Michigan, whose election to the presidency of the Federated American Engineering Societies is announced in another column, has, in addition to his collegiate duties, taken an active part in the field of railway valuation and the appraisal of public utilities and private industrial properties, having served also as chief engineer in charge of appraisals of water and steam power development and electrical distribution for the Michigan State Railway Commission. Dean Cooley is a past-president of the American Society of Mechanical Engineers, served for five years as chairman of the block signal and train control board of the Interstate Commerce Commission, and has been for sixteen years dean of the school of engineering and architecture at the University of Michigan.

He was born in Canandaigua, N. Y., in 1855, and was graduated from the U. S. Naval Academy in 1874. After several years of sea duty he was assigned, as cadet engineer, to the bureau of steam engineering of the Navy Department. In 1881, as assistant engineer, he was ordered to the University of Michigan to teach steam engineering and shipbuilding. Four years later, at the request of the regents, he resigned from the Navy to accept the chair of mechanical engineering at Michigan. Largely through his efforts, the engineering department of the university was built up to its present size and in recognition of his service he was appointed dean of engineering in 1904, having served continuously since that time.

Among Dean Cooley's professional engagements have been the valuation of mechanical equipment for the Detroit street railways and a physical valuation of railways, telephones, telegraphs, and toll roads of Michigan, involving a total of about $230,000,000. In 1902 he assisted the government of New Foundland in the appraisal of certain railways and served as a member of Chicago's traction valuation committee in 1906. He has been an expert in numerous patent cases and advised on the valuation of the Minneapolis General Electric Co.'s property in 1897.

## Bids for Large Pumps Wanted by Montreal Water Board

Bids for one, two or three 30,000,000-gal. electric driven centrifugal pumps for the water-works of Montreal, Que., are to be received by the local water board until Oct. 10.

## Break in Tunnel Deadlock Seems Near

### New York Commission Forces Jersey Body to Declare Itself on Railway Siding Controversy

While it cannot yet be said that the deadlock between the New York and the New Jersey tunnel commissions, which for months has prevented a start on the construction of the Hudson River vehicular tubes, has been broken, events at last week's meeting of the two bodies indicate that the New Jersey commission members are facing the necessity of laying their cards upon the table as the result of the New York demand, made by Gen. George R. Dyer, chairman, for a showdown by the Jersey members on their position of insistence upon perpetual rights for a railroad siding serving the warehouse of the Union Terminal Cold Storage Co., of which T. Albeus Adams, chairman of the New Jersey commission, is president. The New York commission, he said, would never approve a contract with such a clause.

The issue was brought to a head by E. W. Bloomingdale's specific inquiry as to whether or not the New Jersey commission would accept the contract if the Erie R.R. agreed to the omission of any reference to the siding. The New York members submitted the following statement which will be considered by the New Jersey body.

NEW YORK'S PROPOSITION

"It is agreed that if the Erie R.R. will accept contract tendered by the New York commission under date of Sept. 15, which contract contains no reference to the railroad siding, the New Jersey commission will ratify and agree to said contract on its part. It is further agreed that if the Erie R.R. insists upon the inclusion in the contract of the provision contained in the form tendered by the New Jersey commission, which provides for the maintenance of the railroad siding, the New York commission will agree to, ratify, and confirm said contract, provided said inclusion is so framed that the rights of all parties thereto shall remain as they are of this date. It is further agreed between the two commissions that no ordinance or resolution in any form providing for the maintenance of said railroad siding shall be adopted by the authorities of the city of Jersey City, nor will the authorities take any other action that will give rights to claim damages to any of the parties concerned with or having an interest in said railroad siding and that the New Jersey commission will obtain from the Jersey City authorities the necessary assurances to that effect."

## Road Transport Progress Shown in Pageant

**A Conestoga wagon built in 1802, a one-cylinder Cadillac car built in 1902, the famous Washington coach from Valley Forge, a Concord stage coach, a "one-hoss shay" built in the eighteenth century, and dozens of other ancient and modern vehicles were features of the pageant depicting the development of road transportation, which was held at Caledonia Park, between Gettysburg and Chambersburg, Pa., Oct. 4. The Pennsylvania Highway Department and the local automobile clubs were in charge of the program.**

**The pageant comprised 30 episodes, starting with a lone Indian on his pony and ending with a $15,000 passenger automobile.**

## Railway Bridge and Building Men to Meet in New York

At the annual meeting of the American Railway Bridge and Building Association, to be held at the McAlpin Hotel, New York City, Oct. 18-20, the subjects of reports to be discussed will include cleaning structural steel before painting, lining tunnels under traffic, construction of station platforms and engine ashpits, tool equipment for pile driver outfits, and the detection and repair of leaks in water mains.

## Paving Policy for D. C. Suburban Roads Announced

All suburban roadways in the District of Columbia in the future will, where possible, be built of concrete with the idea of resurfacing them with sheet asphalt, as that may become necessary. This policy was revealed in the annual report to the District Commissioners by C. B. Hunt, engineer of highways. The policy is based on experience with streets which have been resurfaced in that manner.

## Indian Engineer Completes Study of American Roads

K. G. Mitchell, of Lahore, Punjab, India, who is connected with the Indian Board of Communications, sailed last Saturday for England after having spent six weeks in the United States studying concrete and dirt road practice and American machinery.

Most of the roads in the Punjab are of dirt, though there are about 1,300 miles of water-bound macadam. The chief traffic consists of steel-tired carts, drawn by bullocks, which have tire widths of about 2½ in., and impose heavy concentrations upon the road, loads of 2½ tons on two wheels not being uncommon. As a result the earth roads are badly rutted and macadam crusts are quickly broken through. In consequence the authorities are considering the construction of a considerable mileage of concrete road.

## Standards Specified for Steel and Explosives

Three specifications have been submitted to the American Engineering Standards Committee for approval. Two of them, defining automatic screw steel of bessemer and open-hearth process, are submitted by the American Society for Testing Materials; a specification for the testing and use of mine explosives is submitted by the U. S. Bureau of Mines. All were originally formulated on the basis of extensive tests and have been in use for several years. The two steel specifications, formulated in 1914 and 1915 respectively, are proposed as American standards, while the explosives specification, which in its finally revised form was issued last April, is proposed as tentative American standard.

## I. C. C. Has Tentative Plan to Merge Railroads in 19 Systems

A tentative plan for the consolidation of all the major railroads of the country into nineteen big systems, a recommendation provided for in the Transportation Act, was announced September 28 by the Interstate Commerce Commission. The proposed combination is designed to remove weaknesses in the national railroad systems and to effect economic readjustment of terminal and other subsidiary facilities. The plan follows the consolidation plan worked out by Professor William Z. Ripley, of Harvard, though some changes have been made.

The groupings, as shown below, contain only the principal roads in the various proposed systems.

Central; Boston & Maine; Cleveland, Cincinnati, Chicago & St. Louis.

cago, Cincinnati & St. Louis.

Group 3—Baltimore & Ohio; Reading system; New York, New Haven & Hartford.

Group 4—Erie; Delaware, Lackawanna & Western; Wabash lines east of the Mis-

Group 5—Lehigh Valley; New York, Chicago & St. Louis.

Group 6—Pere Marquette; Detroit, Toledo & Ironton.

Group 7—New York, New Haven & Hartford; Boston & Maine.

Group 7 consolidated with Delaware & Hudson, Ulster & Delaware; Delaware, Lackawanna & Western; Buffalo, Rochester & Pittsburgh; Pittsburgh & Shawmut; Pittsburgh, Shawmut & Northern, as a variation.

Group 9—Norfolk & Western; Toledo & Ohio Central.

Group 10—Southern; New Orleans Great Northern.

Clinchfield & Ohio; Florida East Coast.

Group 12—Illinois Central; Seaboard Air Line; Carolina, Clinchfield & Ohio.

Group 13—Union Pacific; Chicago & Northwestern; Wabash lines west of the Mississippi.

Group 14—Chicago, Burlington & Quincy; Northern Pacific; Chicago Great Western.

Group 15—Chicago, Milwaukee & St. Paul; Great Northern; Spokane, Portland &

Group 16—Atchison, Topeka & Santa Fe; Denver & Rio Grande; Western Pacific.

Group 17—Southern Pacific; Chicago,

Group 18—St. Louis-San Francisco; Chicago & Alton; Missouri, Kansas & Texas.

Missouri Pacific, Kansas City Southern.

## Engineers Take Active Part in Drainage Congress

A new constitution embodying the principle that private drainage projects should not seek federal aid was adopted by the National Drainage Congress Sept. 22-23, at its meeting in St. Paul, noted in last week's issue of this journal, p. 541. Flood control in its close relation to land drainage was discussed and there was an opinion that in some drainage projects the flood effect on downstream conditions has not been given due consideration. In a paper on "Flood Control Legislation," Frank L. Cliff, Ortonville, Minn., took the position that while the boundaries of drainage districts include only property subject to assessment, a flood control project should include the entire area of a basin whose runoff passes through one outlet. This led to discussion as to whether uplands should be assessed for drainage.

Outlet drainage districts to provide joint outlets for groups of districts were discussed by L. K. Sherman, consulting engineer, Chicago. Such projects are often opposed on the ground that the straightening and deepening of a channel will result in higher flood levels at the lower end. Mr. Sherman explained that as the improved channel gives greater velocity it will carry off more water during the earlier stages of a storm, thus reducing the amount which passes at the crest of a flood.

State control of drainage projects as a check upon speculation and development was urged by S. H. McCrory, chief of drainage investigations, U. S. Department of Agriculture.

A monthly magazine and a paid secretary were decided upon in a policy of expanding the work of the National Drainage Congress. The president is Clark E. Jacoby, consulting engineer, Kansas City, Mo., with vice-presidents as follows: Jacob A. Harman, consulting engineer, Peoria, Ill.; F. H. Newell, consulting engineer, Washington, D. C., and A. J. Bracken, Chicago. The secretary and editor is Robert A. Glenn. It was voted to hold the 1922 meeting at Kansas City, Mo.

## Am. Soc. C. E. Canvasses Ballot on Amended Constitution

**The ballot on the proposed amendments to the Constitution of the American Society of Civil Engineers, canvassed at the regular business meeting held last night in the Engineering Societies' Building, New York City, resulted as follows:**

**FOR Adoption ..... 1,367**

**AGAINST Adoption .....326**

**Note: An affirmative vote of two-thirds of all ballots cast is necessary to the adoption of any amendment to the constitution.**

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; Annual Meeting, New York City, Oct. 18-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-25.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

**The Municipal Engineers of the City of New York** held its monthly meeting on Sept. 28. Thomas H. Wiggin addressed the society on the subject, "An Engineer's Two Years in China." Mr. Wiggin has recently returned from China where he spent two years in charge of engineering investigations for the improvement of the Grand Canal of China and the control of the floods of the Yellow River.

**The Seattle (Wash.) Engineers' Club** was addressed, Sept. 17, by C. E. Drayer, secretary of the American Association of Engineers, on "Engineering Service."

**The Harvard Engineering Society,** at at a joint meeting with the Harvard Club of New York, Oct. 14, in New York City, will be addressed by Clifford M. Holland, chief engineer, New York and New Jersey tunnel commissions on "The Vehicular Tunnel," and by George A. Post, president Hudson River Bridge Corp., on "The Proposed Suspension Bridge."

# Personal Notes

JOHN E. JOHNSON, civil engineer of Paducah, Ky., has been appointed highway engineer for the western district of the State Highway Department of Kentucky, succeeding HUGH CROZIER, who has been appointed assistant engineer in the headquarters office at Frankfort.

MAJOR U. S. GRANT, 3rd, Corps of Engineers, U. S. Army, has been appointed a member of the California Debris Commission.

CAPTAIN JOHN K. ROBINSON has been promoted to be chief of the Bureau of Engineering, U. S. Navy.

THOMAS N. GILMORE has opened an office as consulting engineer in New York City to specialize in layouts and designs of railroad shops, locomotive terminals, power plants, steam stations and industrial plants and in the improvement of these facilities. For the past 16 years he has been connected with Westinghouse, Church,

Kerr & Co. in charge of railroad shop design and construction and later as vice-president and chief engineer in charge of all engineering and construction.

J. B. MAYES, formerly connected with the South Carolina State Highway Department, has been appointed road engineer for Williamsburg County, S. C.

WILLIAM C. H. LEWIS and LAWRENCE WILEY have organized the firm of Lewis & Wiley, Ltd., sluicing contractors, with headquarters at Alix, Alberta, where the firm has entered into a contract for sluicing off a 30-ft. overburden from the seam of coal in the mine of the Tredway Coal Co., the work involving the handling of about 2,000,000 yd. of earth. The two principals are sons of the men who organized the Lewis-Wiley Hydraulic Co., and carried out extensive sluicing contracts in Seattle, Portland and other parts of the northwest some years ago.

H. M. SMITTEN, formerly lieutenant-colonel, 37th Engineers, A. E. F., and, since his discharge from the service, engineer in the valuation department of the Southern Pacific R.R. Co., has resigned to become bridge engineer for the Western Pacific R.R.

PHILIP K. SCHUYLER, formerly in the bridge department of the Wisconsin Highway Commission, has taken a position with the bridge department of the North Carolina Highway Commission, of the North Carolina Highway Commission, at Raleigh, N. C.

VIRGIL KLINE, formerly engaged in road building in Lowndes County, Ga., has been appointed resident engineer for the Georgia State Highway Department in charge of road building in Brooks County.

PROF. HALE HOUSTON who has been in charge of the civil engineering department of the Clemson Agricultural College, Clemson College, S. C., has resigned to become connected with Washington and Lee University.

E. L. CLARKE, for a number of years connected with the Westinghouse, Church, Kerr & Co., has been appointed professor in charge of the civil engineering department of Clemson (S. C.) Agricultural College.

FRANK JOYNER, for many years road commissioner of Los Angeles County, Cal., and recently consulting engineer for the Western Willite Road Construction Co., Los Angeles, has resigned to engage in general consulting and highway engineering practice.

CHARLES A. MAY, for some time asistant state highway engineer of New Mexico, has been appointed state engineer.

ALBERT GIVAN has been appointed city engineer of Sacramento, Cal.

CHARLES R. VANNEMAN, formerly inspector of transportation and recently in charge of most of the engineering work of the old Public Service Commission for the Second District, N. Y., has been appointed chief engineer of the New York State Public Service Commission and will have charge of the engineering and inspection work for all steam railroads, street railways, grade crossings, electric light companies, and telephone and telegraph companies.

LEO K. KENNEDY has been appointed civil engineer for the Happy Valley Irrigation District, Cal., and will direct the completion of the Hoover tunnel and other improvements.

ADMIRAL ROBERT GRIFFIN, for more than 8 years head of the bureau of engineering of the Navy Department and engineer in chief of the Navy, terminated 40 years of active service on Sept. 22 and retired to private life. His influence was responsible in large measure for the adoption of the electric drive for battleships and, under his direction, high-powered radio stations were built at Panama, San Diego, Pearl Harbor, Cavite, Annapolis and Bordeaux, France. The latter was erected during the war, and ranked as the world's most powerful station.

J. A. BERNIER has been appointed city engineer of Shawinigan Falls, Que.

THOMAS H. MACDONALD, director of the U. S. Bureau of Public Roads, recently made an extended automobile trip over some of the newer highways in New York and New England. He was accompanied by A. R. Hirst, state highway engineer of Wisconsin.

## OBITUARY

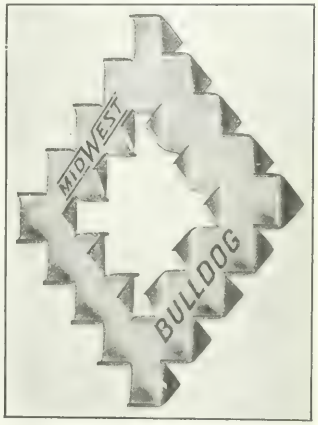
CHARLES L. HYDE, president of the C. L. Hyde Construction Co., San Diego, Cal., died Sept. 17 in San Diego. He was born in Salt Lake City, Utah, in 1862. In 1910, with Jesse Knight, he formed the Knight & Hyde Construction Co. He built many of the roads at Loma Portal, Sunset Cliffs and Point Loma and aided in the grading of Redondo Beach and San Pedro and built a section of state highway in Riverside County, Cal.

S. S. VOORHEES, one of the principal technologists of the U. S. Bureau of Standards, died Sept. 24 in Portland, Me., as the result of an operation. He was born in Springfield, Ohio, 1867, and was educated at Lehigh University and George Washington University. From 1887 to 1896 he was assistant chemist, Cambria Iron Co. and Pennsylvania R.R., Altoona, Pa. He also served as chemist in charge for the Southern Ry., Washington, and for the New York Central & Hudson River R.R. From 1901 to 1908 he served as engineer of tests, U. S. Supervising Architect's Office and later, for 2 years, with the U. S. Geolgical Survey. He has been an engineering chemist in the U. S. Bureau of Standards since 1910. Mr. Voorhees was prominent in the American Society for Testing Materials, of which he was vice-president from 1916 to 1918.

## EQUIPMENT AND MATERIALS

### Timber Joint Plate

The Midwest Steel & Supply Company, Inc., New York City, has devised a simple system of connecting wooden beams and stringers. It is manufacturing the "Midwest Bull Dog" which is a steel plate provided with a number of sharp strong teeth on both sides. When placed between two wooden members and the joint is drawn up tight with the bolt going through the square hole in the plate, great rigidity and




strength are provided. As the nut is tightened the teeth cut into the wood evenly and easily on both sides and a firm connection is made. It is made of a special quality of cold rolled steel, having a high tensile strength combined with great ductility. The normal size is approximately 4 in. square. It is suitable for use in connection with standard bolts from ¾ in. to 1½ in. in diameter and is usually packed in crates of 100 each, weighing approximately 25 lb.

### Out of the Ordinary Trade Publications

The advantages of the conical mill method of pulverizing fuels are set forth in a catalog issued by the HARDINGE CO., New York City. The Hardinge mill operates on the principle of a multiplicity of grinding bodies rolling in a rotating conical drum supported on hollow trunions, through which the material passes into and out of the grinding zone. The grinding bodies in rolling and dropping grind and crush the material passing through the mill. For those demanding a very high combustion efficiency in fuel used, this bulletin from the Hardinge Conical Mill, complete as to the description of the method of installation of a conical mill and as to the various processes used in grinding fuel, will be interesting. The catalog is well illustrated.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Common Brick Shows Decided Production Impetus

Quoting from the October *Digest* of the Common Brick Manufacturers Association of America, "The most cheerful aspect of the current month's report is that out of the 126 manufacturers, 69, or more than one-half, report either good or fair outlook for the forthcoming month. This is a decided change from the pessimistic reports of the past." During the month of September, orders for common brick practically held their own, the orders booked during the month equaling in volume the orders filled. Shipments from plants during the month have about equaled production. The 126 manufacturers, representing every section of the United States in which common brick is made in any quantity, show 254,000,000 burned brick on hand with orders on their books for 158,000,000.

The composite price of burned brick as reported from all sections of the country, shows another slight recession, being $13.87 as compared with $14.04 on September 1. This figure is merely a composite one and not a representative figure. The *Digest* indicates that the prevailing price of common brick might be said to be between $15 and $16 a thousand. The composite price is brought to an abnormally low level by the competitive prices.

Labor and fuel conditions in the industry continue to be satisfactory. About 35 plants among the firms reporting are still shut down on account of no demand. These are largely in the western and northern states, as usual, the pick up showing itself first in the East and then moving westward.

## July Marked Turning Point in Steel Production

Continued improvement in the steel industry is indicated in reports received by Walter F. Tower, chief of the iron and steel division, U. S. Department of Commerce. Writing in a recent issue of *Commerce Reports* Mr. Tower asserts that "as expected the August figures for production of pig iron and steel ingots showed an upward trend from the low point touched in July, and further increases in operation during September strengthen the conclusion that July actually was the turning point toward better conditions. Steel export activities, however, still lag, for neither volume nor value of shipments during August shared in the increase reported for export.

During August the exports of iron and steel from the United States totalled only 73,792 tons, the lowest point recorded since January, 1909. The total export for the eight months was at the rate of 2,500,000 tons per year.

*(1)*

**Here are a few interesting points regarding September, 1921, contracts:**

*(2)*

*Second highest value recorded so far this year—$123,473,797.*

*(3)*

*Within one-half of 1 per cent of contract value for September, 1920.*

*(4)*

*Taking into account the decrease in the cost of construction during the past year, the value would be, based on 1920 costs, $148,000,000.*

*(5)*

*The largest value for miscellaneous building since May, 1920.*

*(6)*

*Twice as much water-works and sewer construction put under contract as in September, 1920.*

*(7)*

*More industrial work than any month since March, 1921.*

*(8)*

*And*

*(9)*

*As to contracts let so far this year:*

*(10)*

*Street and road work is valued at $258,000,000, as compared to $230,000,000 for the first nine months of 1920.*

*(11)*

*The total value of contracts for the first nine months of 1921 is $913,000,000 as compared to $1,314,000,000 for the same period of 1920.*

*(12)*

*The average amount of construction work put under contract for the six spring and summer months totaled in value $141,000,000 a month for 1920, and $115,000,000 a month for 1921. Reducing the 1921 figures to a basis of 1920 costs, the 1921 average becomes $143,000,000. In other words, there has been practically the same amount of construction work carried on during this spring and summer as was carried on during the spring and summer of 1920, though the cost this year has been 23 per cent smaller.*

## May Lower Pittsburgh Bond Issue

Reduction of the proposed $41,000,000 road and bridge bond issue of Allegheny County (Pittsburgh) before it is put to vote of the people Nov. 8 is considered probable. Revision of the estimates for the several improvements to be financed by the bonds in the light of cost reduction made evident by recent bids is the principal element of the expected reduction.

## September Second Highest Month in Contracts Let

### Total Value Is $123,473,797, Within One-Half of 1 per Cent of the Value for the Same Month of 1920

September proved to be the second best month of 1921 in construction work, judging from the number and value of contracts let as reported to *Engineering News-Record*. The total value of all contracts was $123,473,797. The only month of 1921 so far to exceed September was June, when contracts valued in excess of $140,000,000 were recorded. The value of contracts let in

VALUE OF CONTRACTS LET DURING SEPTEMBER

| Classification | 1920 | 1921 |
|---|---|---|
| Waterworks | $742,791 | $1,487,296 |
| Sewers | 2,318,687 | 5,063,900 |
| Bridges | 2,750,821 | 3,409,876 |
| Streets, roads | 26,536,814 | 23,256,996 |
| Excavation | 858,751 | 9,025,229 |
| Industrial | 37,709,100 | 13,259,789 |
| Buildings | 45,321,507 | 60,979,116 |
| Federal government | 1,662,264 | 3,694,113 |
| Miscellaneous | 6,259,158 | 3,301,392 |
| Total | 124,159,893 | 123,473,797 |

September of this year was within one-half of 1 per cent of the value of contracts let in September, 1920, the latter figure being $124,159,893.

Practically half the money involved in contracts let in September of this year is represented in the construction of miscellaneous buildings such as office and bank buildings, lofts, theaters, schools, churches, etc. The amount of money involved in street and road work is in excess of $23,000,000, and industrial work amounts to more than $13,000,000. This is the second highest figure that has been recorded during 1921 for industrial construction.

The total value of contracts let thus far in 1921 is in excess of $913,000,000, whereas the value for the first nine

VALUE OF CONTRACTS LET DURING FIRST NINE MONTHS OF

| Month | 1920 | 1921 |
|---|---|---|
| January | $173,148,766 | $54,328,36 |
| February | 148,264,596 | 56,336,82 |
| March | 148,123,161 | 113,213,846 |
| April | 216,068,386 | 105,667,392 |
| May | 165,870,787 | 108,904,531 |
| June | 114,710,161 | 140,678,814 |
| July | 129,284,470 | 106,013,049 |
| August | 92,661,818 | 104,644,113 |
| September | 124,159,893 | 123,473,797 |
| Total | 1,314,792,038 | 913,378,738 |

months of 1920 exceeded $1,314,000,000. These figures do not include any housing construction except that for industrial purposes, neither is residential building included.

Inasmuch as there has been a decrease in the cost of construction within the past year of approximately 25

per cent, the amount of money involved in the value of contracts let during September, 1921, would build structures worth more than $148,000,000 if prices existing in September, 1920, were taken into account.

One of the notable points in this past month's value of contracts let is the fact that the total value for miscellaneous building is in excess of $60,000,000, the highest record since May, 1920. Another significant thing is found in the fact that the total value of street and road contracts up to and including the month of September has been more than $258,000,000, as compared to $230,000,000 for the first nine months of 1920. The year 1920 was considered a very good construction year from the standpoint of highway work, yet for the first nine months of 1920 the contract value was but 89 per cent of what has been recorded so far during 1921.

Another notable point is the pick-up in public works construction, the amount of money involved in contracts for the construction of sewers, waterworks, and bridges for September being in excess of $10,000,000. Federal government work has also shown considerable activity. In only three out of the nine classifications of construction work did the year 1920 exceed 1921 to date.

With the large amount of highway work and miscellaneous building work that is contemplated for next year, it is practically certain that numerous contracts will be let during the ensuing fall and winter months.

### Engineering News-Record Construction Cost Index Number

| | |
|---|---|
| October, 1921 | 182.57 |
| September, 1921 | 188.27 |
| October, 1920 | 261.20 |
| Peak, July, 1920 | 273.80 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Cost Index Number is 5.3 (3 per cent) lower than this time last month, owing to decreases in steel and cement. The structural steel base is now $1.75 per 100 lb., as against $1.85 last month. Cement in Chicago is $1.97, as against $2.17 formerly. The average labor rate for the country this month is 50c. Pine in New York remains at $45, to contractors. Thus, general construction cost is 30 per cent cheaper than one year ago and 34 per cent under the peak.**

### Double Federal Aid to Relieve Employment Is Proposed

The Minnesota State Highway Department proposes to make an appeal to Congress to double the Federal aid highway appropriation for 1921 in order that the work may be continued on a large scale through the winter so as to relieve the unemployment situation.

# Labor Rates and Conditions Throughout the Country

Chicago, Montreal, Kansas City and Seattle are the only cities reporting changes in labor rates. The outstanding feature is the recent building wage decision by Judge Landis, in Chicago, which placed brick layers at $1.10 as against $1.25 per hr.; carpenters at $1 as against $1.25; structural iron workers at $1.05 from $1.25, and common labor, union, at 72½c., from $1. Hoisting engineers for operation of high pressure boilers and engines, cable ways, derricks, pile drivers, cranes and cable hoists receive $1.10; others, 85c.

Montreal reports considerable unemployment and slight readjustments in wage rates. Brick layers are receiving 85c. as against 90c. per hr., carpenters 60c.@65c. instead of 65c. per hr., hoisting engineers 50c.@55c. from 60c., hod carriers 35c.@40c., from 40c., structural iron workers 60c., from 65c., common labor 30c.@35c.

In Seattle much of the building construction is being done by non-union labor under the "American plan." Hoisting engineers are receiving 90c., structural iron workers 80c.@90c., and common labor 50c.@60c.

We print the union scale for Kansas City, but non-union labor is plentiful at much lower figures.

In Detroit about 60 per cent of all classes of labor are employed at present, and common labor in many cases is being paid less than the regular rate.

Denver reports that among brick layers, about 60 per cent are working, 70 per cent of the carpenters and 50 per cent of the hoisting engineers. Structural iron workers have even greater difficulty in obtaining employment. In Minneapolis about 20 per cent of the skilled labor in the building trades are unemployed. Plasterers, however, find plenty of work. Most unemployment is among the unskilled.

Although the regular union scale for carpenters is 80c. in Baltimore, most of the work is being done by non-union carpenters at 50c. per hour. Pipe coverers are on strike because of a 20c. reduction, to 80c.

New Orleans reports continued increases in the volume of residential construction; but no industrial building is being undertaken there.

S means scarce; E, enough; P, plentiful—Higher rates indicated by +, decreases by—

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | $0.90P | $0.70P | $1.00P | $0.50P | | $1.00P | $0.20P |
| Baltimore | 1.25P | .80P | .87½P | .50P | $0.75P | 1.00P | .30P |
| Birmingham | 1.00P | .75P | .. | .25 | | 1.00P | 15@.25 |
| Boston | .90P | .90P | .90P | .60P | .90P | .90P | .55P |
| Cincinnati | 1.25P | 1.00P | .70E | .85P | 1.00E | 1.25P | .35@.40 |
| Chicago | −1.10P | −1.00P | −1.10P | | | −1.05P | −.72½P |
| Cleveland | 1.04P | 1.04 | 1.04P | .60P | .91P | 1.04 | .57½P |
| Dallas | 1.00P | 1.00P | 1.00E | .60E | 1.00E | 1.00E | .50@75P |
| Denver | 1.37½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | .37½@50P |
| Detroit | 1.00P | .80P | .80@.90P | .50@.60P | 1.00P | .60@.80P | 50P |
| Kansas City | 1.07½ | 1.00 | 1.07½P | .80 | 1.07½ | 1.07½ | .70 |
| Los Angeles | 1.25P | 1.00P | 1.00P | 1.12½P | 1.00P | 1.00P | 50@.56¼P |
| Minneapolis | 1.00P | .80P | .80P | .65P | | .80P | .50P |
| Montreal | −.85P | .60@.65P | .50@.55P | .35@.40P | .50P | −.60P | .30@.35P |
| New Orleans | 1.00P | .88P | .80P | .40P | .80P | 1.00P | .30P |
| New York | 1.25 | 1.12½ | 1.25 | .87½ | 1.12½ | 1.12½ | .75@.80 |
| Pittsburgh | 1.12½P | 1.00P | 1.00P | .80P | | 1.00P | Open |
| St. Louis | 1.25P | 1.25P | 1.25P | .85P | 1.25P | 1.25P | .62½P |
| San Francisco | 1.25P | 1.12½P | 1.12½P | 1.00P | 1.12½P | 1.12½P | .81¼P |
| Seattle | 1.00P | .80P | .90P | .70P | 1.00P | .80@.90P | .50@.60P |

It is hoped that several thousand men may be employed on the roads of northern Minnesota during the winter in rock blasting and in distribution of materials for use by contractors next spring.

In St. Louis County alone during 1921 over 103 miles will have been paved by the end of the construction season and 680 miles will have been graded. About 440 miles of highways will have been graveled by the end of this year. In addition to that work the maintenance department has regraveled 462 miles of road and reshaped 713 miles.

The highway funds for trunk line construction for the current year are estimated at $13,500,000 exclusive of any Federal aid that may be voted, according to a recent statement made by the chief engineer of the state highway commission recently. The motor vehicle tax revenue exceeds $5,500,000 and approximately $7,500,000 of the proceeds from county reimbursement funds are being used for road improvements.

---

The New Jersey State Highway Commission will ask Congress to double its appropriation for highways so as to lessen the cases of unemployment during the coming winter. The highway commission has requested every man and woman in the state to ask the New Jersey senators at Washington to give their support for the double appropriation. Individuals are requested to write to the senators and congressmen and tell of the great number of unemployed cases. If Congress takes the action desired, New Jersey will receive as her share of the double allotment the sum of $2,420,000.

## Southern Pine Orders Increase

For the week ended September 23, 141 mills reported to the Southern Pine Association orders received approximating 91,981,764 ft. b.m. Shipments for the week amounted to in excess of 89,000,000 ft. b.m. and production approximately 79,000,000 ft. b. m. This represents a production only 18½ per cent below normal. The shipments above production for the week were in excess of 10,000,000 ft. b.m. and the orders above production 13,-000,000 ft. b.m. The orders on the books of southern pine mills at the end of the week ended September 23 amounted to about 280,000,000 ft. b.m.

## Canadian Labor Down

According to the Montreal correspondent of *Engineering News-Record*, there have been several decreases recently wages paid the skilled trades and common labor in various parts of Canada. The Federal Department of Railways and Canals has recently put into effect a 20 per cent decrease in wages. The Ontario Hydro-Electric Commission has also put in force a decrease for all employees on the Chippawa development, the cut being 10 cents per hour. The building trades of Hamilton, Ontario, have consented to a decrease in the wages of carpenters from 85 cents to 75 cents per hour. Common labor, Prince Edward Island, in the building trades has been reduced from $2.70 to $2.25 per 9-hour day.

## Railway Extension to Provide Work for Unemployed

Premier Drury has recently announced that the Ontario Government will proceed with the extension of the Timiskaming & Northern Ontario Ry. north from Cochrane to Smoky Falls, about 70 miles. One of the reasons why the extension is to be made is to provide employment for those now out of work. The district to be traversed by the railroad extension is well adapted for agricultural purposes, and the terminus of the extension offers large opportunity for the development of water power.

The estimated cost of the extension is about $3,500,000.

## Chicago Labor Chiefs Indicted

Harry Jansen, president of the Chicago District Council, and Thomas S. Church, a business agent, have been indicted along with four other labor leaders by a special building grand jury in Chicago. The charges against the labor leaders are conspiracy. Bonds are fixed at $10,000 each. Previous indictments had been returned against three of the men named in this latter indictment.

## Biltmore Hotel at Providence

The jurisdictional dispute which was reported to be holding up the construction of the Biltmore Country Club at Rye, N. Y., has not affected that work, as reported in *Engineering News-Record* last week. The trouble is being experienced on the new Biltmore Hotel at Providence, R. I.

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Iron and Steel**—While quotations as low as $1.60@$1.70 on structural shapes and plates have been reported, the official Pittsburgh base of $1.75 stands, except for very large orders. Bars are quoted at $1.65 per 100 lb. Mill prices of black steel sheets, base size, are quoted at $3 as against $2.75 and No. 10 blue annealed sheets at $2.50 as against $2.25 per 100 lb. Mill shipments, New York, of structural shapes and plates, are quoted at $1.98 @$2.03; bars at $1.88@$1.98 per 100 lb. Advances ranging from $1 to $2 per ton reported in pig-iron prices at various shipping points.

**Pipe**—New Pittsburgh basing card of Sept. 16 quotes increases in discounts ranging from 4 to 5 per cent on wrought steel pipe, which are reflected in warehouse quotations. Cast-iron pipe advances $2 in New York and Chicago; drops $2 in Birmingham and $3 per ton in St. Louis. Sewer pipe advances in St. Louis and declines slightly in Cincinnati and Baltimore.

**Road and Paving Materials**—Decreases ranging from $1 to $3 per ton in asphalt reported in Baltimore, Cincinnati and Atlanta. Paving stone and wood-blocks down in Kansas City, St. Louis, Cincinnati and Baltimore. Flagging advances 29c. in Chicago, present price 99c. as against 70c. per lin.ft.

**Sand Gravel and Crushed Stone**—Gravel down 5c. to 25c. per cu.yd. in New York, Chicago, Atlanta, Cincinnati and Montreal. Sand drops 5c. in Chicago and advances 6½c. per cu.yd. in Cincinnati. Crushed stone drops 10c. in New York and 25c. in Chicago; slight advances in Cincinnati and St. Louis.

**Lime and Cement**—Decreases ranging from $1.80 to $2 in hydrated finishing lime quoted in New York, St. Louis, Detroit and Montreal. Declines of from 50c. to $1 per ton in common hydrated lime in St. Louis and Detroit. Common lump lime down in Chicago, Minneapolis and Detroit, up 10c. per bbl. in Atlanta. General decline of 10c. to 25c. per bbl. in cement throughout principal cities. Minneapolis dealers quote cement at $2.45 delivered and $2.31 per bbl. on cars. However, we list $2.26 as the price f.o.b. Minneapolis, because cement can be bought direct from the manufacturer at that figure.

**Structural Material**—Slight reductions reported in triangle mesh in New York warehouses and rather heavy decreases in expanded metal lath in St. Louis.

**Brick and Hollow Tile**—Common brick advances $1 wholesale in New York and drops from $1 to $2 per 1,000 in Cincinnati, Kansas City and Montreal. Slight decline in hollow tile in St. Louis.

**Lumber**—Long leaf yellow pine advances $2 to $8 in Baltimore, Montreal and New Orleans and drops 50c. per M ft. in Kansas City and Atlanta. Douglas fir advances $1 to $3 in Seattle; both fir and hemlock drop $4 to $6 in Los Angeles and fir is down 50c. per M ft. in Kansas City.

**Manila Rope**—Advances of 1c. per lb. reported in New York, Minneapolis and Atlanta.

**Explosives**—Reduction of ½c. per lb. on 40% and 60% gelatin dynamite quoted in Cincinnati, Minneapolis and Denver; slight advances in Atlanta and Montreal.

**Scrap**—Advances ranging from $2.50 to $4.50 per net ton, reported in St. Louis. New York quotes rises of 50c. to $1.50 per gross ton.

Price advances since last month are indicated by **heavy type**; declines by *italics*

**PIG IRON**—Per Gross Ton—Quotations compiled by The Matthew Addy Co:

| | Current | One Year Ago |
|---|---|---|
| **CINCINNATI** | | |
| No. 2 Southern (silicon 2.25 @ 2.75) | $24 50† | $45 60 |
| Northern Basic | 22 52† | 51 30 |
| Southern Ohio No. 2 (silicon 1.75 @ 2.25) | 23 52† | 48 50 |
| **NEW YORK, tidewater delivery** | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | 30 26† | 52 10 |
| **BIRMINGHAM** | | |
| No. 2 Foundry (silicon 2.25 @ 2.75) | 20 00† | 42 00@45 00 |
| **PHILADELPHIA** | | |
| Eastern Pa., No. 2X, (2.25@2.75 sil.) | 22 76† | 51 25* |
| Virginia No. 2 (silicon 2.25 @ 2.75) | 28 74† | 50 00† |
| Basic | 20 75† | 51 00* |
| Grey Forge | 21 [illegible] | 49 00* |
| **CHICAGO** | | |
| No. 2 Foundry Local (silicon 1.75 @ 2.25) | 22 70† | 46 00 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | 26 66† | 50 00 |
| **PITTSBURGH, including freight charge from the Valley** | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | 22 86† | 49 56 |
| Basic | 23 96† | 48 96 |
| Bessemer | 24 96† | 51 96 |

*F.o.b. furnace † Delivered

# RAILWAY SUPPLIES

**RAIL STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

| | Pittsburgh Current | Pittsburgh One Year Ago | Birmingham | Chicago |
|---|---|---|---|---|
| Standard bessemer rails | $45 00 | $55 00 | $47 00 | $45 00 |
| Standard openhearth rails | 47 00 | 57 00 | [illegible] | 47 00 |
| Light rails, 8 to 10 lb | 45 00 | 2 88@3 50* | 1 75 | 2 45@3 00* |
| Light rails, 12 to 14 lb | 45 00 | 2 84@3 34* | 1 [illegible]* | 2 41@2 95* |
| Light rails, 25 to 45 lb. | 40 00 | 2.75@3 25* | 1 [illegible]* | 2 32@2 85* |

*Per 100 lb.

**RAILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8 Ft. | 7 in. x 9 In. by 8 Ft. 6 In. |
|---|---|---|
| Chicago, White Oak | $1 35 | $1 40 |
| Chicago, Hardwood and Red Oak | 1 20 | 1.30 |
| Chicago Empty Cell Creosoting (add'l) | 45 | 50 |
| San Francisco Green Douglas Fir | 80 | 1 12 |
| San Francisco, Empty Cell Creosoted, Douglas Fir | 1 76 | 2 48 |

Prices on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pine and Sap Cypress |
|---|---|---|---|
| Grade 3 | $1 15 | $1 05 | $0 95 |
| Grade 2 | 1 05 | 95 | 85 |
| Grade 1 | 95 | 85 | 75 |

**TRACK SUPPLIES**—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh Current | Pittsburgh One Year Ago | Chicago | St. Louis | San Francisco | Birmingham |
|---|---|---|---|---|---|---|
| Standard spikes, ½-in and larger | $3 00 | $4 00@4 25 | $3 00 | $ [illegible] | $ [illegible] | 4 05 |
| Track bolts | 4 00 | 6 00@6 50 | [illegible] | [illegible] | [illegible] | 4 15 |
| Standard-section angle bars | 2 75 | 3 00@4 00 | 2 75 | 3 25 | [illegible] | 3 25 |

# PIPE

**WROUGHT PIPE**—The following discounts are to jobbers for carload lots at Pittsburgh basing card of Sept. 16, 1921

BUTT WELD

| Inches | Steel Black | Steel Galv | Inches | Iron Black | Iron Galv |
|---|---|---|---|---|---|
| ⅛ to ¼ | 68½ | 56 | ⅛ to 1¼ | 39½ | 24½ |

LAP WELD

| | | | | | |
|---|---|---|---|---|---|
| ⅜ to 6 | 61½ | 49 | 2 | 34 | 20½ |
| 7 to 8 | 65½ | 53 | 2½ to 6 | 37½ | 24½ |
| 9 to 12 | 62½ | 50 | 7 to 12 | 35 | 22½ |

BUTT WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| ⅛ to ¼ | 60½ | 45 | 1 to 1½ | 39½ | 25½ |
| ⅜ to ⅝ | 65½ | 53 | | | |

LAP WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| ⅛ | 59½ | 48 | 2 | 35½ | 22½ |
| ¼ to ⅜ | 62½ | 51 | 2½ to 4 | 38½ | 26½ |
| ½ to ⅝ | 63½ | 52 | 4½ to 6 | 37½ | 25½ |
| ¾ to 1 | 65½ | 54 | 7 to 8 | 30½ | 18½ |
| 1¼ to 1½ | 67½ | 56 | 9 to 12 | 25½ | 13½ |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe

| | Black New York | Black Chicago | Black St. Louis |
|---|---|---|---|
| ⅛ to 3 in. butt welded | 60% | 55&5% | 56&5% |
| ⅜ to 6 in. lap welded | 51% | 46&5% | 46&5% |

| | Galvanized New York | Galvanized Chicago | Galvanized St. Louis |
|---|---|---|---|
| ⅛ to 3 in. butt welded | 46% | 50% | 42&5% |
| ⅜ to 6 in. lap welded | 37% | 40% | 38&5% |

Malleable fittings, Class B and C from New York stock sell at list less 50%. Cast iron, standard sizes, 32½% off.

**CAST-IRON PIPE**—The following are prices per net ton for carload lots.

| | New York Current | New York One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
|---|---|---|---|---|---|---|
| 4 in. | **$50 30** | $86 20 | *$48 00* | **$47 10**@49 10 | *$46 90* | *$55 00* |
| 6 in. and over | **45 30** | 81 20 | *45 00* | **44 10**@46 10 | *45 90* | *50 00* |

Gas pipe and Class "A," $3 per ton extra. 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin. ft.

| Size, In. | New York Current | New York One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 3 | $40 00 | $42 50 | $35 00 | $50 00 | | $55 00 |
| 4 | 50 00 | 60 00 | 85 00 | 60 00 | $90 00 | 65 00 |
| 5 | 80 00 | 85 00 | 140 00 | 80 00 | 115 00 | 84 00 |
| 6 | 105 00 | 110 00 | 140 00 | 100 00 | 150 00 | 110 00 |
| 8 | 175 00 | 175 00 | 200 00 | 150 00 | 250 00 | 181 00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots:

| Size, In. | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | $0 14 | [illegible] | [illegible] | **.1175** | $0 135 | $0 [illegible] | [illegible] |
| 4 | 14 | [illegible] | $0 09 | **.1175** | 135 | [illegible] | $0 18 |
| 5 | 21 | [illegible] | [illegible] | **.1645** | .2025 | [illegible] | 165 |
| 6 | 21 | [illegible] | .135 | **.1645** | .2025 | .21 | 25 |
| 8 | 35 | [illegible] | .225 | **235** | 315 | [illegible] | 35 |
| 10 | 52 | [illegible] | [illegible] | **.329** | .4725 | .42 | |
| 12 | 67 | [illegible] | .3825 | **423** | .6075 | .54 | 80 |
| 15 | 1 15 | [illegible] | .5625 | **73** | 81 | [illegible] | |
| 18 | 1 55 | [illegible] | .765 | **1 029** | 1 125 | 1 [illegible] | |
| 20 | 1 98 | [illegible] | 1.125 | **1 372** | 1 35 | [illegible] | |
| 22 | 2 64 | [illegible] | [illegible] | [illegible] | 1 80 | [illegible] | |
| 24 | 2 97 | [illegible] | 1 4625 | **1 764** | 2 025 | 2 [illegible] | 2 40 |
| 27 | 4 50 | [illegible] | [illegible] | **2 75** | 3 75 | 3 [illegible] | |
| 30 | 5.00 | [illegible] | 4 00 | **3 40** | 4 75 | 4 [illegible] | |
| 33 | 6 55 | [illegible] | [illegible] | **4 05** | 5 50 | [illegible] | |
| 36 | 7.50 | [illegible] | [illegible] | **4 45** | 6 00 | [illegible] | |

| | 3 | 5 | 8 | 12 | 24 | 36 |
|---|---|---|---|---|---|---|
| Boston | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | **$4 92** |
| Minneapolis | [illegible] | [illegible] | 40 | 77 | 2 55 | 5 66 |
| Denver | [illegible] | [illegible] | 15 | 30 | 50 | 1 95 |
| Seattle | 145 | [illegible] | [illegible] | 36 | 72 | 2 59 |
| Los Angeles | .11* | [illegible] | 165* | 275 | 485 | 1 65 |
| New Orleans | [illegible] | [illegible] | 108 | 27 | 459 | 1 755 |
| Cincinnati | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Atlanta | 098* | [illegible] | 147* | 245 | 4165 | 1 5925 |
| Montreal, *delivered* | .30* | [illegible] | 45* | 85* | 1 35 | 4 50 |
| Detroit | .105 | [illegible] | 1575 | 245 | 4725 | 2 115 |
| Baltimore | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Baltimore, *delivered* | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

*4-in., 6-in., 9-in., respectively.

# ROAD AND PAVING MATERIALS

**ROAD OILS**—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45% asphalt (at terminal) | $0 05 | $0 13 |
| New York, 65% asphalt (at terminal) | .05 | 12 |
| New York, binder (at terminals) | .06 | 13 |
| New York, flux (at terminal) | .05½ | 13 |
| New York, liquid asphalt (at terminal) | .06½ | 13 |
| St. Louis, 50-60% asphalt (Texas Type) | .015* | 12 |
| Chicago, 40-50% asphalt | .05 | 10½ |
| Chicago, 60-70% asphalt | .05½ | 11½ |
| Dallas, 40-50% asphalt | 10 | 08 |
| Dallas, 60-70% asphalt | 13 | 10 |
| Dallas, 75-90% asphalt | 15 | 12 |
| San Francisco, binder, per ton | 15 00 | 13 00 |

* Freight $21 75 per ton to Whiting, Ind.

**ASPHALT**—Price per ton in packages (350-lb. bbls. or 425-lb. drums), and in bulk in carload lots:

| | Package | Bulk |
|---|---|---|
| New York (Bayonne, N. J.) | $24.00 | $15.00 |
| Boston | No quotations | |
| Chicago | 24.50 | 17.00 |
| San Francisco, *f.o.b. refinery*, Oleum Cal | 21.50* | 15.00* |
| Dallas | 35.00 | 27.00 |
| Seattle | 27.50 | 21.50 |
| Denver | 45.00 | 65.00 |
| Minneapolis | | 20.50 |
| St. Louis | sold out for 1921 | |
| Baltimore | 28.00 | |
| Los Angeles, *at factory* | 22.50 | 15.00 |
| Montreal | 28.00 | 21.00 |
| Atlanta | 30.00 | |
| Detroit (petroleum asphalt) | 24.50 | 20.00 |
| Cincinnati | 22.49 | 19.49 |
| Maurer, N. J. (asphalt) | 27@38 | ... |
| Maurer, N. J. (asphalt cement) | 29@36 | 25@31 |

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

**PAVING STONE**—

| | | |
|---|---|---|
| New York | 5-in. granite, 28@29 blocks per sq.yd. | $130.00 per M |
| Chicago | About 4x8x4 dressed | 3.35 sq.yd. |
| | About 4x8x4 common | 3.00 sq.yd. |
| San Francisco | Basalt block 4x7x8 | 65.00 per M |
| Boston | 5-in. granite | 125.00 per M |
| Atlanta | Granite | 2.00 sq.yd. |
| Detroit | Granite, 26½ blocks per sq.yd. | 107.00 per M |
| Baltimore | Granite | 2.15 sq.yd. |
| Montreal | Granite | 130.00 per M |
| New Orleans | Granite, 4 x 8 x 4 | 3.25 sq.yd. |
| Cincinnati | Granite | 4.30 sq.yd. |
| St. Louis | 4x8x4 dressed | 4.25 sq.yd. |
| | 4x8x4 common | 3.00 sq.yd. |
| Kansas City | No. 1 Granite | 9.00@11.95 sq.yd. |

**FLAGGING**—

| | | | |
|---|---|---|---|
| New York | Bronx | $0.25 | sq.ft. |
| | Manhattan, 4 ft. | .26 | sq.ft. |
| | Queens, 5 ft. | 1.00 | lin.ft. |
| | 6x20-in. cross-walk | .99 | lin.ft. |
| | 18 in. wide | | |
| Chicago | | | |

**CURBING**—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in., in cargo lots.

**WOOD BLOCK PAVING**—

| | Size of Block | Treatment | Per Sq.Yd. |
|---|---|---|---|
| New York | 3 | 16 | $2.09 |
| New York | 3 | 16 | 2.17 |
| New York | 4 | 16 | 2.37 |
| New York | 3 | 16 | 2.17 |
| Boston | 4 | 16 | 3.00@3.25 |
| Chicago | 3½ | 16 | 2.50@2.75 |
| Chicago | 3½ | 16 | 3.25 |
| St. Louis | 4 | 16 | 3.75 |
| St. Louis | 4 | 16 | Off market |
| Seattle | 3½ | 16 | 2.13 |
| Minneapolis | 3½ | 16 | 2.30 |
| Atlanta | 3 | 16 | 2.00 |
| New Orleans | 3½ | 16 | 2.35 |
| New Orleans | 4 | 16 | 2.65 |
| New Orleans | 4 | 18 | 3.90 |
| Dallas | 4 | 16 | 3.60 |
| Baltimore | 3½ | 16 | 2.60 |
| Montreal, *delivered* | 4 | 16 | 4.50 |
| Detroit | 3 | 16 | 2.84 |
| Detroit | 4 | 16 | 3.00 |
| Cincinnati | 4 | 16 | 2.35 |
| Kansas City | 4 | 16 | 2.00@2.25 |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots in as follows, per cu.yd.:

| | Gravel 1½ In. | | Gravel ¾ In. | | Sand | |
|---|---|---|---|---|---|---|
| | Current | One Year Ago | Current | One Year Ago | Current | One Year Ago |
| New York | $2.00 | $3.00 | $2.00 | $3.00 | $1.25 | $1.50 |
| Denver | 2.00 | 2.00 | 1.80 | 1.80 | 1.60 | 1.00 |
| Chicago | 1.75 | 2.75 | 1.75 | 2.75 | 1.75 | 2.75 |
| St. Louis, *per ton* | **1.35** | 1.60† | **1.40** | 1.65 | **1.40*** | 1.65 |
| Seattle | 1.50 | 1.25 | 1.50 | 1.25 | 1.50 | 1.25 |
| Dallas, *delivered* | 3.09 | 2.50 | 3.50 | 2.50 | 2.50 | 2.00 |
| Minneapolis, *at pit* | 2.00 | 2.25 | | | 1.00 | 0.75 |
| Cincinnati | [illegible] | | **2.36‡** | 1.50 | **1.75‡** | 1.45 |
| San Francisco | 2.25 | 1.50 | 2.50 | 1.50 | 1.50 | 1.50 |
| Boston, *per ton* | 2.65 | 3.00 | 2.65 | 3.00 | 2.00 | 2.75 |
| New Orleans | 2.85 | 3.60 | | | 1.35 | 1.85 |
| Los Angeles, per ton | 1.35† | 1.25 | [illegible] | 1.25 | 1.20† | 1.15 |
| Atlanta, per ton | | | [illegible] | | 1.35 | 2.75 |
| Detroit | 2.00 | 2.25 | 2.00 | 2.25 | 2.00 | 2.00 |
| Baltimore, per ton | 1.40 | 1.40 | 1.60 | 1.60 | 2.40 | 70 |
| Montreal, per ton | [illegible] | 1.45 | [illegible] | ... | 1.25 | 1.30 |
| Birmingham, per ton | .... | .... | .... | | 1.37 | 1.25† |

* Fine white sand, Pacific $4 per ton. Ottawa, $4.50.
† Freight from quarry to Los Angeles, $1.20 per ton, is also included in above price.
‡ Delivered.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1.80@1.90 | $1.90@2.00 | $1.80@1.90 | $2.15 |
| Chicago | 1.75 | 2.75 | 1.75 | 2.75 |
| St. Louis *delivered* | **1.65*** | 2.00 | **1.65** | 2.00 |
| Dallas | 2.80 | 3.50 | 2.80 | 3.50 |
| San Francisco | 2.25 | 1.50 | 2.50 | 1.50 |
| Boston, *delivered* | 3.00* | 3.00* (del.) | 3.00* | 3.00* (del.) |
| Minneapolis, *at plant* | 2.00 | 2.25 | 2.25 | 2.50 |
| Kansas City† | 1.50 | 2.35 | 1.50 | 2.35 |
| Denver | | | | |
| Seattle *delivered* | 3.00 | 3.50 (del.) | 3.00 | 3.50 (del.) |
| Atlanta | 2.25* | | 2.25* | |
| Cincinnati *delivered* | **2.68‡** | | **2.06‡** | 1.65 |
| Los Angeles | 1.60* | 1.60* | 1.70* | 1.70* |
| Detroit | 1.90* | 1.75 | 1.90* | 1.75* |
| Baltimore | 1.75* | 1.80* | 1.65* | 2.20* |
| Montreal | 2.00* | 2.35* | 2.10* | 2.80* |
| Birmingham *delivered* | 3.20 | | 3.10 | |

†Per ton. †F.o.b. Joplin, Mo.

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants:

| | 1½-In. | ¾-In. | Roofing | Sand |
|---|---|---|---|---|
| Lebanon or Bethlehem, Pa. | $1.00 | $1.00 | $2.50 | $0.90 |
| Easton or Catasaqua, Pa. | 1.00 | 1.00 | 2.00 | .90 |
| Buffalo, N. Y. and Erie, Pa. | 1.25 | 1.25 | 2.25 | 1.25 |
| Emporium, Pa. | 1.25 | 1.25 | | 1.25 |
| East Canaan, Conn. | 1.25 | 1.35 | 4.00 | 1.10 |
| Birmingham, Ala. | .90 | 1.15 | 2.05 | .80 |
| Toledo, Ohio | 1.50 | 1.50 | 2.35 | |
| Atlanta, Ga. | | 2.10 | | |
| Easter Pennsylvania and Ne Jersey | 1.20 | 1.20 | 2.50 | .90 |
| Westrn Pennsylvania and New Jersey | 1.25 | 1.25 | 2.50 | 1.25 |

Birmingham, f.o.b. sidings $1.12 (or $1.45 per cu. yd. on site)

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per 180-Lb. Barrel(net) Finishing | Lump, per 180-Lb. Barrel(net) Common |
|---|---|---|---|---|
| New York | $16.99 | | | $3.69* |
| Chicago | 18.00 | | | 1.40 |
| St. Louis | 22.20 | $19.00 | $2.25 | |
| Boston | 23.00 | 20.00 | 3.35 | 3.10 |
| Dallas | 25.00 | | | 2.75 |
| Cincinnati | 0.19 | 0.15 | | 1.30 |
| San Francisco | 25.40 | 22.00 | | 1.40 |
| Minneapolis | 29.00 | 22.00 (white) | 1.80 | |
| Denver | 30.00 | 2.95 (bbl.) | .95† | |
| Detroit | 18.25 | 13.25 | 11.50‡ | 10.50‡ |
| Seattle | 27.50 | | 3.50 | 3.25 |
| Los Angeles | | 30.00 | 3.00* | 3.00* |
| Baltimore | 15.00 | 13.00 | | 12.00‡ |
| Montreal | 26.00 | | 15.00‡ | |
| Atlanta | 19.00 | 16.00 | 2.00 | 1.60 |
| New Orleans | | 17.25 | | 1.75 |

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.
Minneapolis quotes common lump lime Kelly Is. white; brown is $1.50.
Cincinnati quotes hydrated lime per 50-lb. sack.
NOTE—Refund of 10c. per barrel.

**NATURAL CEMENT**—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

| | Current | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2.80 | $3.00 |
| Kansas City (Ft. Scott) | 1.60 | 1.60 |
| New Orleans | 3.16 | 3.36 |
| Atlanta (Magnolia) | 11.00 ton | 1.90 |
| Cincinnati (Utica) | 1.25 | 2.85 |
| Boston (Rosendale) | 1.05@.95 | 2.35 |

**PORTLAND CEMENT**—Current prices are for barrels in carload lots, *without* bags, to contractors:

| | Current Without Bags | One Month Ago Without Bags | One Year Ago Without Bags |
|---|---|---|---|
| New York (delivered) | $2.50 | $2.60@2.70 | $4.10 |
| New York, alongside dock to dealers | 2.10 | 2.40 | |
| Jersey City (delivered) | 2.60 | 2.89 | 4.39 |
| Boston | 2.61 | 2.86 | 3.32 |
| Chicago | 1.95 | 2.17 | 2.35 |
| Pittsburgh | 1.95 | 2.17 | 2.42 |
| Cleveland | 2.08 | 2.43 | 2.73 |
| Detroit | 2.04 | 2.43 | 2.71 |
| Indianapolis | 2.08 | 2.43 | 2.57 |
| Toledo | 2.04 | 2.49 | 2.71 |
| Milwaukee | 2.19 | 2.39 | 2.59 |
| Duluth | 1.95 | 2.10 | 2.35 |
| Peoria | 2.05 | 2.45 | 2.63 |
| Cedar Rapids | 2.01 | 2.51 | 2.71 |
| Davenport | 2.00 | 2.47 | 2.67 |
| St. Louis | 2.00 | 2.90 | 3.00 |
| San Francisco | 2.09 | 3.09 | 3.09 |
| New Orleans | 3.20 | 3.20 | 5.00 |
| Minneapolis (delivered) | 2.25 | 2.60 (del.) | 3.42 |
| Denver | 3.10 | 3.10 | 3.25 |
| Seattle | 3.10 | 3.10 | 3.12 |
| Dallas | 2.55 | 2.80 | 2.92 |
| Atlanta | 2.60 | 2.75 | 4.90 |
| Cincinnati | 2.25 | 2.85 | 2.85 |
| Los Angeles | 3.11 | 3.31 | 3.10 |
| Baltimore (del.) drayload lots | 2.88 | 2.98 (del.) | 3.59 (del.) |
| Detroit | 2.41 | 2.43 | 3.50 |
| Birmingham | 2.85 | 2.88 | |
| Kansas City | 2.80 | 2.75 | 2.76 |
| Montreal | 2.75 | 2.75 | 2.95 |

NOTE—Bags, 10c. each, 40c. per bbl.; 80c. per bbl. in Montreal. 60c. per bbl. in Los Angeles.

| | |
|---|---|
| Current mill prices per barrel in carload lots, without bags | $1.70 |
| Bellingham, Ind. | 1.60 |
| Pittsburgh, Pa. | 1.60 |
| Steelton, Minn. | 1.60 |
| Northampton, N. Y. | 1.85 |
| Hudson, N. Y. | 1.60 |
| Valparaiso, N. J. | 1.60 |

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

| Style Number | Weight in Pounds | Pittsburgh, Mill | New York (Warehouse) | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|---|
| 032 | 0 022 | $0 74 | 1 13 | $0 82 | $1 15 | $1 24 |
| 049 | 0 028 | 94 | 1 40 | 1 05 | 1 46 | 1 56 |
| 068 | 0 035 | 1 14 | 1 67 | 1 27 | 1 80 | 1 92 |
| 093 | 0 045 | 1 46 | 2 11 | 1 63 | 2 30 | 2 46 |
| 126 | 0 057 | 1 80 | 2 58 | 2 02 | 2 86 | 3 07 |
| 153 | 0 068 | 2 14 | 3 05 | 2 40 | 3 40 | |
| 180 | 0 078 | 2 46 | 3 48 | 2 76 | 3 93 | |
| 245 | 0 103 | 3 24 | 4 55 | 3 63 | 5 15 | |
| 287 | 0 119 | 3 75 | 5 25 | 4 20 | 5 96 | 6 41 |
| 336 | 0 138 | 4 35 | 6 07 | 4 87 | 7 32 | |
| 395 | 0 160 | 5 04 | 7 01 | 5 65 | 8 00 | |

PAVING

| | | | | | | |
|---|---|---|---|---|---|---|
| 036P | 0 017 | $0 56 | $0 88 | 0 62 | $0 88 | |
| 053P | 0 024 | 79 | 1 20 | 0 88 | 1 24 | |
| 072P | 0 031 | 99 | 1 48 | 1 11 | 1 57 | |
| 097P | 0 040 | 1 28 | 1 87 | 1 43 | 2 02 | |
| 049R | 0 024 | 79 | 1 20 | | 1 24 | |
| 067R | 0 031 | 99 | 1 48 | | 1 57 | |
| 084R | 0 040 | 1 28 | 1 87 | | 2 02 | |

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | $23 25 | $23 39 | $23 39 | $27 62 | $25 50 |
| 26 | 250 | 24 65 | 24 93 | 22 54 | 26 87 | 27 56 |
| 25 | 300 | 27 30 | 27 45 | 27 45 | | 30 71 |
| 24 | 340 | 29 10 | 29 33 | 29 33 | 30 90 | 33 16 |
| 22 | 433 | 33 80 | 34 06 | 26 60 | | 35 10 |

* Material shipped from mill, freight allowed, or at warehouse. Delivery charge s lc. per sq.yd.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.:

ROLLED FROM BILLETS

| Inches | Pittsburgh Mill | Birmingham Mill | Warehouse, Uncut— New York | Chicago | St Louis | Dallas | San Francisco |
|---|---|---|---|---|---|---|---|
| and larger | $1 65 | $1 90 | $2 78 | $2 78 | $2 87 | $3 50 | $2 35 |
| and larger | 1 70 | 2 25 | 2 83 | 2 82 | 2 92½ | 3 55 | 2 40 |
| and larger | 1 75 | 2 25 | 2 88 | 2 88 | 2 97½ | 3 60 | 2 45 |
| and larger | 1 90 | 2 25 | 2 93 | 3 03 | 3 13½ | 3 75 | 2 60 |
| and larger | 2 15 | 2 25 | 2 98 | 3 48 | 3 87½ | 4 00 | 2 85 |

* Includes 15c charge for cutting to lengths of 2 ft. and over
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| and larger | $1 90 | $1 90 | $3 25 | | $2 30 | $2 15 | $3 50 |
| in. | 1 95 | 1 95 | 3 30 | | 2 30 | 2 40 | 3 75 |
| | 2 00 | 2 00 | 3 35 | | | | |

**BRICK**—Contractors price per 1,000 in cargo or carload lots is as follows:

| | Common— Current | One Month Ago | One Year Ago | Paving Block— 3-inch* | 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $18 40@19 40 | $18 40 | $22 70 | $47 00 | $42 50 |
| New York (at dock) | 15@15 50 | 15@15 50 | | | |
| Chicago | 11 00 | 11 00 | 15 00 | 34 00 | 42 50 |
| St. Louis, salmon | 17 00 | 17 00 | 17 00 | | |
| Denver, salmon | 14 50 | 14 50 | 15 00 | | |
| Dallas | 12 72 | 12 72 | 22 07 | 44 00 | |
| San Francisco | 18 00 | 18 00 | 18 00 | | 44 38 |
| Los Angeles | 15 50 | 15 50 | 13 50 | (not used) | |
| Boston (del.) | 17 00 | 17 00 | 30 00 | 46 00 | 56 25 |
| Minneapolis (del.) | 17 00 | 17 00 | 24@26 | 37 00 | 43 00 |
| Kansas City | 13 50 | 15 50 | 22 00 | | |
| Seattle | 14 00 | 14 00 | 19 00 | 48 00 | 53 50 |
| Cincinnati | 18 50 | 19 00 | 24 00 | 41 00 | |
| Montreal (del.) | 16 00 | 18 00 | 20 00 | 100 00 | 120 00 |
| Detroit (del.) | 17 00 | 17 00 | 22 00 | 41 30 | 44 00 |
| Baltimore (del.) | 20 00 | 20 00 | 20@25 | 38 00† | |
| Atlanta | 10 00 | 10 00 | 24 00 | 40 00 | |
| New Orleans | 14 00 | 14 00 | 25 50 | | |
| Birmingham | 11 50 | 11 50 | | | |

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Vitrified, f.o.b. plant, Baltimore.

**HOLLOW TILE**—Price per block in carload lots for hollow building tile:

| | New York— Current on Trucks* | One Year Ago | Chicago | St. Louis | San Francisco | Perth Amboy N. J., Factory |
|---|---|---|---|---|---|---|
| 8x12x12 | $0 11370 | $0 2444 | $0 0926 | $0 080 | $0 145 | |
| 10x12x12 | 15160 | 3259 | 1343 | 11 | 12 | |
| 12x12x12 | 20210 | 4345 | 1575 | 13 | 29 | $0 17810 |
| 8x12x12 | | | 1855 | 16 | | 22260 |
| 10x12x12 | | | 2408 | 20 | | 26720 |

* 5 per. off for cash.

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Boston | $0 09 | $0 185 | $0 60 |
| Minneapolis (f.o.b. cars) | 084 | 161 | 230 |
| Minneapolis (delivered) | 092 | 175 | 250 |
| Cincinnati | 0682 | 128 | 175 |
| Kansas City | 100 | 175 | 225 |
| Denver | 09 | 16 | 23 |
| Seattle | 10 | 175 | 30 |
| Los Angeles factory | 103 | 185 | 22 |
| New Orleans | 14 | 25 | 42 |
| Detroit (delivered) | 070 | 135 | 225 |
| Cincinnati | 20 | 30 | 33 |
| Baltimore | 16 | 26 | 42 |
| Dallas | 0765 | 136 | |
| Atlanta | 124 | | |
| Birmingham | 095 | 128 | |

**STRUCTURAL MATERIAL**—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

| | Pittsburgh, Mill | Birmingham Mill | New York (del.) | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | 1 75 | $2 00 | $2 88 | $4 00 | $2 97½ | $2 88 | $3 85 |
| Channel, 3 to 15 in. | 1 75 | 2 00 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 85 |
| Angles, 3 to 6 in., ¼ in. thick | 1 75 | 2 00 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 85 |
| Tees, 3 in. and larger | 1 75 | 2 00 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 85 |
| Plates | 1 75 | 2 00 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 85 |

**RIVETS**—The following quotations are per 100 lb.:

| | STRUCTURAL — Warehouse — Pittsburgh, Mill | New York— Current | New York— One Yr. Ago | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | $2 65 | $4 40 | $6 00 | $3 68 | $3 77½ | $5 50 | $5 50 |

| | CONE HEAD BOILER | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | 2 75 | 4 50 | 7 10 | 3 78 | 3 87½ | 5 60 | 5 65 |
| ⅜ and ⅞ | 2 90 | 4 65 | 7 25 | 3 93 | 3 87½ | 5 75 | 5 80 |
| ½ and ⅝ | 3 15 | 4 90 | 7 50 | 4 28 | 3 87½ | 6 00 | 6 05 |

Lengths shorter than 1 in take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse.

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2 75@$3 00 | $3 50 | $4 90 | $5 00 | $3 48 | $4 95 |
| Cut | 3 00@ 3 25 | 6 10 | 6.25 | 7.75 | 4 08 | 5 00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

| | New York— 1-Ply l.c.l. | 2-Ply l.c.l. | 3-Ply l.c.l. | Philadelphia— 1-Ply l.c.l. | 2-Ply l.c.l. | 3-Ply l.c.l. |
|---|---|---|---|---|---|---|
| No. 1 grade | $2 12 | $2 48 | $2 90 | $2 02 | $2 38 | $2 80 |
| No. 2 grade | 1 87 | 2 18 | 2 55 | 1 77 | 2 08 | 1 67 |

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.15 per roll in carload lots and $2.40 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $6.15 per square in carloads; $6.40 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft. | $1 85 |
| Tar pitch (in 400-lb. bbl.), per 100 lb. | 1 85 |
| Asphalt roofing (in barrles), per ton | 47.50 |
| Asphalt felt (light), per ton | 77.00 |
| Asphalt felt (heavy), per ton | 78.50 |

**SHEETS**—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill.

| Blue Annealed | Pittsburgh, Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $2 50 | $2 87½ | $3 48 | $5 50 | $3 28 |
| No. 12 | 2 60 | 2 97½ | 3 58 | 5 55 | 3 33 |
| No. 14 | 2 70 | 3 07½ | 3 68 | 5 60 | 3 38 |
| No. 16 | 2 80 | 3 07½ | 3 68 | 5 70 | 3 48 |
| **Black** | | | | | |
| *Nos. 18 and 20 | 2 85 | 3 05 | 3 95 | 5 80 | 3 58 |
| *Nos. 22 and 24 | 2 90 | 4 00 | 4 00 | 5 85 | 3 85 |
| *Nos. 26 | 3 00 | 4 10 | 4 10 | 5 90 | 3 90 |
| *Nos. 28 | 3 00 | 4 10 | 4 10 | 6 00 | 4 00 |
| **Galvanized** | | | | | |
| No. 10 | 3 60 | 4 17 | 4 15 | | 3 90 |
| No. 12 | 3 70 | 4 25 | 4 25 | 6 85 | 4 10 |
| No. 14 | 3 80 | 4 35 | 4 35 | 6 95 | 4 15 |
| No. 17 to 21 | 3 90 | 4 35 | 4 35 | 6 15 | 4 20 |
| No. 22 and 24 | 3 95 | 4 50 | 4 50 | 6 30 | 4 35 |
| *Nos. 25 and 26 | 4 00 | 4 50 | 4 50 | 6 50 | 4 50 |
| *No. 28 | 4.00 | 5.15 | 5.15 | 6.75 | 5.00 |

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c. all gage.

**LINSEED OIL**—These prices are per gallon

| | New York— Current | One Year Ago | Chicago— Current | One Year Ago |
|---|---|---|---|---|
| Raw in barrel (5 bbl.) | $0 90 | $1 25 | $0 87 | $1 40 |

**WHITE AND RED LEAD**—Base price per pound

| | Red — Current | | Red — 1 Year Ago | | White — Current | White — 1 Yr Ago |
|---|---|---|---|---|---|---|
| | Dry | In Oil | Dry | In Oil | Dry and In Oil | Dry and In Oil |
| 100-lb. kegs | 12 25 | 13 75 | 15 50 | 17 00 | 12 25 | 15 50 |
| 25- and 50-lb. kegs | 12 50 | 14 00 | 15 75 | 17 25 | 12 50 | 15 75 |
| 12½-lb. kegs | 12 75 | 14 25 | 16 00 | 17 50 | 12 75 | 16 00 |
| 5-lb. cans | 15 25 | 16 75 | 18 50 | 20 00 | 15 25 | 18 50 |
| 1-lb. cans | 17 25 | 18 75 | 20 50 | 22 00 | 17 25 | 20 50 |

## LUMBER

**San Francisco**—Prices of rough Douglas fir No. 1 common & better flat carload lots:

| | Lumber Prices in Yards at San Francisco — 6–8 and 12 Ft. | 10–16–18 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft. |
|---|---|---|---|---|
| 3x3 to 3x4 | $25 00 | $28 00 | $31 00 | $33 00 |
| 3x6 and 8 | 25 00 | 28 00 | 29 00 | 31 00 |
| 4x4–6 and 8 | 27 00 | 30 00 | 31 00 | 33 00 |
| 3x10 and 12 | 27 00 | 29 00 | 31 00 | 33 00 |
| 3x14 | 28 00 | 30 00 | 32 00 | 34 00 |
| 4x10 and 12 | 29 00 | 31 00 | 33 00 | 35 00 |
| 4x14 | 30 00 | 32 00 | 34 00 | 36 00 |
| | 24 Ft. and Under | 25 to 32 Ft. | | 33 to 40 Ft. |
| 8x10 | $30 00 | $32 00 | | $34 00 |
| 6x14 | 32 00 | 34 00 | | 36 00 |
| 8x10 | 30 00 | 32 00 | | 34 00 |
| 8x14 | 32 00 | 34 00 | | 36 00 |

**New York, Chicago and St. Louis**

| | Southern Pine — New York — 20 Ft. and Under | 20–24 Ft. | Chicago — 20 Ft. and Under | 22–24 Ft. |
|---|---|---|---|---|
| 3x 4 to 8x8 | $35 00 | $36 00 | $41 00 | $42 00 |
| 3x10 to 10x10 | 37 00 | 38 00 | 43 00 | 44 00 |
| 3x12 to 12x12 | 40 00 | 41 00 | 46 00 | 47 00 |
| 3x14 to 14x14 | 45 00 | 46 00 | 49 00 | 50 00 |
| 3x16 to 16x16 | 50 00 | 51 00 | 59 00 | 60 00 |
| 3x18 to 18x18 | 55 00 | 56 00 | 64 00 | 65 00 |
| 4x20 to 20x20 | 65 00 | 66 00 | 66 00 | 67 00 |

* Wholesale prices (to dealers) of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

Price to contractors, on lighters or cars, New York, about $5 additional.

**St. Louis**—Yellow pine, 22@ 24 ft. long, 3 x 4 to 4 x 4, $34 50; 3 x 6 to 8 x 8, $37; 3 x 12 to 5 x 12, $40; 3 x 14 to 4 x 14, $46; 3 x 16 to 4 x 16, $51; 3 x 18 to 5 x 18, $58.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

**Other Cities**

| | 8 x 8-In. x 20 Ft. and Under — P. | Fir | Hemlock | Spruce | 12 x 12-In. 20 Ft. and Under — P. | Fir |
|---|---|---|---|---|---|---|
| Boston | $47 00 | $52 00 | $55 00 | $48 00 | $57 00 | $52 00 |
| Seattle | | 22 00 | | | | 22 00 |
| New Orleans | 28 00 | 23 50 | | | 33 09 | 27 00 |
| Baltimore | 30 00 | | | | 32 50 | |
| Cincinnati | 38 00 | 50 00 | | | 45 00 | 64 00 |
| Montreal | 78 00 | 85 00 | 68 00 | 78 00 | 78 00 | 100 00 |
| Los Angeles | | 41 00 | 42 00 | | | 41 00 |
| Detroit | | Quotation for mill only | | | | |
| Denver | | 31 75 | | | | 32 75 |
| Minneapolis | 42 00 | 36 00 | 33 00 | | 49 00 | 36 00 |
| Atlanta | | 32 00 | | | 39 00 | |
| Dallas | 31 00 | | | | 35 00 | |
| Kansas City | 40 00 | 47 00 | 47 00 | | 44 00 | 44 50 |
| Birmingham | 30 00 | | | | 34 00 | |

| | 1-In. Rough, 10 In. x 16 Ft. and Under — P. | Fir | Hemlock | 2-In. T and Gr. 10 In. x 16 Ft. — P. | Fir |
|---|---|---|---|---|---|
| Boston | $47 00 | $48 00 | $57 00 | $45 00 | $48 00 |
| Seattle | | 15 00 | | | 16 00 |
| New Orleans, at mill | 52 00 | 29 00 | | 32 00 | |
| Baltimore | 34 00 | | | 32 50 | |
| Cincinnati | 62 50 | 80 00 | | 33 50 | |
| Montreal | 120 00 | 60 00 | 60 00 | 80 00 | 80 00 |
| Los Angeles | | 33 00 | 33 00 | | 63 00 |
| Denver | | 29 75 | | | 27 75 |
| Minneapolis | 38 00 | 31 25 | 30 25 | 32 00 | 29 25 |
| Atlanta | 15 00 | | | 18 00 | |
| Dallas | 32 00 | 30 00 | | 34 00 | |
| Kansas City | 37 00 | 31 00 | | 36 00 | 36 00 |
| Birmingham | 25 00† | | | 23 00 | |

* Montreal—Up to 32 ft.; over which, $3 00 per M increase up to 30 ft.

Price at mill—1 1x12x16, $2 select cond per M. ft. for delivery

Detroit—General quotation per 1,000 board ft. Rough five 2 x 12 and 2 x 4 by 16 ft. $44 etc 12 x 16 ft., $48; 2 x 4 to 2 x 12 $42

## FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

| | | | |
|---|---|---|---|
| Baltimore | $0 33½ | Detroit | $0 33 |
| Birmingham | 76½ | Kansas City | 81½ |
| Boston | 41 | New Orleans | 51 |
| Buffalo | 29 | New York | 38 |
| Chicago | 98 | Pittsburgh, Coke Region | 1 66½ |
| Cincinnati | 325 | Philadelphia | 35 |
| Cleveland | 24 | St. Louis | 47½ |
| Denver | 1 65 | St. Paul | 66½ |

Note—Add 1c. for transportation tax. Minimum carload 40000 lb.

Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

## CONTRACTORS' SUPPLIES

**STEEL SHEETPILING**—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $2 00 | $2.00 | $4.00@$5 00 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | New York and East of Missouri River |
|---|---|
| Hercules red strand, all constructions | 25% |
| Patent flattened strand, special and cast steel | 25% |
| Patent flattened strand, iron rope | 10% |
| Plow steel round strand rope | 40% |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| Iron strand and iron tiller | 10% |
| Galvanized iron rigging and guy rope | +7½% |

California, Oregon, Nevada and Washington: Galvanized iron rigging and guy ropes +12½%; bright plow 35% off.

Wyoming, New Mexico and Colorado: Plow steel, round strand, 35% off, galvanized iron rigging and guy rope +12½%.

Arizona: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Utah: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Western territory not included in above: Plow steel, 35%; galvanized iron rigging and guy rope +12½%.

**MANILA ROPE**—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6 ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in., 1¼-in., 2 ft 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0 19 | New Orleans | $0 16 |
| New York | 17½ | Los Angeles | 14½ |
| Chicago | 18 | Seattle | 16 |
| Minneapolis | 18½ | St. Louis | 16½ |
| San Francisco | 15 | Montreal | 30 |
| Atlanta | 20 | Detroit | 175 |
| Denver | 18 | Baltimore | 22 |
| Cincinnati | 17 | Kansas City | 16 |
| Dallas | 29 | Birmingham | 20½ |

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | 0 3075 | $0 3425 |
| Boston | 24 | 275 |
| Kansas City | 24 | 275 |
| Seattle | 1875 | 2125 |
| Chicago | 2275 | 2525 |
| Minneapolis | 2874 | 2574 |
| St. Louis | 28 | 315 |
| Denver | 2550 | 2700 |
| Dallas | 29 | 375 |
| Los Angeles | 25 | 27 |
| Atlanta | 2675 | 3025 |
| Baltimore | 2550 | 27 |
| Cincinnati | 2625 | 27 |
| Montreal | 32 | 37 |
| Birmingham, delivered | 1925 | 2275 |
| New Orleans | 2725 | 3075 |

**PILES**—For plain pine piles, delivered New York, the price is as follows:

| | |
|---|---|
| Pine 12-in. butts, 6-in. tops, length 41-50 ft. | $9.00@11 00 |
| Pine 14-in. butts, 6-in. tops, length 51-60 ft. | 18 50@15 50 |
| Pine 14-in. butts, 6-in. tops, length 61-71 ft. | 19 00@21 00 |

| | Dallas | | St. Louis |
|---|---|---|---|
| 6-in. x 20 ft | $4 60 | 6-in. x 30-ft | $6 00 |
| | | 7-in. x 30-ft | 8 50 |
| 6-in. x 30-ft | 7 10 | 7-in. x 35-ft. | 11 50 |
| | | 8-in. x 35-ft | 13 00 |
| 8-in. x 30-ft | 8 45 | 7-in. x 40-ft | 15 00 |
| | | 8-in. x 45-ft | 18 50 |
| 8-in. x 35 ft | 10 38 | 8-in. x 50-ft | 22 50 |

**SCRAP**—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton at over delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 railroad wrought | $10 50 | $11 50 | $13 50 |
| Steel rails | 10 50 | 12 00 | 13 50 |
| No. 1 machinery cast | 16 50 | 13 50 | 16 00 |
| Machine shop turnings | 3 00 | 4 00 | 6 50 |
| Cast borings | 3 75 | 5 50 | 8 50 |
| Railroad malleable cast | 9 50 | 12 50 | 11 00 |
| Scrap rails | 11 50 | 13 00 | 12 00 |
| Relaying rail | 30 00 | 30 00 | 27 00 |

**SHIP SPIKES**—Current prices per 100 lb.:

| In | San Francisco — Galv. | Black | Seattle — Black |
|---|---|---|---|
| ½ | $9 10 | $8 40 | $8 50 |
| ⅝ | 8 65 | 6 65 | 8 25 |
| ¾ | 8 50 | 6 50 | 8 30 |

Pittsburgh base, $5 25@$3 40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, OCTOBER 13, 1921 — Number 15

## Why Stop There?

AS A PART of a policy of retrenchment the city council of Swift Current, Sask., has dismissed its city engineer and its chief of police. The reported savings is $12,000 a year. Why should the city council stop there? Why not abolish the whole city government?

## Freight on Street Railways

THREE of the most serious problems in city life today are how to relieve street congestion, how to provide a low-cost street railway ride, and how to reduce the cost of product distribution. During the past week two separate proposals have been made to solve, partly at least, all three by one expedient, the transportation of interior freight on street-car or rapid-transit lines. At the American Electric Railway Association meeting at Atlantic City, J. R. Bibbins urged the utilization of all electric railways for freight terminal service, for the transport to and from the city of the goods laid down in or to be delivered to the railway terminal yard. In New York City the Transit Commission proposed to the Port Authority that the express tracks of the subways be used in non-rush hours at night for distribution of freight to outlying terminals. By such utilization the subway revenue would be increased and the local freight distributed at low cost with an appreciable reduction of the motor traffic now involved in such transfer. These are not new suggestions but they are pertinent ones which deserve more consideration now than they have received in the past. There is a big investment in street railways in our cities, which is in danger of being wiped out; if there is a chance that it can be saved by utilizing it to reduce living costs and make traveling about the city by foot or by vehicle more tolerable, the experiment would be worth trying.

## Progress on Highway Bill

THOSE state highway departments which have been concerned with the course of Congressional action on the proposed amendments to federal-aid highway legislation will welcome this week's news from Washington indicating that the conferees of the Senate and the House have reached agreement on a measure. The present bill is very similar to the one passed by the Senate; the principal changes are enumerated in this week's news pages. The appropriation has been left at $75,000,000, although many favored a larger sum but feared adverse action by the House in the event of greater demands. In connection with the status of the federal highway bill, it is worth while to note the comment from a number of state highway engineers, appearing in this week's news section, in answer to a query as to policy on the letting of next season's highway contracts this fall. It is clear that many states have either entirely used up or definitely allocated all available funds for road-building purposes and that if their highway construction programs are not to be interrupted additional federal aid must be provided. It is essential that this be done at the earilest date, for there is always a lengthy interval between the authorization of funds by the federal government and their availability for actually paying construction costs in the states. This feature, so well known to state highway engineers, is not generally realized by our legislators, who need not concern themselves with problems of planning the year's work, developing a highway-building organization and maintaining it with the properly qualified personnel. Seasonal slackness or activity, as has been pointed out convincingly in the survey initiated by Secretary of Commerce Hoover and recently carried out by the American Engineering Council, is one of the biggest sources of waste in industry. In the prosecution of our highway building program the full value for the millions spent each year can be secured only under a continuing policy which assures to those charged with the planning and execution of the work a steady and adequate supply of funds.

## No Time to Discriminate

IN A RECENT meeting of the New York Building Congress, Hugh Frayne, general representative of the American Federation of Labor for the New York District, urged that in the present crisis preference be given American citizens in finding work for the unemployed. He believes that the worker who has no intention of becoming Americanized should be replaced, if employed, and deported to his native country if unemployed. This is a drastic recommendation. With the general principle of trying to induce those who come to our shores to enter heartily into the spirit of America, to cast their lot here permanently, to adopt our standards of living and our ideals, we are in hearty accord. But having allowed these people to come here, we have contracted an obligation of protecting them from discrimination. Mr. Frayne's recommendation is, to our mind, thoroughly un-American, though we are sure that in making his proposal he is entirely unconscious of the injustice he contemplates. Now is not the time for discrimination. Rather, by giving every honest worker a helping hand we shall aid in that Americanization of which Mr. Frayne is so strenuous an advocate.

## The Revival of Business

OBSERVERS in every field speak hopefully of the outlook. Optimism reigned last week at the convention of the American Bankers Association. The textile and shoe industries are working at nearly full capacity; the steel industry is picking up. Retail stores are reporting good business, and newspaper advertising is on the increase. The railroads are getting into better position. Carloadings are increasing weekly, and, even though maintenance and repair forces have been increased on some roads, there is, in general, a steady

improvement in net earnings. All of these factors contribute to the growing feeling of confidence, and well established confidence is a sure forerunner of healthy business conditions. Only export trade seems to lag badly, but that is caused by the very unsatisfactory position of the foreign exchanges and the consequent inability of Europe to buy in large volume. While the outlook is encouraging, there is nevertheless a feeling that we cannot count upon a boom, that the improvement will be slow. In any event, we have "turned the corner." It is far healthier for business to be looking uphill than to be putting on the brakes and trying to avoid the dangers of a rapid downward descent.

### Unemployment Statistics

FIVE and three-quarter millions was the estimate of decrease of employment between the peak of 1920 and July of this year made during the summer by the Department of Labor. At the Unemployment Conference this figure was challenged. The National Industrial Conference Board puts present unemployment at 3,500,000, and, judging by the testimony at Washington, the correct figure is probably not far from 4,000,000. Even this, however, is not a figure of normal unemployment—that is, unemployment of those who naturally work for a living—but is a measure of the decrease of employment from the high figures of last year. The situation, therefore, is not as serious as the country was led to believe from the figures put out by the Department of Labor. Nevertheless, the activities springing out of the Unemployment Conference are fully demanded by present conditions.

### Aggravated Sludge

THE *sceptic* tank has now been followed by *aggravated sludge*. Curiously enough, and quite fittingly; some will think, "aggravated" sludge is coupled, in this latest newspaper nomenclature, with the Imhoff tank. Thus the *Herald*, of Brownsville, Tex., in its issue of Aug. 5, announces that: "The construction of an Imhoff sewage disposal tank, with the aggravated sludge" at a cost of $15,000 is proposed by "visiting sanitary engineers," or as an alternative "an Imhoff tank" and a "carry off sewer line" to the river at a cost of $65,000. Engineers can guess what is really intended, even if the citizens of erstwhile turbulent Brownsville are left in the dark, but the best of engineers will be puzzled to know what one of the visiting engineers really had in mind when the *Herald* represents him as speaking of the "evaporation process" as a possible way of disposing of the "water" from the proposed sewage-works. Thus do the daily newspapers, in places large as well as small, enlighten or darken the public mind on municipal engineering projects.

## Business Men or Statesmen

THERE is always danger in trying to dismiss with brief comment a subject involving the welfare of great states and their millions of population. Nevertheless, we do not want to let go by without at least a word Hugo Stinnes' remark to Isaac F. Marcosson as reported in the Sept. 24 issue of the *Saturday Evening Post*. Said Stinnes: "The whole world is sick and the politicians of Europe give it no opportunity to get well. A few business men sitting around a table, discussing matters calmly and amicably, could achieve more reconstruction than all the chatter of self-seeking politicians. The curse of Europe is politics, and until the politician is eliminated there can be no stabilization."

Most men, we believe, are willing just now to rail at the statesman, and to assent to the generalization that too often he is nothing but an international politician. We are not so sure, however, that the remedy lies in turning the job over to the business man, except as a temporary assignment. For the minute, he would probably be willing to overlook all past jealousies and stick to the task of working out a solution that would make for quick world readjustment. We are inclined to doubt, though, whether as a long-time director of international adjustment his results would be better than those achieved by the statesmen of the past. Surely the latter have had an economic, a business ideal. Territorial expansion, trade penetration, international alliances have been dictated on economic grounds. Certainly the international business relations before the war should have deterred business men from the cataclysm. That they did not may be chargeable to the over-ruling of their views by war-lords, but business had long been intimate and in accord with the military powers.

Could the business men be relied upon to do that which was best not for business, not for business men as distinct from the rest of the community, not for the glory and perpetuation and strengthening of a dynasty or of a political clique, but rather that which was good for the masses in their respective countries, something might be gained in passing over to them the powers now, and hitherto, lodged in the statesmen. Without such purpose, however, we could hardly look for more from them than we have received from the international politicians who have directed Europe's destinies.

Again we say that this is too big a question to be dismissed with brief comment, but even a few words may help to stimulate the thinking of our readers in this important direction.

## Public-be-Damned Policy of the Building Industry

"CROOKED business agents, ignorant and poorly-balanced workmen, selfish and narrow-visioned contractors, greedy material dealers, all are taking part in what is in effect a conspiracy to ruin Chicago." Thus the *Chicago Tribune*, in a recent editorial discussion of Judge Landis' decision concerning wage adjustment in the building trades, characterizes the local building industry. The *Tribune* extends to Judge Landis its sympathy in his endeavor to fix a scale equitable to all concerned, asserting that compared to his task of "cleaning up the Chicago building trades the labor of Hercules in the Augean stables is as the parlor maid's difficulties in dusting the grand piano."

Repudiation by labor organizations of their pledge to abide by the decision and their request for a rehearing as well as the action of contractors in continuing the old scale after the new was announced, merely to avoid labor difficulties, are the reasons for the well-deserved censure. It is just such actions that account for the public's lack of faith in the building industry. One decayed apple in a basket will soon ruin the rest. A group of crooked transactions undermines confidence in the whole industry. Much is being said about the need for securing public confidence by stabilizing material prices and wages, and giving honest effort for a day's pay. But such incidents as have been brought out in

New York, Chicago, and Buffalo through legislative investigations, and in other cities through other means of publicity, have set back far the restoration of public confidence. Judge Landis, the agent of mediation and the representative of the public in the Chicago case has found out too well that a pledge is not inviolable. The industry will not clean itself; it will not allow others to help in the process. The penalty is protracted public suspicion, with inevitable but difficult-to-estimate losses to all concerned. In the end may come some form of public regulation, for the public in the past has stepped in and thus protected itself against those who infringed its rights.

## Airplane Photographic Maps

ENGINEERS with a vision cannot fail to see in the development of the airplane photographic map a new tool with a wide variety of engineering uses. The mosaic map, however, has been so generally identified with war-time operations that its field of application in civilian practice is just beginning to receive recognition. Both in the technique of aerial map-making and in the equipment employed therefor substantial progress has been made since the signing of the armistice. Private enterprise, aided by governmental co-operation, has taken the development of the art where the army left it and carried it forward to a point of commercial practicability.

A number of cities today are using or planning to use aerial photographic maps in connection with such a wide range of engineering studies as city planning, traffic control, water-front improvements, transit facilities, location of new schools, street widening and fire protection. These, of course, are distinctly municipal uses, as pointed out in the article on the general subject of airplane mapping, appearing elsewhere in this issue, but in addition such maps offer possibilities in the preliminary investigation of watersheds, hydro-electric developments, highway, railroad or canal location, forest surveys, etc. Comparatively few engineers have sensed the application of the airplane map to the solution of many problems upon which they are now engaged. With such innovations as the automatic timing of exposures to cover the proper ground area and at the same time secure the necessary overlap for the accurate fitting together of individual negatives, lenses especially adapted to this type of work, development of the technique covering such details as the best height from which to take pictures for specific purposes, speed of the airplane, and the maintenance of a level flight to insure verticality in the view, the maps now being produced attain a high degree of accuracy and a wealth of valuable detail. Among the points worth considering in connection with airplane photography in engineering work are the speed with which such maps may be produced, their ability to cover territory inaccessible on foot, their comparatively low cost, and the impossibility of omitting any feature of the area photographed—the detail, of course, depending upon the altitude and the characteristics of the lens employed. Most of our larger cities are concerned with the problem of handling the ever-increasing volume of street traffic. In this field, alone, the airplane photograph offers extremely interesting possibilities.

The advent of the mosaic map, of course, does not mean that such time-tried tools as the transit and stadia or the plane-table are to be discarded. They have now, and always will have, a distinct field of usefulness. Airplane mapping, however, has already established itself as a practical means of securing quickly, cheaply, and accurately information which can be put to a wide variety of uses in engineering practice. Engineers who think of surveys only in terms of the old field tools may soon find themselves out of date.

## Health Association Jubilee

THE "HEALTH FORTNIGHT" of the American Public Health Association in New York City, Nov. 8 to 19, has been planned on a scale worthy of an organization that is looking backward over a half century of useful existence and forward to an even brighter and more fruitful career. In the fifty years of the existence of the association a small band of devoted seekers after scientific truth and efficient methods in the field of public health, working for the most part blindly and stumblingly along empiric lines, and with little or no governmental backing—municipal, state or federal—has grown to a goodly army of trained public-health administrators and research students. The omnibus conventions have given place to many sectional meetings, run in parallel, and a few general sessions of all-inclusive appeal. Meanwhile, the annual proceedings, made dull by their bulk and age, have been superseded by a live and useful monthly journal and a frequent news letter. Supplementary to the association is the National Health Council, that is co-ordinating the scores of public and private health agencies of the Americas.

Of the many lines of work now separately conducted by the American Public Health Association, those of most interest to readers of this journal center in the Sanitary Engineering, Laboratory, Vital Statistics and Industrial Hygiene sections. In these fields, whether before or since the sectional organizations were effected, the most notable work has been the formulation and revision of standard laboratory methods for the examination of water, sewage and milk; a long series of reports and papers on garbage disposal, for which through many years the association and the country at large was chiefly indebted to Rudolph Hering, who is still a member of the committee now in charge of the subject; a pioneer report on disinfection and disinfectants, and much work on the standardization of vital statistics. Today, the various sections combined, through committees or otherwise, are dealing with scores of phases of public-health work.

A unique feature of the Health Association Jubilee is the holding of a Health Institute in New York the week before the convention—an experiment that may well be watched by other organizations. The institute will afford an original opportunity to get into intimate touch, by personal visits and other means, with the many public and private agencies, laboratories and sanitary engineering works in and near New York City. To do this during the convention, without neglecting the convention itself, would be impossible; and to do it without organized assistance would mean either a great loss of time or failure to see all that might readily be seen under guidance.

The Health Institute before and the Health Exposition during the week of the convention should ensure a record-breaking attendance at the jubilee of the American Public Health Association, and help to raise the event to a position proportionate to its importance to the public throughout the country.

# Aerial Photographic Mapping Developed for Municipal and Other Engineering Services

## Wide Variety of Uses Includes Traffic Studies, Street Layout and Waterfront Development—Methods and Equipment Improved Since the War—Exposures Made Automatically

*(An article prepared from data supplied by* FREDERIC E. JONES, *American Air Service Corp., Springfield, Mass.)*

AERIAL photography, an outstanding development of the World War as a quick means of securing information regarding enemy operations, such as troop movements and the location of batteries, ammunition and supply dumps, or lines of communication, is being put to new commercial uses in the field of engineering. Engineers, in fact, are just beginning to recognize the possibilities of the air photographs in the solution of problems relating to city planning, traffic regulation, water resources, housing conditions, water-front development and mapping of areas, such as forests, not easy of access except by air routes. As a preliminary to ground surveys for railroads, canals, highways, hydro-electric developments and scores of similar engineering projects surveys from the air and the resulting photographic maps produced by piecing together prints of films covering the areas in question, are proving of great value.

One of the main advantages of the aerial survey, of course, is the rapidity with which it can be made, and the great amount of detail which it can be made to show even when the photographs are taken from considerable altitudes. In fact, a number of large cities are actually using or contemplating the use of aerial maps in connection with the work of their engineering departments.

The more recent types of aerial mapping cameras are greatly improved over those used during the war, and, due to the effort of private promotion linked with government assistance, the results obtained are superior to those formerly secured. There has been developed an automatic camera, adjusted in the bottom of the airplane, by which exposures are made automatically, with clocklike precision at the correct intervals, so as to produce in the film sufficient overlap to enable the operator to join the finished pictures into a continuous map or mosaic. The usual overlap is one-third of the length of each picture. Film is used instead of plates as it is lighter and can be carried in larger quantities. In all recent work a compass, level gage, serial number, altitude gage, and time clock are so arranged as to be photographed on every exposure. These features are especially helpful in work where mosaic maps are made of city areas for traffic studies, as the time-clock automatically records the hour, minute, and second when each picture was made, thus fixing accurately the time at which traffic conditions shown on the negative existed.

Aerial photographs are of two general types, the oblique and the vertical. The oblique photographs represented the earlier development of the art. They were not entirely satisfactory for detail information over large areas, as each picture had a perspective different from others of adjacent territory, making it difficult to combine them in a single map. The oblique view, however, is useful in preliminary studies or reconnaissance work. Better results were eventually obtained by using the vertical view. Negatives made in this way are much easier to match and by enlargement or reduction they can be brought to a uniform scale even though the airplane from which they are taken does not fly at a constant altitude. In taking the vertical pictures, howver, the airplane should be kept in line with the objects to be photographed and maintained on as even a keel as possible, avoiding steep banking at turns.

PORTION OF MOSAIC MAP OF ROCHESTER, N. Y., MADE FROM 80 NEGATIVES COVERING 30 SQUARE MILES AVERAGE ALTITUDE 9,930 FT. AND ORIGINAL SCALE 1:9980

Mosaic maps, as now made for commercial use, show a great deal of detail and, when properly made, are generally accurate within 1 per cent; as the art develops, small errors now caused by differences of elevation of the airplane at the time of taking a photograph will be largely eliminated. The newer cameras produce negatives which show land beneath water surfaces and may

VERTICAL VIEW OF NEW YORK CITY IN REGION OF FIFTH AVE AND 34TH ST. (ALTITUDE 4,000 FT. FOCAL LENGTH OF LENS 12 IN.)

be used in interpreting the location of deep and shallow channels.

A recent development, particularly valuable in aerial surveys of forest areas, is the use of color-sensitive plates and film which indicate the species of trees as well as their location. With the use of color-sensitive films pine and spruce can be differentiated from balsam by the difference in shade; the black spruce of the swamps is readily recognized by very dark shade in photographs. Pure jack pine stands have a distinct color and appearance. Birch can be distinguished from poplar. Elms and maples are readily recognized. When the leaves are turning in the autumn the recognition of different species is easy and tamaracks are particularly noticeable. After the leaves have fallen white birches are distinct from other hardwoods and maples and beeches show up distinctly. The boundaries of burns are easily seen and where reproduction has commenced the amount and approximate height can be easily estimated. Even when the new growth is coming up under a thin stand of poplar and white birch one can tell whether the trees are 3 ft. or 6 ft. high.

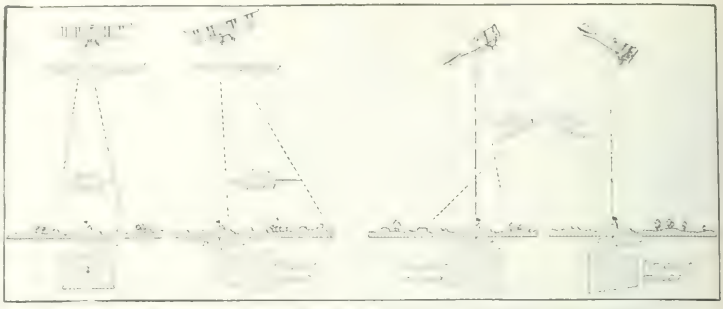
The latest type of airplane camera, developed by the Eastman Kodak Co., is mounted over an aperture in the floor of the observer's cockpit and is entirely automatic in its action, the driving power being provided by a wind motor mounted on the side of the airplane body, with a control lever easily accessible to the pilot or observer. Electric driving power is also used. Exposures are made upon a continuous roll of autochromatic film—each negative measuring 18 x 24 cm. The film is held flat at the recording plane by constant vacuum suction, thereby overcoming all vibration of the film during exposure.

The camera is fitted generally with a 12-in., 18-in. or 20-in. lens, carefully adjusted and rigidly set at infinity focus, although provision is made for readjustment of focus, if necessary. A focal-plane shutter is employed and the interval between exposures may be adjusted, depending upon the altitude of the airplane, speed, and vibration.

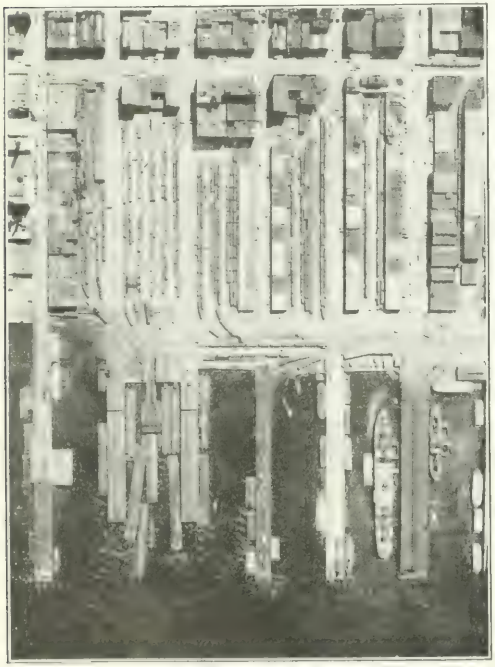
The automatic cycle of operation is as follows: After each exposure a safety curtain is interposed between the lens and the film. The film is then wound into position for the next exposure. The focal-plane shutter is reset and the safety curtain withdrawn just before the next exposure is made. The movement of the film across the recording plane is entirely automatic and continuous as the focal-plane shutter and the safety curtain are alternately released and reset between exposures.

Variation in altitude of flight is an important factor in the computation of the interval between exposures

that will produce the required amount of overlap in the negatives, thereby permitting accurate matching. Tables have been computed by the manufacturer of the airplane camera showing the number of seconds between exposures required for 25 per cent and 50 per cent overlap both for the 20-in. and 12-in. lenses, at varying altitudes and ground speeds of the airplane. Having decided upon the altitude from which pictures will be made and the percentage of overlap required in prints, the camera is adjusted, by reference to the manufacturer's tables, to make exposures at the proper intervals. For example: If the altitude is 5,000 ft. and the ground speed of the airship 90 miles per hour, the interval between exposures with a 20-in. lens will be 10 sec. for a 25-per cent overlap in the pictures and 6 sec. for a 50-per cent overlap. For pictures made at an altitude of 3,000 ft. and 80 miles per hour, the interval between exposures with a 12-in. lens is 11 sec. for a 25-per cent overlap and 7 sec. for a 50-per cent overlap. Time intervals for an 8-in. lens are shown in the table and sketch on p. 599.



DIAGRAMS SHOWING EFFECTS OF BANKING, CLIMBING AND DIVING ON AERIAL PHOTOGRAPH



AERIAL PICTURE OF WATERFRONT CONDITIONS TAKEN AT ALTITUDE OF 1,000 FT.

Allowance must be made for any difference between the ground speed and the air speed of the airplane, due to prevailing winds and direction of flight. If an airship has an air speed of 60 miles per hour and flies against a wind of 30 miles per hour, it is obvious that the plane will pass over the ground at a speed of only 30 miles per hour, which will determine the required interval between exposures.

One of the most important uses for aerial photography today is in mapping cities and towns. The photograph on p. 596 shows part of a mosaic map of the city of Rochester, N. Y., where an area of approximately 30 sq.mi. required 80 separate photographic exposures. This map, in its original form, was at a scale of 1:9980 and the photographs were taken from an airplane flying at an average altitude of 9,930 ft. Comparison of this map with one made by ground survey methods indicated an error of less than one-half of 1 per cent. For purposes of checking, a triangle measuring 5,000 ft. on each side was surveyed on the ground at Rochester. Measurement of this triangle taken from the aerial map gave a length for each side of 4,990 ft., an error of only 10 ft. in 5,000.

In reporting on the accuracy of an aerial map of the Kalamazoo quadrangle, the U. S. Geological Survey found that the accuracy of the mosaic map was so close to that of the ground survey that when reduced three times—lessening the error by 3—it fitted "exactly with our previous survey data."

In one large city the American Air Service Corp. was retained to make a map to serve as a basis for a complete study of traffic, transit, and water-front conditions. Another city is to use an aerial mosaic as a new survey, while still another town will employ an aerial map in an investigation of housing conditions and street layout, with particular reference to the location of new schools. In a locality, where a campaign of mosquito elimination was under way, an aerial map was employed to advantage to show pools and ponds which served as breeding places for the pests but which were off the main lines of travel and would probably have been overlooked by the mosquito exterminators.

A large city which has the project of an aerial map under consideration recently received from its principal assistant engineer a report from which the following excerpts are taken:

"An aerial map of the city would show more detail than we could ever hope to put on any plan prepared from surveys. Such a map would be an invaluable aid to us on traffic studies, city plan work, regulating, grading, and repaving work, encroachment and building-line work if made at a time of peak traffic load. It would show at a glance traffic conditions of all the streets and could be used as a basis for determining

streets requiring widening where congestion exists and sparsely used streets through which it would be possible to route part of the vehicular traffic using the congested areas.

"By superimposing a proposed street layout on the aerial map it would serve to determine the extent of the damage to private property, such as buildings, and, in addition, would show the character of the neighborhood which the proposed improvement would serve. It would assist in locating retaining wall, slopes, etc., so as to minimize damage to adjacent private property. Often there has been some question as to whether or not new curb corners require the shifting of hydrants, lamp posts, etc. This question could be answered immediately by an inspection of an aerial map, whereas, formerly, it would be necessary to make a survey or field inspection. Questions as to building encroachments could be readily answered from the aerial map without the necessity of going into the field to make examinations.

"We are frequently called upon to make studies for the alignment of street-car tracks and the layout of

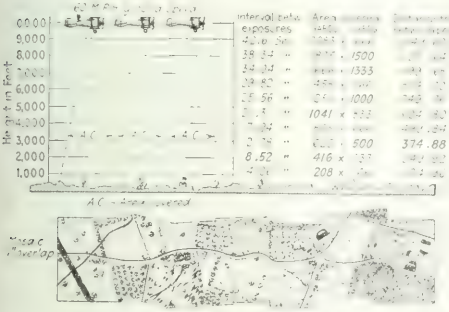



Table showing Intervals of Exposure giving "O... on 5"x4" Negative with an 8" Lens

OVERLAP PHOTOGRAPHS

AREA COVERED BY 8-IN. LENS AND TIME INTERVAL BETWEEN EXPOSURE

new streets in connection with the development of private property for bridge approaches, tunnel approaches, and for increasing the width of the street which would include a demolition of buildings. In such cases, particularly where several studies of a project may be made, the map would save a considerable amount of time and money.

"I have examined similar photographs of parts of this city and other cities and it is surprising the amount of detail photographs taken at an altitude of 1,000 ft. present. A photograph made of one section at this altitude shows clearly the street railway tracks, manhole heads, types of pavement, curbs, sidewalks, traffic, and even the small police stanchions."

With reference to the foregoing report, it should be stated that altitudes higher than 1,000 ft. are desirable for aerial photographs. The detail above reported, therefore, is not to be expected in aerial maps. Such features as manholes and police stanchions will not be shown clearly, but street railway tracks and traffic conditions will be definitely indicated.

By the use of panchromatic film which is very sensitive detail in shadows can readily be brought out. Negatives also may be intensified after development to show objects in shadow.

With regard to the use of aerial maps for other municipal purposes, the following is quoted from a report from a New England city: "The council could profitably utilize a photographic map of the settled portion of the town in deciding important questions of public policy. For example, by taking the area tributary to a specific school and counting the number of buildings, we could develop a ratio between the number of children of school age and the number of dwellings. At the same time, analysis of the adjacent land would indicate the ultimate probable number of dwellings and indirectly the ultimate need for school expansion. The photographic map also could be used in connection with a study of fire protection, street lights, street paving, storm-water sewers, and problems relating to police administration."

### Cost

With regard to cost of aerial surveys, the American Air Service Corp., recently made the following quotations to a New England city for a map to a scale of 700 ft. to the inch:

COST ESTIMATE FOR AERIAL MAPPING

| | | |
|---|---|---|
| 1. | For congested city areas, including high buildings, considerable traffic and congestion, per square mile | $350 00 |
| 2. | For city areas, exclusive of above, such as residential sections, harbor and water fronts, etc., per square mile | 125 00 |
| 3. | For other city areas, such as partially developed tracts, suburban area, parks, etc., per square mile | 100 00 |
| 4. | In the event you should desire only a small area, such as a few square miles, we classify and quote the following approximate prices: | |
| | 4 sq. mi. at $350 | 1 400 00 |
| | 10 sq. mi. at 125 | 1,250 00 |
| | 4 sq. mi. at 100 | 400 00 |
| | Total | $3,050 00 |

When a city procures an aerial mosaic map, it has at its disposal a photographic map that can be made into a line map survey. By placing tracing paper over the completed mosaic, all information desired may be traced off, thereby giving a line map without the photograph showing. This can be done for the entire map or any particular section of same, and may be reproduced at any scale desired.

## Wastes at Tannery Chlorinated To Guard Against Anthrax

To guard against the spread of anthrax germs from the new tannery of the Surpass Leather Co., Gloversville, N. Y., the wastes from the soak vats and milling drums are chlorinated. These wastes are piped to a tank below the floor level, about 18 x 67 ft. in plan and 6 ft. deep, with a working capacity of 31,400 gal. According to a description of the concrete work of the new tannery by Walter Kidde, president of Walter Kidde & Co., Inc., New York City, engineers for the plant, in *Contractor's Atlas* for September, the chlorination tank is "lined with a special acid-resisting asphalt membrane." Mr. Kidde also states that three longitudinal baffles divide the tank into four compartments, in one of which there is located a 36-in. bronze propeller, on a shaft leading to an electric motor outside the tank. At the end of each day the contents of the tank are dosed with chlorine. The required total amount, as shown by a float gage and indicator, is fed in by the dosing apparatus during the period of an hour. Meanwhile, the propeller is used to mix the chlorine and the tank contents and to keep the solids in suspension. Finally, the chlorinated contents of the tank are discharged to a sludge-settling tank, from which the supernatant clarified liquid goes to the city sewer.

# Experiment on Desert Road with Asphaltic Pavement

## Powdered Copper Sulphate Added to Toughen Material in Summer Temperatures of 130 Deg. Fahr.

THE California state highway in Imperial Valley includes a stretch of 22 mi. across a sandy desert, almost devoid of vegetation, where the average annual rainfall is only about 2 in. The cost of a concrete pavement in this territory was prohibitive, the division engineer reported, on account of the scarcity of water and the long, expensive haul required to bring in concrete materials. To determine whether the desert sand could be combined with asphalt to form a pavement of sufficient stability the commission laid at one end of the desert stretch a series of short sections of pavement in which several combinations of sand and asphalt were tried. This pavement was recently inspected after having been in service for a year and was found to be, for the most part, in good condition. A statement of what materials were used and what decisions were reached as a result of the experiment, are set forth in reports of the division engineer to A. B. Fletcher, chief engineer of the California Highway Commission, from which the following has been extracted:

### Copper Sulphate Added to Asphalt

The temperature in this part of the desert rarely goes below freezing in the winter time, but in the summer rise to 125 or 130 deg. F. in the shade and very much higher in the sun. Under these conditions ordinary sheet asphalt would probably be unsatisfactory, but the manufacturers of Willite, a patented asphaltic paving compound, claimed that 2 to 3 per cent of finely powdered copper sulphate, added to the hot asphalt, would toughen it and reduce the penetration without increasing its brittleness. Their plan was accordingly tried.

The several sections of pavement laid were all 15 ft. wide, placed directly on the sandy subgrade which had been prepared by leveling and dragging. The only unusual feature of the subgrade was that 2 x 12-in. headers were used and were solidly staked in position. The deep headers were considered necessary because the desert winds tend to blow the sand from beneath the edges of the pavement which, in addition to weakening the shoulders, encourages burrowing by desert rats and other small animals.

In all of the several combinations tried, the materials, obtained near the roadside, were heated in a standard asphalt mixing plant and combined with grade D asphalt of 40 to 48 deg. penetration, to which copper sulphate had been added. The amount of asphalt used varied from 6 to 14 per cent, depending upon the coarseness of the aggregate. The mixed materials were then hauled and placed by methods usual in handling asphaltic paving materials.

The first section, 1,600 ft. long, was built up of two layers, the first layer 3 in. thick and the top layer 2 in. thick, with a paint binder-coat applied to the top of the first layer before spreading the second. The materials for this stretch were obtained from an old sea beach and approximated a Topeka mixture in character. The specific gravity of this pavement was about 2.30.

The second section, 400 ft. long, was built with what is commonly called "desert blow" sand, which is so fine that 80 per cent will pass a 100-mesh sieve and about 50 per cent will pass a 200-mesh sieve. The specific gravity of this pavement was about 1.80. This stretch was also built in two layers, the lower 3 in., and the upper 2 in. in thickness.

The third section, 1,300 ft. long, was built with a medium grade sand obtained from a small pit about three-quarters of a mile from the mixing plant. From 5 to 10 per cent of this sand passed the 80-mesh sieve and the specific gravity of the pavement was about 2.16. A part of this section was made 5 in. thick, laid in two courses, and part of it was laid as a single-course, 3-in. pavement.

The fourth section, a few hundred feet long, was made of desert-blow sand which it was planned to lay as a single course, 3 in. thick. However, on account of the difficulty of rolling and getting a reasonably smooth surface, the thickness was increased to 4½ in., made up of a 2½-in. bottom course and a 2-in. top course.

In a fifth section, also several hundred feet long, the medium grade sand was used and because it was of a uniform grade some of the fine desert-blow sand was added to improve the grading, the percentage of asphalt being increased accordingly.

### Effects of Cold Weather Studied

Immediately after finishing the work the mixing plant, which weighed 18 tons and had a compression on the rear steel-tired wheels approximating 1,000 lb. per linear inch of tire, was hauled over the completed pavement without marking it or damaging it in any way.

The pavement came through the summer season without cracks of any description, nor were there any signs of movement or of the effect of traffic during the hot weather. However, an inspection was made Jan. 27, on a morning following a freeze and at a time when the pavement had probably reached an average temperature lower than any it had undergone previously. This inspection showed about 30 transverse cracks of various sizes, confined almost entirely to the 3-in. and 3½-in. pavements. With the exception of two very small cracks there were none in the approximately one-half mile of 5-in. pavement.

The cracking seemed to be confined to the portions of the pavement which were made with a relatively small amount of asphalt and with an insufficiency of fine aggregate. No cracks appeared in the pavement made with the desert-blow sand and which contained 12 or 13 per cent of asphalt.

Pavement made with the desert-blow sand, which was thought by the engineers in charge likely to prove the least satisfactory of any of the experimental sections, withstood the heat of summer without perceptible softening and came through the winter without any cracks, although in most cases the thickness was only 3 in. However, it is recommended that no more such pavement be constructed of 3-in. thickness because the extremes in temperature are much more severe on such a pavement than upon one 5 in. thick.

A later inspection of the pavement made in July of this year showed that the cross cracks due to shrinkage had become filled with sand and could not close with the arrival of hot weather. Otherwise the appearance of the pavement was the same as it was a year ago.

---

## Automatic Regulation of Locomotive Cut-off

Tests have recently been conducted on the Big Four R.R. to demonstrate the mechanical possibilities of an apparatus to regulate locomotive cylinder cut-off automatically from the back pressure. The device employed consists of valves connected to the four exhaust passages of the cylinder which actuate the air supply for the power reverse gear; a circular quadrant to limit minimum cut-off at higher speeds, but to permit the reverse lever to follow the gear and indicate the cut-off as well as to provide a quadrant for operating under hand control. An auxiliary to the device is a control valve connected to the throttle, requiring full throttle opening and placing the engine under control of the automatic cut-off apparatus. Comparative tests are reported as demonstrating that it is possible to regulate locomotive cut-off by automatic means to the point of maximum economical capacity within the practical limits of load and speed.

# Arkansas River Dammed by a Single Large Blast

## Portion of Rock Cliff Blown Into River to Force Additional Water Into an Old Irrigation Ditch

By Ivan E. Houk
Miami Conservancy District

A DAM was thrown across the Arkansas River, about 14 miles above Pueblo, Colo., on Aug. 21, 1921, by blasting down an overhanging rock cliff in one large shot. A portion of the cliff about 60 ft. high, 30 ft. thick and 45 ft. long was dislodged. At the bottom the rock was sandstone without seams, and above it was limestone and shale in comparatively thin strata. Fig. 1 shows the cliff, before the blast, from a point about 400 ft. upstream, and Fig. 2 is a view from the same point showing the dam which resulted from the blast.

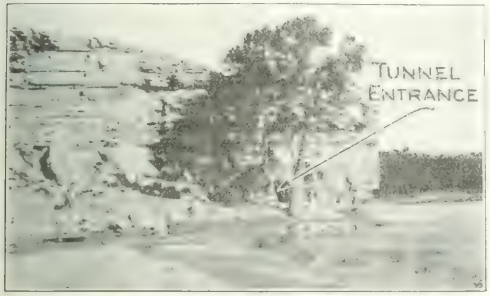



FIG. 1. VIEW SHOWING CLIFF BEFORE THE BLAST

FIG. 2. DAM MADE BY BLASTING CLIFF INTO RIVER

The dam was made necessary by channel changes which occurred during the recent flood. Before the flood the main channel of the stream was on the south side of the island seen at the right of the river in Fig. 1, where a dam diverted a part of the flow into the Bessemer irrigation ditch. During the high water, however, a new channel was scoured out along the bluffs. After the flood subsided nearly all of the flow continued along the new channel, so that the head on the ditch headgates was materially reduced. Prior to the blast the ditch had been getting about 70 sec.-ft. Within an hour afterward 775 sec.-ft. were passing the headgates and the ditch was taking its full capacity of about 300 sec.-ft.

The charge, which consisted of 5,000 lb. of black powder, with 50 lb. of dynamite scattered through the powder in order to give better ignition, was placed in the end of a tunnel driven into the cliff near its base. The entrance to the tunnel may be seen at the left of the tree in Fig. 1. It was 4 ft. wide and 6 ft. high and was driven straight in for a distance of 35 ft., then offset 5 ft. to give a better control of the blast, and then driven 10 ft. further. The charge was placed in the last 10 ft.

About 300 lb. of dynamite were used in driving the tunnel. Holes were drilled 18 in. deep, then shot, and the rock cleaned out. It required 14 days to complete the tunnel, working three eight-hour shifts of two men each. The entire cost of the work did not exceed $2,000.

The work was done by Arthur, Potter & Allen, contractors, of Pueblo, Colo. C. K. McHarg is secretary of the Bessemer Irrigation Ditch Co.

# Repairs to a Wind-Indented Standpipe at Bath, Maine

By C. E. Carter
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

*Abstract of a paper read before the New England Water Works Association, September, 1921.*

DURING a heavy gale, Dec. 14, 1917, the easterly side of the 34 x 74-ft. wrought-iron standpipe of the Bath Water District (Me.) was blown in or indented by wind pressure. The records of the Weather Bureau of Portland, Me., show a maximum wind velocity at this date of 60 mi. per hour. The standpipe was built in 1887 by the New England Shipbuilding Co., Bath, Me. The contract called for "C. L. Bailey's refined iron stamped 'Central' or iron equally good" with a tensile strength of not less than 50,000 lb. per square inch. The standpipe was built with plates of five different thicknesses, each three rings from the top downward having thicknesses as follows: $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{5}{8}$ in. All joints were lapped. All vertical joints were double riveted and all horizontal joints were single riveted, except that those on the lowest side of the bottom sheet were double riveted. The top of the upper ring was reinforced by a 3-in. angle iron in short lengths.

WIND-INDENTED STANDPIPE, BATH, ME.

From the time of the accident until the latter part of the summer of 1919 the standpipe was kept filled to a depth of 40 ft. At the time mentioned the contract for repairing the pipe was let to the Bath Iron Works.

The repairs were made from an outside staging and an inside float, with steam hoists for raising and lowering the plates, and an air compressor for riveting.

A total of 27 plates was removed. Of these all except three that were too badly damaged were hauled to the shop, re-rolled, hauled back and replaced. The top of the upper ring was reinforced by a 6 x 6 x

⅝-in. angle iron, in 18-ft. lengths, and anchored to rock about 100 ft. from the standpipe base by means of four 1-in. wire guys.

The repairs were made in 49½ days, during which the structure was entirely out of service for only the six days required to place 1 ft. of concrete in the bottom and paint the structure. The total cost of the repairs was $7,138, of which $5,409 were for repairing the plate, $1,438 for the guys and concrete bottom, and $292 for painting. The contract price of the original structure was about $8,000. Both details and cost data were supplied by Walter F. Abbott, superintendent of the Bath Water District.

## Protection of Railway Track from Falling Rocks

### Slopes Inspected and Cleared — Watchmen During Troublesome Season—Securing Rocks in Place—Removal of Slides

ON RAILWAYS traversing rocky canyons and steep mountain slopes special precautions have to be taken to protect the line from rock slides and falls of loose rock. Periodical inspection of threatening points is necessary, as the washing of steep slopes by storms and drainage or the alternating conditions of freezing and thawing of moisture in crevices of the rocks, tend to loosen or disintegrate large rock masses from time to time. Such inspection is usually under the direction of the engineering or maintenance of way department.

More trouble from steep rocky slopes than from vertical cliffs or bluffs is found in some cases, since the latter are largely monolithic, presenting comparatively few seams for the collection of water and being secure against the undermining effects of erosion. On the other hand, steep slopes are formed largely by disintegration, which is a continuous process, so that crumbling under atmospheric influences and erosion due to washing result in producing instability of the slopes. Geologic conditions are among the factors affecting individual localities. Seasonal and meteorological conditions are largely responsible for falls of rock, experience indicating the portions of line to be watched and the weather indicating when falls may be expected.

Day and night patroling by special trackwalkers or watchmen is a general precaution at points where falls or slides are likely to occur. At certain times these men may be required to patrol their sections before and after every train. Shelters must be provided for them, as they work largely during severe weather. On some roads the rules require the entire section gang to carry on such patrol duty during heavy storms or under such a combination of circumstances as very warm days followed by cold nights when there is a deep blanket of snow on the slopes. The watchmen are provided with flags, lamps and torpedoes for stopping trains in case of emergency. Telephone booths are often installed near points of potential danger, so that if rocks or slides foul the track the watchmen can not only warn the trains but also notify the train dispatchers to hold traffic and send the necessary equipment for clearing the track.

Inspection of slopes and cliffs is undertaken according to local requirements. When slopes are to be cleared, extra gangs are organized as a rule, the removal of large loose or threatening masses being effected usually by the aid of ropes, bars and explosives. Along high bluffs it is often necessary to lower men from the top to make inspections or clear away loose rocks. Trains may be held up occasionally, but most of the work can be done in the intervals between trains. During such work the track is frequently covered with old timbers to protect it from damage by the material thrown down and to facilitate removal of the debris by a steam shovel or ditcher without injury to the track.

Much of the material is likely to require a derrick car or locomotive crane to remove it from the track, the smaller material being handled by a steam shovel or ditching machine. The material may be loaded into cars and used for widening banks or filling trestles, but in some cases it is practicable to throw it clear of the track on the downhill side. If a stream flows near the railway, care must be taken not to obstruct or restrict the waterway by this waste material. Side ditches of liberal width afford good protection against the smaller pieces of rock which fall down rocky slopes.

On the Erie Ry., as stated in Tratman's "Railway Track and Track Work," the watchmen on rocky divisions are supplemented by a rock gang composed largely of quarrymen who are experienced in climbing and in the detection and removal of loose or dangerous rocks. It may be noted also that immediately after the construction of the Spokane, Portland & Seattle Ry., in 1907, a number of large rock gangs were organized to go over the work along the banks of the Columbia and Snake rivers for the purpose of clearing and dressing the slopes. As a result it is stated that rock slides have been comparatively infrequent.

A very exceptional piece of work on the West Shore R.R. in securing a loose 6,000-ton mass of rock in place by long 10-in. steel pins grouted in holes drilled through to solid rock, in order to protect an adjacent bridge, was described in *Engineering News* of Aug. 24, 1916, p. 358. Another case mentioned in the same issue was the building of concrete walls to support ledge rock left overhanging the Pennsylvania R. R. by the disintegration of an underlying stratum of clay. This was along the face of Mount Washington, opposite Pittsburgh. In recent years, concrete facing applied in ordinary ways or by means of cement gun has been applied to rock cuts to close seams and fissures and to prevent weathering. In rare cases concrete or masonry galleries have been built on European railways at points where rock falls are frequent.

### Tension Tests of Steel at High Temperature

High-temperature tension tests of various steels conducted in the laboratory of the Allis-Chalmers Co. and reported at the recent meeting of the American Society for Testing Materials showed a sharp drop in the tensile strength for most steels, especially when heat-treated, at or somewhat below 800 deg. F. Usually a maximum in strength occurred shortly before the drop; the author concluded that the maximum tensile strength of annealed rolled carbon steel and forged 3½ per cent nickel steel occurs between 600 and 650 deg. F. He found the larger percentages tended to lower the temperature at which tensile strength began to decline. A steel containing nickel was the only one in which the ductility materially diminished at the higher temperatures; but the same property was observed in one set of forged monel metal bars. Alloy steels containing chromium were less affected by temperature rise than carbon steels.

# Coaling Barge Combines Dragline Bucket and Conveyor

## Simple Coal Handling Unit at Galveston Requires No Shipboard Equipment—Designed for Flexible Operation

A COALING BARGE combining a dragline bucket and a belt conveyor in a simple coal-handling unit of 1,000 tons capacity has recently been put in operation at Galveston, Tex. This barge carries the entire equipment for transferring coal to fuel bunkers of steamers, or to the cargo hatches when the steamer is carrying coal as cargo, without the necessity for shipboard equipment. It was designed primarily for flexibility of operation, which is performed by two men, an engine runner and a fireman. The barge itself, which carries a steel tower, has its own boiler and power equipment for driving, hoisting and dragline cables and for operating the belt conveyor and the crosshead carried on the steel tower.

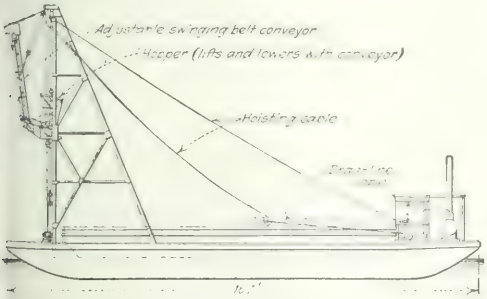



FIG. 1. SHIP COALING UNIT EMBODIES DRAGLINE AND CONVEYOR

An outline side elevation of the barge is shown in Fig. 1 and a photograph of the plant in operation is shown in Fig. 2. Coal is handled from the self-trimming barge (see Fig. 3) by a scoop bucket of 1½ tons capacity, controlled by the hoisting and dragline cables. Driving power is supplied by a 10 x 12 double cylinder engine in the stern of the barge, which has two drums set in friction by air cylinders. The front drum operates the dragline, which pulls the bucket lengthwise of the barge through the coal until it fills, by a line passing between sheaves at the front of the bucket and made fast to a shackle on the swinging bottom, as indicated in Fig. 4. Thus the bucket is closed fast while the strain is kept on the dragline until it is over the hopper, where it can be dumped by slacking off on the dragline cables. The rear drum operates the hoist line which runs over a sheave at the top of the steel frame at the bow of the barge, down through a block attached to the bucket, and thence back to the top of the framework, giving a two-part purchase for hoisting the loaded bucket. From the hopper, which is of five tons capacity, coal is fed into a Robins belt conveyor which delivers it to the steamer bunkers or cargo hatches.

The crosshead or frame, carrying with it the hopper and conveyor, is raised or lowered to any elevation, within operating limits as required by the height of vessel to be coaled. Two hoists located at the foot of the tower, operating independently, lower and raise the crosshead and the end of the belt conveyor to any

FIG. 2. BARGE IN OPERATION WITH AUXILIARY CHUTE FOR COALING WITHOUT SHIPBOARD EQUIPMENT
(A) hopper; (B) belt conveyor; (C) auxiliary chute; (D) crosshead frame carrying hopper and conveyor.

required height and angle. Both hoists are self-locking, holding the hopper and conveyor frames safely at whatever height or angle is required without the use of brakes or pawls. The five-ton hopper capacity gives a sufficient storage margin for operating contingencies of bucket and conveyor.

The conveyor with its supporting boom is 31 ft. long and is driven by a motor housed almost directly under the hopper and supplied with current from a 10 kw. turbine generator set in the engine house, which also supplies current for lighting. The conveyor works at any point between an upward angle of 20 deg. and a downward angle of 15 deg. and can be raised practically to a vertical position for housing while moving the barge. It swings through a horizontal angle of almost 180 deg.

Coal is delivered by the conveyor to a chute, leading to either bunker, cargo hatches or pockets. The chute

FIG. 3. DRAGLINE BUCKET DIGS OVER THE KEEL

is of light steel construction and readily shifted when desired. It is pointed out that this arrangement, adapted to the attachment of an auxiliary chute in almost any position at the end of the conveyor, results in a very flexible handling unit suitable for almost universal service in coaling operations. Another major advantage is claimed from the bucket always digging over the keel, thus avoiding listing from unbalanced load in the barge.

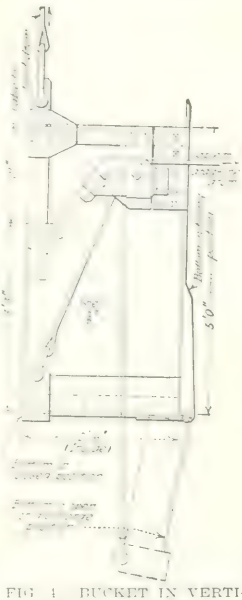


FIG. 4. BUCKET IN VERTICAL, OPEN AND CLOSED POSITIONS

In operation, the barge is loaded at the coal storage yard of the coal company by means of a Lidgerwood coal transfer. The barge is then placed alongside a ship, and the hopper, with conveyor, raised to the required height to clear the ship's sides. The conveyor is next swung so that the chute will reach the hatches amidship or on either side of the ship or side pockets. The bucket takes the coal from the barge; discharges through the main and feeder hoppers on to the conveyor, which carries and drops the coal through a chute directly into hatches or side pockets. This is done without any hopper or apparatus on the deck of the ship, and without the necessity of transferring coal or receiving hoppers on shipboard. With this device, the operation of coaling goes on without interference with handling ship's cargo, and without the use of any ship's gear.

The handling capacity of the barge is limited rather by the receiving capacity of the steamer than the capacity of handling machinery. An average of 100 to 110 tons of coal per hour is about the maximum that can be received, stowed and trimmed. About 60 tons of coal per hour is the average stowed and trimmed in the bunkers.

The barge is operated by the Galveston Coal Co. under the supervision of Wesley Merritt of that firm. It was designed and built under the Evans and other patents by the Lidgerwood Manufacturing Co., New York City, owners or licensees of such patents.

### Revised Road Regulations in Britain

The committee appointed to investigate British motor speed conditions will shortly present its report to the Minister of Transport. The recommendations of this committee are based not only on the general convenience of road users but also on the preservation of the road surfaces to which all users are, in some form or other, compelled to subscribe. It is likely that all steel-tired vehicles will continue to be restricted to 5 miles per hour, motor coaches, omnibuses and chars-a-bancs to 16 miles per hour and other vehicles, not over a certain weight, and shod with pneumatic tires will be restricted to 24 miles per hour.

## Progress On Pit River Project In California

### First Plants Completed—Large Units and High Voltage—Construction Program Laid Out for Next Ten Years

DESPITE unfavorable weather conditions during the winter of 1920-21, construction on the several plants of the Pit River hydro-electric project in Northern California was carried on without interruption and the first plant in the series, Hat Creek, No. 1 was completed and put in service Aug. 22. Work has also been under way simultaneously on two more plants, Hat Creek No. 2 and Pit River No. 1. The former was to be ready early in September and the latter by June of next year. Plants lower down the river, Pit River No. 2, 3 and 4, are being given further study, such as borings at dam sites, comparisons in cost of length of conduits and height of dams, etc., and will probably be constructed in their numerical order.

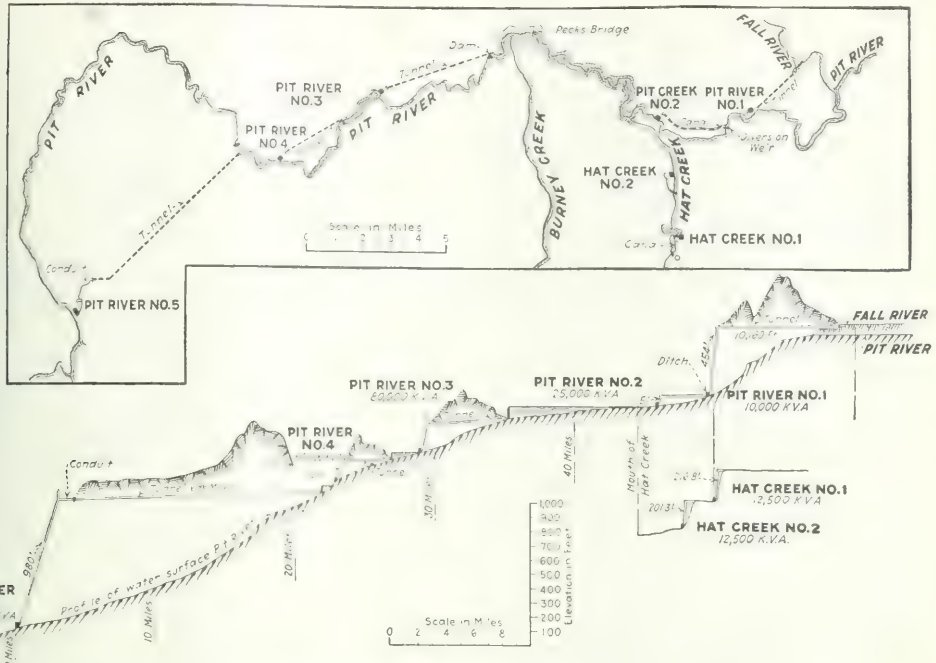
The complete series of plants contemplated on this stream is expected to add about 600,000 hp. (installed capacity) to the company's system. This amount of energy is estimated to be enough to take care of the company's load-demand increases for a period of 10 years or more. The development program is being laid out so construction will be continuously under way during this period, the plants to be completed and put in service as needed. A résumé of plans for the Pit River development appeared in *Engineering News-Record* Sept. 16, 1920, p. 575, but the plants mentioned there as Fall River No. 1 and 2 are now known as Pit River 1 and 2. Numbers on the other Pit River plants have also been changed.

Features of this development will be the 220,000-volt transmission line, the 7-mile, 3,000-sec.-ft. tunnel on Pit River No. 5 and the 40,000-hp. reaction turbines under 454 ft. head in Pit River No. 1. The relative position of the plants is such that only about 21 miles of conduit were required for serving all seven plants. The flow of the Pit River is so uniform, that no storage has been provided for any of the plants thus far built and only very low diversion dams are required. In this respect the stream is unlike other California rivers.

#### 33 Miles of Railroad Built

Studies of truck versus rail transportation brought out the fact that due to rain and snow conditions trucking operations could be carried on in the districts between these plants and the Southern Pacific R.R., for only about five months of the year, while a railroad line could probably be kept open all year round. Rail transportation was believed to be cheaper and to assure a more dependable schedule of delivery. The question of where to locate the railroad was affected to a considerable extent by the time element. The value of the power developed in Pit River No. 1 plant for 80 days, for example, will amount to half a million dollars. Hence it was important to find a railroad route which would not delay the construction of so important a plant.

The most direct route to the Pit plants would be from some point on the Southern Pacific south of the Dunsmuir-Sisson grade in the vicinity of Redding, but this would have required some 70 miles of construction through rough country. The route selected is above the Dunsmuir-Sisson grade and does not




PLAN AND PROFILE OF PRESENT AND PROJECTED WORK IN PIT RIVER BASIN

connect with the Southern Pacific direct but starts from the end of the McCloud River Railroad at Bartle. From this point, however, it was found possible to locate a line to Pit River No. 1 power house which is only 33 miles long and has a maximum gradient of 4 per cent and a maximum curvature of 15 deg.

Surveys on this line were begun early this spring when there was still 10 ft. of snow over some parts of the route. Grading was started May 20. Track had been laid 13 miles from Bartle by Aug. 15 and the entire line was to be ready for service Sept. 15, about 115 days after construction began. No tunnels or large bridges were required and the yardage moved averaged about 3000 cu. yd. per mile, making the cost of the line about $16,000 per mile. The line is standard gage and has 50-lb. rails.

Pending the completion of the railroad, trucks were used to take in supplies over the wagon road from Bartle. Most of the supplies for last winter's use were taken in in the fall while the roads were still passable and stored at the several camp sites. Emergency supplies were taken in during the winter on sleighs. The penstock for Hat Creek No. 1 and No. 2, for example, all went in during the winter, the usual requirement being 12 horses per sled. These penstock sections are 33 ft. long, 9 to 10 ft. in diameter, and weigh 8½ tons.

### One Thousand Nine Hundred Men in Camps

About 1,500 men are now employed in the camp of the Pit River Basin working on tunnels, railroads, power houses and other phases of the development; and about 400 men are engaged in constructing the 220,000-volt transmission line. This line is now being built from Pit River No. 1 to Vacaville, a distribution center 205 miles from the Pit River plant and about 60 miles from San Francisco Bay. The line is to be finished by July 1, 1922, as is also a $1,250,000 substation at Vacaville.

DETAILS OF FIRST THREE PLANTS, PIT RIVER PROJECT

| | Hat Creek, No. 1 | Hat Creek, No. 2 | Pit River, No. 1 | |
|---|---|---|---|---|
| Static head, ft | 216 8 | 201 3 | 454 0 | |
| Normal flow, sec.-ft | 400 | 600 | 1,400 | |
| Normal output, hp. | 7,900 | 10,200 | 60,500 | |
| Diversion: | | | | |
| Type of dam | Crib | Crib and piling | Radial gates | |
| Height of dam | 5' | 6 5' | About 15' | |
| Conduit: | | | | |
| Type | Open ditch | Flume | Canal | Tunnel |
| Length, ft | 2,750 | 4,469 | 1,150 | 10,111 |
| Size | 17' bottom 9' depth | 16' 3" bottom 7' 0" depth | 50' bottom | Horseshoe 13.5' high |
| Grade ft. per 1,000 | 0 25 | 0.7 | | 3 0 |
| Max. cap'y, sec.-ft. | 600 | 800 | 1,800 | |
| Surge chamber | None | None | Yes | |
| Forebay capacity, cu ft | 12 5 | None | | |
| Penstock: | | | | |
| Type | Single pipe Riv. steel | Single pipe Riv. steel | Double pipe Riveted | Welded |
| Length, ft | 1567 | 355 | 448 | 952 |
| Dia., thickness | 10'x ⅜" - 8'x½" | 10'x¼" - 8'x⅜" | 10'9"x ⅞" - 9'9"x ¾" | 9'0"x ⅝" - 8'0"x ½" |
| Number units | 1 | 1 | 2 | |
| Type wheel | Vert. turbine | Vert. turbine | Vert. turbine | |
| Mfg. by | Wellman-Seaver-Morgan | Wellman-Seaver-Morgan | Allis-Chalmers | |
| Capy., hp. | 15,000 | 15,000 | 40,000 | |
| Generator mfgs. | G.E.Co. | G.E.Co. | Allis-Chalmers | |
| Capy., kva. | 12,500 | 12,500 | 35,000 | |
| R.p.m. | 225 | 225 | 257 | |
| Voltage | 6,600 | 6,600 | 11,000 | |
| Exciter type | Sep. impulse-wheel | Sep. impulse-wheel | Direct conn. | |

Up to the middle of August headquarters for construction operations was at Hat Creek No. 1, but with the completion of the two plants in that vicinity headquarters was moved to Pit River No. 1 about 10 miles northeast of the Hat Creek work. On Aug. 15 about

50 per cent of the 100,000 cu. yd. excavation in the approach-cut on Pit River No. 1 tunnel had been completed. About 25 per cent of the 100,000 cu.yd. excavation in Pit River No. 1 power house and tailrace also had been finished. The tunnel for the Pit River No. 1 plant is to be 10,111 ft. long and is being driven by the heading-bench method working from two headings. On this tunnel 5,911 ft. had been completed on Aug. 10 and the remainder was scheduled for completion by Feb. 1, 1922. The diameter of this tunnel is 14 ft. and it will be entirely lined with concrete. Where the formation traversed is poor, the section will be circular and reinforcing will be used. Otherwise, an unreinforced horseshoe section is specified.

Power for construction purposes was developed in a temporary plan near the junction of Fall and Pit Rivers, about 10 miles from Hat Creek No. 1 and 3 miles from Pit River No. 1. Here the head and flow available were suited to an old 1,000-hp. unit which the company had in a generating station at Folsom. This unit was accordingly "loaned" to the Pit River project until the first plants there should be in service.

The Pit River project is being carried out by the Pacific Gas & Electric Co., of San Francisco. O. W Peterson construction engineer for the company is in charge of work on the Pit River projects. E. H. Steele is engineer in charge of line construction.

## Putting Large Bascule in Service

### Program for Change to New Structure Involves Minimum Stoppage of Street and Elevated Railway Traffic

RAPID replacement of an old 220-ft. double-deck swing span by a double-leaf double-deck bascule span, 268 ft. c. to c. of trunnions, is planned for the Wells St. crossing of the Chicago River. The new structure, now nearly completed, will be the third double-deck bascule bridge built across the river by the city of Chicago, and will be the second carrying an elevated railway on the upper deck. For similar replacement at the Lake St. bridge in 1916, traffic on the street deck was diverted during the construction period, and that of the elevated railway was interrupted for six days (see *Engineering News*, April 20, 1916, p. 756). In view of the inconvenience to the public during the Lake St. work and in view also of the greater importance of Wells St. as a traffic thoroughfare, the work was so planned by T. G. Pihlfeldt, engineer of bridges, that both decks of the bridge have been kept open throughout the entire construction period and it is proposed to interrupt the elevated railway traffic for only 48 hours while putting the new span into service. The present condition of the work is shown in the accompanying view.

In order to maintain traffic on the street or lower deck during construction, it was necessary to provide temporary supports for the roadway and sidewalks on the approaches to the old bridge to permit of building the new substructure. For this purpose steel girders and trusses were provided and the floor loads were carried by them to pile clusters outside of the limits of the new work. The construction of the greater part of the cofferdams could then be accomplished without disturbing the old bridge. During the remodeling of the lower deck on the fixed part, the street was closed to vehicular traffic only, one roadway at a time, with but slight inconvenience to the public.

For driving those portions of the cofferdams directly under the swing bridge, traffic was stopped between 1 and 4:45 a.m. for about two weeks for each cofferdam, the span being swung to the open position during that time. The completion of the cofferdam was followed by the excavation and concreting of the counterweight pits and sub-piers. In this work the north pier was begun first and its sub-piers were completed in 1918. The main piers and counterweight pit were finished in April, 1919, and the north abutment in May, 1919. The permanent longitudinal and cross-girders for supporting the new bridge superstructure were then placed and the entire north substructure work was completed in July, 1919. Excavation for the south substructure was begun in December, 1919, and the permanent new steel girders were placed in October, 1920.

To avoid interference with traffic during erection of the bridge superstructure, with the leaves in the open or upright position, it was necessary to omit a part of the upper and lower deck floor beams, stringers and bracing, so that vehicles and elevated-railway trains could pass through the structure. When the work on the superstructure has progressed as far as possible in the raised position, it will be necessary to stop all traffic long enough to swing the old bridge to its open position, block it up on the pier protection and remove the portion over the center pier by burning or cutting the members, to afford clearance for lowering the new bridge. While this is being done, the steel floor system and bracing of the new bridge can be completed and tracks installed on the upper deck.

NEW AND OLD DOUBLE-DECK BRIDGES OVER CHICAGO RIVER AT WELLS ST

To minimize the interruption to elevated railway and

street traffic a program was laid out covering the different steps. The first step was to close the lower deck to traffic, on Sept. 28, and it is planned to have the lower deck approaches completed by Nov. 9. Alterations to the elevated structure on the approaches will necessitate discontinuing the railway traffic temporarily, but this work can be performed on three successive Sundays, Nov. 6, 13, and 20. The leaves of the new bridge should be ready to lower to a horizontal position six days later, or on Saturday, Nov. 26. During the lowering and adjusting of the leaves, elevated traffic over the bridge will be discontinued for a period of only about 48 hours, and the new bridge should be available for use by trains on Monday morning, Nov. 28. When the leaves have been lowered, work on the lower-deck roadway of the bridge proper can be started. Final completion of the bridge and approaches should be effected by Dec. 27. Pedestrian traffic will be maintained with the least possible interruption during the period that the bridge and approaches are closed to vehicle traffic. Dredging and clearing of the channel will be done between Dec. 5 and Feb. 4.

### Specifications of New Bascule

The new bridge is of the trunnion bascule type, with a span of 268 ft. c. to c. of trunnions, giving a clear channel 200 ft. wide. It has two lines of trusses spaced 41 ft. c. to c., the lower deck having a 38-ft. roadway and two 13-ft. walks (outside). On the upper deck are two tracks for the elevated railway. The total weight of each leaf complete will be about 2,460 tons, including 1,300 tons of counterweight. The deck arrangements are similar to those of the Lake St. bridge. In the Michigan Ave. bridge (*Engineering News-Record*, Sept. 9, 1920, p. 508) there are four trusses with two roadways and inside walks on the lower deck, and two wider roadways and outside walks on the upper deck. The old Wells St. swing bridge, with a length of 220 ft., was built in 1888 as a street bridge, being reinforced in 1896 to permit of carrying the elevated railway.

This important bridge was designed in the bureau of engineering of the Chicago department of public works, under the direction of Alex. Murdoch, city engineer; Charles F. Healey, assistant city engineer; Thos. G. Pihlfeldt, engineer of bridges. The construction work is under Clarence S. Rowe, engineer of bridge construction, and F. A. Berry, engineer in local charge. The principal contractors were the FitzSimons & Connell Dredge & Dock Co., substructure; Ketler-Elliot Co., superstructure and operators' houses, the steel being fabricated by the Fort Pitt Bridge Co. under sub-contract; Norwood-Noonan Co., electrical equipment. The bridge is built under license from the Strauss Bascule Bridge Co. as it embodies features patented by that concern.

---

**House Fly Journeys Five to Six Miles a Day**

Experiments conducted by the Bureau of Entomology, U. S. Department of Agriculture, show that the house fly journeys 5 to 6 miles in 24 hours and in one observed instance traveled 13.14 miles in that time. This and other species of flies, totaling 234,000 of all kinds, were dusted with red chalk in Texas, liberated, and recaptured in traps placed at various distances.

# Texas County Tries Lump-Sum-Fee Road Contract

## Straight Contract Prices Cut 40 per Cent—Actual Cost Runs Under Price Bid—Excellent Average Speed Maintained

HIGH prices bid in 1920 on 45 miles of concrete road, a portion of a 110-mile system planned for Wichita County, Texas, resulted in a contract being made by which the contractor receives a lump-sum fee based on a cost estimate prepared by himself. The county purchases the materials and assumes all risks, but the equipment is purchased and paid for by the contractor. With 7 miles of road completed in 1920 and 27 miles more under construction this year, the special contract is considered a success. The plant is high class, the cost is materially less than the original prices bid, and the speed of construction has been greater than the average for similar operations.

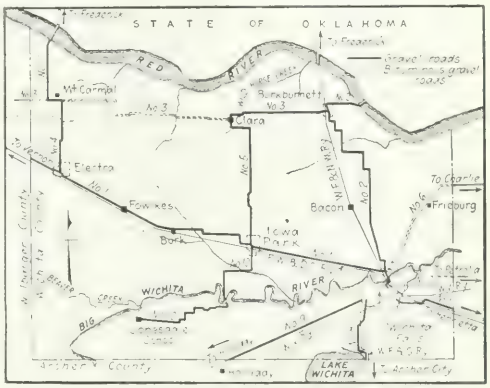



FIG. 1. MAP OF IMPROVED ROAD SYSTEM FOR WICHITA COUNTY, TEXAS

Paved roads were required by the oil-field development. A bond issue of $2,250,000 was voted and 45 miles of concrete road were planned for immediate construction. Commercial production of concrete aggregates had not been developed, so the first act of the county was to assist financially in establishing a stone-crushing plant costing $300,000. The county advanced $100,000 on a stone contract.

Bids for construction were received in January, 1920. There was one bid and it averaged $80,000 a mile. It was rejected and new bids were asked. This time the county itself put in a bid of $50,000 a mile and another bid was received from the contractor who had previously bid, but his price had been cut to $60,000 a mile. The county commissioners' court awarded the contract to the county.

In explanation of the high prices it is to be noted that the time was early in 1920 during the peak of the oil boom in Wichita County. There was a serious railroad congestion, an acute labor shortage and a heavy constant traffic to be handled by diversion from the roads under construction.

Being without equipment or organization for construction, the county engineer decided to sublet the contract. General contractors were asked to submit

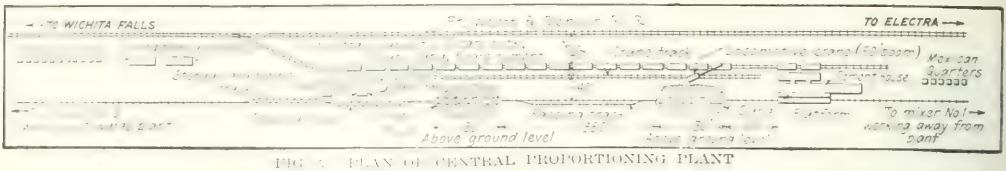



FIG. 2. PLAN OF CENTRAL PROPORTIONING PLANT

bids on their own basis, with the understanding that price alone would not be regarded a reason for giving the contract but ability and reputation would be given careful consideration. A number of proposals were received, the majority being some form of cost-plus-percentage contract. All cost-plus-percentage propositions were eliminated at once as undesirable. Of the other proposals, one by Potts & Prentice, Waco, Tex., general contractors, was considered most favorably.

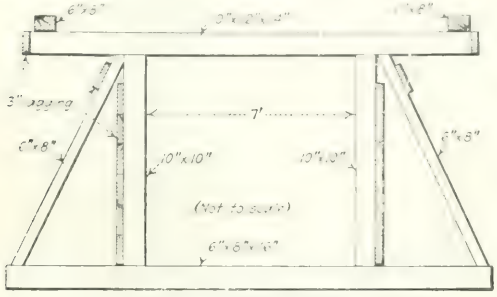



FIG. 3. BENT FOR ABOVE-GROUND TUNNEL

After careful analysis of the conditions, Potts & Prentice prepared a detailed estimate of what it would cost to do the work without bond, the county assuming all risks. On the basis of this estimate which amounted to approximately $45,000 a mile, including a lump-sum fee, the contractors agreed to undertake the work. The essential provisions of the contract were:

1. The contractors agreed to complete 44.4 miles of concrete road at an estimated cost, based upon unit prices and estimated quantities.

2. The contractors were to furnish the construction plant, which would include designated equipment of a character and quality which would insure proper construction and the completion of the project within an estimated time.

3. For the use of the equipment, the contractors were to be paid a designated rental and depreciation within the time estimated for completion. The contractors were also to be paid a portion of their lump-sum fee on monthly estimates.

This form of contract has justified itself. The county was able to begin construction at the height of the local oil boom when contractors would not assume the risks arising from the congestion of railroad traffic, uncertain materials supply and shortage of labor. The county was also able to select a contractor upon considerations not limited entirely to unit prices; it could take into account his experience, integrity and ability satisfactorily to complete the project in the estimated time. With the stabilizing of local conditions and the general decrease of material and labor costs, the savings thus accomplished have returned directly to the county.

Road improvement as planned for Wichita County, as indicated by Fig. 1, includes the 45 miles of concrete road originally contracted, and some 65 miles of concrete road yet to be constructed. The high type of pavement for the main highway was felt to be warranted by the traffic. This traffic, Wichita County being the center of the largest oil producing section of the southwest, consists largely of motor trucks hauling casing and other heavy supplies for the oil wells. A substantial section was, therefore, adopted. All the pavement is 18 ft. wide. The slabs are built in two thicknesses, 7 in. at the side and 8½ in. at the center, and 6 in. at the sides and 7½ in. at the center, depending upon the location as related to traffic and upon the condition of the subgrade. The pavement is reinforced with steel fabric weighing 28 lb. per square (100 sq.ft.) over all poor subgrade. The concrete is a 1:2:3 crushed stone mix.

With 45 miles of construction, the contractors installed a $142,000 plant, providing for central proportioning and industrial railway haulage. It consists of one standard-gage locomotive crane with a 50-ft. boom and a clamshell bucket; five trains each consisting of a 6-ton gasoline locomotive and 10 cars, each car carrying two batch boxes containing cement, sand and stone compartments; one extra locomotive for emergency purposes; four double-truck platform cars for transporting track, forms, water pipe, reinforcing mesh, tools, fuel and all miscellaneous hauling; 6½ miles of 24-in. gage, 20-lb. rail, steel tie track with slip joint ties and a full assortment of curves and switches; two number 14-E paving mixers with boom and bucket and batch transfer; two finishing machines; two subgraders; two scarifiers; two 10-ton gasoline road rollers; enough steel side forms for three days' run at each mixer; two double-unit gasoline driven pumps each with a capacity of 3,600 gal. per hour.

In 1920 owing to delays in securing materials by railway, and time consumed in installing the plant, concrete laying was not begun until October. The Wichita Falls-Lake road, 5 miles long, was completed about the end of December. Then the plant was installed on the Wichita Falls-Iowa Park-Electra road about 27½ miles long, now under construction. The plant arrangement and construction methods described refer to the present year's work.

In general, the plan is to build 10 miles from one location of the proportioning plant and then move the plant into the middle of the next 10-mile section. Fig. 2 is the plant arrangement at the first setup for 1921. Two paving outfits are operated, one working from and one working toward the plant so as to maintain a balanced haul. Track is taken up back of the paver working toward the plant and carried forward and laid in front of the paver working away from the plant As indicated, the stone and sand, unloaded from railway cars by a locomotive crane, are piled over above-ground tunnels 130 ft. long. The sketch, Fig. 3, indicates the tunnel construction with bents spaced 4 ft. apart. In the

top are tunnel traps for charging the batch boxes. Cement is charged from the platform of the cement house by means of the sliding hoppers shown by Fig. 5. The cement house of two 16 x 80 ft., and one 16 x 160-ft. section, holds 6,000 barrels. About 2,400 cu.yd. of aggregates can be stored over each tunnel.

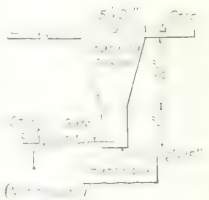


FIG. 4. DIAGRAM OF CHARGING HOPPER

All structures of the proportioning plant are built of sections erected by bolting so that they are knocked down and set up again without much labor or damage.

It requires five men about 12 min. to load a ten-car train (20 batches) with sand, stone and cement. The average loading time for a week, including time for replenishing gas and oil, was 17 min. and the minimum was 7 min. At the cement house the individual charging hoppers designed to reduce the time of the train in loading are a feature. They are 15 x 21 in. at the top and 6 x 15 in. at the bottom, and are about 35 in. high. The bottoms are closed by slide gates. Each hopper holds a batch and is pulled up close to the platform when being filled. When the train is in position for loading the hopper is pushed out over it as shown in Fig. 5. As the hopper is pushed out, the gate is pulled open by the cord as indicated by Fig. 4, and when the hopper is pulled back to be refilled, the gate strikes a stop and is closed. In 1½ min. six men load 70 bags of cement into a 20-batch train using 20 hoppers, which they have previously filled. The wooden hoppers illustrated have been difficult to keep tight as they weather, and it is proposed to make others of sheet iron.

Ten cars make up the average train which is pulled by a 6-ton gasoline locomotive. Each car carries two batch boxes of 25 cu.ft. capacity. Six locomotives, 52 cars and 104 boxes were purchased but only 50 cars and 5 locomotives are used to haul material, the remainder being employed in hauling forms and for replacements and moving track.

To minimize delays, switches 150 ft. long were placed approximately one mile apart, while a passing track 150 ft. long is maintained about 450 ft. in advance of each paver. The five trains are apportioned to the mixers according to the distance each mixer is from the central plant. For a ½-mile stretch, where the haul is nearly equal, one extra train alternates first to one mixer and then to the other. Train speed is about eight miles per hour empty and six miles loaded. Only one derailment has taken place on straight track. The track is laid on the shoulder of the road outside of the forms. The first laying cost $65 per mile. A foreman with four men will take up and relay one-half mile of track per day. Track maintenance requires continuously one foreman and four to six men. The locomotives burn approximately 15 gal. of gasoline per day, making six average trips of 4½ miles. The cost for labor and gasoline is 5c. to 6c. per ton-mile. Gasoline costs 18c. per gallon delivered.

The two concrete placing units are identical and include a ½ cu.yd. mixer, a subgrader, a scarifier, a 10-ton gas engine roller, a finishing and tamping machine, with belt, 900 road feet of side forms, ten canvas covers for the fresh concrete, and the necessary water lines.

The canvas covers are made in 12-ft. sections, each of which has 1 x 4-in. ribs, 20 ft. long, bowed with No. 9 wire ties, so as to make a 2-ft. rise in the center. The ends of the bows are nailed to a 2 x 6-in. longitudinal piece. A 1 x 4-in. strip spaces the bows apart at the center and helps support the six-ounce canvas.

Water was supplied first from the city mains through a 2-in. line. Later a refinery company accommodated the contractor from its water plant. Finally wells, 10 ft. square and 18 ft. deep at the material depot, were utilized. There are two double unit gas engine pumps, each pump of each unit furnishing 30 gal. per minute at 225 lb. pressure.

The gas engine on the road roller consumes 15 to 18 gal. of gasoline, steady running per eight-hour day. The 4-hp. engine on the tamper requires 5 gal. Ten 100-lb. sacks of coal are consumed by the mixer per day. The average cost of the labor per square yard of pav-

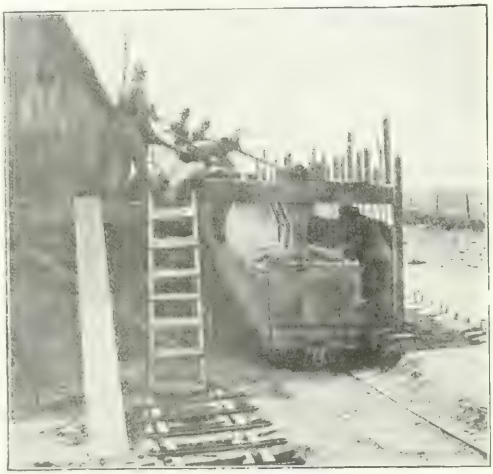


FIG. 5. CHARGING CARS WITH CEMENT BY SLIDING HOPPERS

ing including all unloading and loading of material, transportation, track maintenance, form setting, subgrading, mixing and placing of concrete, finishing and curing and repairs to equipment, has averaged 30c., but for a week's time was as low as 25½c. not including overhead, rental and depreciation. In 21½ working days in April, 38,676 sq.yd. were placed. A crew of 22 men operate the proportioning plant and each mixing crew consists of 21 men.

J. M. Isbell, Wichita Falls, Texas, is county engineer in charge of the work.

## Road Surfacing Costs in Manchester, England

The municipality of Manchester, England, has issued figures from its own experience showing the comparative costs and lives of various road surfacing materials:

| | Cost per Sq.Yd. | Life |
|---|---|---|
| | 38 6d. | 10 years |
| | 67 | 20 years |
| | 21 | 10 years |
| | 17s. 6d. | 10 years |
| | 12 6d. | 12 to 18 years |
| | 9 | 8 to 8 years |

These figures are for the thoroughfares carrying the heaviest traffic of all kinds.

# Aeration Period of Sludge in the Activated-Sludge Process

By Alva G. Husted
Assistant Sanitary Engineer, Department of Public Service, Cleveland, Ohio

During the past six years much experimental work has been done on the activated-sludge process of sewage treatment. The investigations which have been made range all the way from laboratory cultures of bacteria and other micro-organisms found in activated sludge and credited with much of the biological action in the treatment process to municipal treatment plants having capacities of more than 1 m.g.d. In spite of the study that has been given to the subject, there are still many features of the process concerning which little is known.

Among other subjects there is often discussed by those interested, the question of re-aeration of the activated sludge prior to its being returned to the sewage aeration compartment. Such re-aeration, when resorted to, is for the purpose of improving the quality of the sludge. In some cases this may be necessary to maintain the sludge in an aerobic condition while in other cases it may be considered desirable from the standpoint of increasing the number and activity of nitrifying bacteria in the sludge. In any event, if done at all it is because it is considered more economical to aerate the sludge separately than to give it the additional aeration in contact with the sewage in the sewage aeration tanks.

## Factors Affecting Aeration Period

At first thought it appears that from the standpoint of maintaining the sludge in a good condition the greatest economy could be effected by separate aeration of the sludge. If the aeration period of sludge particles were a function of the aeration period of the sewage only, this would very likely be true. However, the aeration period of sludge particles in the sewage aeration tanks depends on other factors. To discuss this matter intelligently it will be necessary first to determine the various factors which affect the aeration period of sludge particles and the relation which they sustain to each other.

To work out a mathematical formula to determine the aeration period of sludge particles it is necessary to make certain assumptions. For the sake of simplicity it is assumed: (1) That all suspended solids in the crude sewage remain in the tank (until withdrawn as sludge) in the form of sludge particles. (2) That all dissolved solids in the crude sewage remain in solution even though changed in character by the activated-sludge process. Neither assumption is exactly true, but they are no doubt near enough the truth for the purpose of making comparisons.

## Average Number of Sludge Aeration Cycles

If no sludge were returned to the inflowing sewage the aeration period of the sludge particles would be exactly equal to the aeration period of the sewage. By returning the sludge to the aeration tank inlet, however, the sludge particles are given additional aeration. The average number of cycles of aeration to which the sludge particles are subjected can be determined from the following equation:

$$N = A/S + 1 \quad \ldots\ldots\ldots\ldots (1)$$

In which $N$ is the average number of aeration cycles to which the sludge particles are subjected; $A$ is the quantity of suspended solids added to the sewage (by means of the returned sludge) expressed in parts of solids per million parts of sewage; and $S$ is the quantity of suspended solids in the sewage expressed in parts per million. $A/S$ is, therefore, the ratio of total suspended solids in the returned sludge to the total suspended solids in the sewage. The value of $A$ in the above equation depends upon two factors: the ratio to the sewage of the sludge returned, and the moisture content of the returned sludge. It may be computed from the following equation:

$$A = 100R(100 - M) \quad \ldots\ldots\ldots\ldots (2)$$

in which $R$ is the ratio of returned sludge to inflowing sewage expressed in per cent; and $M$ is the moisture content of the returned sludge expressed in per cent.

Combining equations (1) and (2) we have the following equations:

$$N = \frac{100R(100 - M)}{S} + 1 \quad \ldots\ldots\ldots\ldots (3)$$

From this equation we can determine the total number (average) of aeration cycles of the sludge particles if we know the quantity of suspended matter in the sewage, the ratio of sludge return to sewage, and the moisture content of the returned sludge.

The writer has worked out the accompanying diagram for the graphical solution of equation (3). The use of

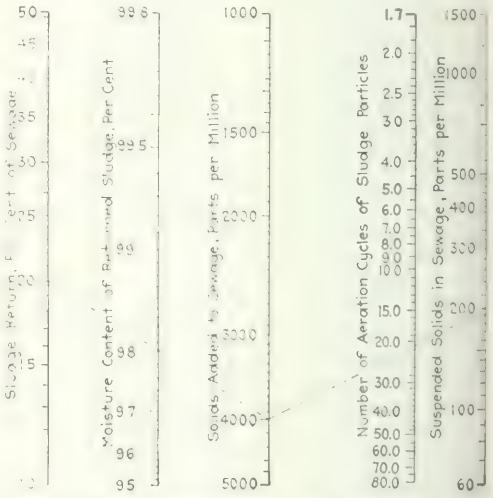

Sludge Returned, Per Cent of Sewage
Moisture Content of Returned Sludge, Per Cent
Solids Added to Sewage, Parts per Million
Number of Aeration Cycles of Sludge Particles
Suspended Solids in Sewage, Parts per Million

DIAGRAM FOR DETERMINING AVERAGE NUMBER OF AERATION CYCLES OF SLUDGE PARTICLES

Based on the formula, $N = \frac{100R(100 - M)}{S} + 1$

this chart is as follows: Through the values of $R$ and $M$ on the first and second scales draw a straight line intersecting the middle vertical scale of the chart. This gives the corresponding value of $A$. From this intersection draw a straight line to the value of $S$ on the fifth vertical scale. This line intersects the fourth vertical scale at the corresponding value of $N$. On the chart is shown with dotted line the solution of a problem having given sludge return of 20 per cent, moisture

content of sludge of 98 per cent, and suspended solids of sewage of 200 p.p.m. The number of aeration cycles is seen to be 21.

From the foregoing discussion it is seen that the aeration period of sludge particles is a function of the suspended matter content of the sewage, of the moisture content of the returned sludge, and of the percentage of returned sludge. The operator of a plant has absolutely no control over the suspended matter content of the sewage and very little control over the moisture content of the returned sludge. He has entire control, however, over the percentage of sludge to be returned. By knowing the sewage aeration period the operator can regulate the aeration period of the sludge particles to any predetermined amount. This can be done merely by controlling the percentage of sludge returns.

It is true that an increase in the percentage of sludge return reduces the volume of aeration tank effective for sewage aeration; but the decrease in aeration period of the sewage is very small compared with the increase in aeration period of sludge particles. Stating this another way, the additional aeration tank capacity required for increasing the aeration period of sludge particles with no change in the aeration period of sewage is relatively very small.

### Increased Aeration and Separate Re-Aeration

If the additional tank capacity required for increasing the aeration period of sludge particles computed in the above manner is compared with the additional tank capacity using separate re-aeration compartments it will be found that they are theoretically exactly equal. The former method is much more elastic in operation than the latter, however, and since any required aeration period of sludge particles can be obtained in a plant without separate sludge aeration tanks there does not seem to be any good reason for constructing activated-sludge plants with such sludge re-aeration tanks for improving the quality of the sludge prior to its being mixed with the inflowing sewage.

The foregoing statement is based on the assumption that the aeration of sludge particles in contact with sewage is as beneficial to the sludge as an equivalent period of aeration separately. I have no experimental data to support this contention but can see no reason why there should be any difference in the effect upon the sludge. On the other hand it does seem that from the standpoint of quality of effluent produced the advantage would probably be in favor of the larger percentage of returned sludge due to the greater number of nitrifying bacteria in contact with the sewage. The problem certainly merits serious consideration by anyone contemplating the installation of an activated-sludge plant, and particularly if there is present the opportunity for making practical tests beforehand in an experimental plant.

---

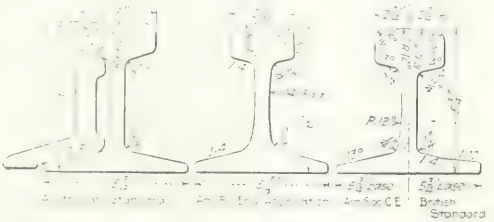
### Toronto Takes Over Street Railways

The street railways of Toronto were taken over by the city on Sept. 1 and are being operated by the Toronto Transportation Commission. The price to be paid the former private owners will be determined by arbitration. Extensive track and equipment improvements are proposed.

# Australian Standard Rail Sections and Specifications

## Approved by Engineers, Manufacturers and State Governments—Sections Not in Accord With American Designs

THE adoption of standard rail sections and rail specifications for all the railways of the Commonwealth of Australia by the railway engineers and commissioners of the several states and by the steel manufacturers constitutes an important step in the railway and industrial development of Australia. These new standards now apply to the continental states of New South Wales, Victoria, South Australia, Queensland and Western Australia, and to the two island states of Tasmania and New Zealand, in all of which the railways are owned and operated by the governments under the direction of railway commissioners. The type of rail




COMPARISON OF AUSTRALIAN, AMERICAN AND BRITISH 100-LB. RAILS

section is at variance with American principles of rail design. The following brief history of this development is from a pamphlet issued by the Institute of Science and Industry (Commonwealth of Australia.)

Sections of rails and splice bars were decided upon at an interstate conference of railway engineers held in Melbourne in July, 1914. Drawings and specifications were approved in 1915, but owing to war conditions the approval of the railway commissioners was not obtained. In 1919 a conference, at which both the state railway engineers and the steel manufacturers were represented, was called by the Institute of Science and Industry, which was interested in railway standardization and in making Australia self-supporting as to steel products. Rail sections and specifications were adopted at a fourth engineering conference in 1920. The specifications were considered later at an interstate meeting of railway commissioners, but amendments then suggested were not acceptable to the manufacturers. An agreement was reached, however, and the specifications were approved at a conference of railway engineers and steel manufacturers, held at Sydney in April, 1921. Finally, these specifications were approved at a conference of railway commissioners.

### Rail Sections

Five standard sections have been adopted, from 60 to 100 lb. per yd. A broad shallow head with round corners, a tall thin web and an exceptionally shallow base are typical features of the design. Cracks due to a thin base have been an unfavorable experience with the sections of the American Society of Civil Engineers, but the Australian sections have an even thinner base

An unusual feature is that different fishing angles are used for the top and bottom fishing surfaces. The very marked difference between the Australian and American Railway Engineering Association section is shown in Fig. 1, which gives also the Am. Soc. C. E. and British standard sections. A comparison of these four types of rail sections is given also in Table I.

TABLE I. COMPARISON OF 100-LB. RAIL SECTIONS

| | Australian Standard | American — A.R.E.A. | A.S.C.E. | British Standard |
|---|---|---|---|---|
| Height, in | 6 | 6 | 5⅞ | 5⅞ |
| Width of base, in. | 5½ | 5½ | 5⅞ | 5⅞ |
| Width of head, in | 3 | 2 11/16 | 2⅞ | 2⅞ |
| Side of head: slope | Vert. | 1 to 16 | Vert. | Vert. |
| Depth of head, in | 1 | 1 41/64 | 1 45/64 | 1 13/32 |
| Depth of web, in. | 3 1/16 | 3 13/32 | 3 49/64 | 3 |
| Depth of base, in | ⅞ | 1 1/32 | 63/64 | 63/64 |
| Web thickness, in | 7/16 | 7/16 | 7/16 | 7/16 |
| Radius of head, in | 12 | 14 | 12 | 12 |
| Radius: top corners, in | 3/16 | 3/16 | 3/16 | 3/16 |
| Radius: bott. corners, in | 1/16 | 1/16 | 1/16 | 1/16 |
| Radius: top fillets, in | 1 | 1 | 1 | 1 |
| Radius: bott. fillets, in | 1 | 1 | 1 | 1 |
| Radius: top edge base, in | 1/16 | 1/16 | 1/16 | 0 |
| Radius: bott. edge base, in | 1/16 | 1/16 | 1/16 | Sharp |
| Radius: sides of web, in | Vert. | 14 | 12 | Vert. |
| Fishing angles: top | 1:3 | 1:4 | 1:3 | 1:4 |
| Fishing angles: bottom | 1:5 | 1:4 | 1:3 | 1:4 + 1:10 |
| Metal in head, per cent | .... | 38.2 | 42 | 45 |
| Metal in web, per cent | | 22.6 | 21 | 19 |
| Metal in base, per cent | | 39.2 | 37 | 36 |

Four grades of steel are included in the Australian specifications: Ordinary basic open hearth and acid bessemer steel and high-silicon basic open hearth and acid bessemer steel, the last two being made by the process of the late C. P. Sandberg. From the chemical compositions as given in Table II it will be noted that for ordinary steel the carbon content varies with the weight, while for the high-silicon steel it is uniform.

TABLE II. COMPARISON OF CHEMICAL COMPOSITION OF RAILS

| | Carbon, per cent | Manganese, per cent | Silicon, per cent | Phosphorus, per cent Max. | Sulphur, per cent Max. |
|---|---|---|---|---|---|
| 1 *Australian* | | | | | |
| O-H, 60-lb | 0 46–0 52 | | | 0 04 | 0 07 |
| O-H, 100-lb | 0 62–0 75 | 0 6–0 9 | 0 10 min. | 0 04 | 0 07 |
| Bess., 60-lb | 0 42–0 52 | 0 6–0 9 | 0 10 min. | 0 07 | 0 07 |
| Bess., 100 lb | 0 60–0 70 | | | | |
| O-H., high-sil | 0 50–0 65 | 1 0 max. | 0 2–0 4 | 0 06 | 0 06 |
| Bess., high-sil | 0 40–0 55 | 0 7–1 0 | 0 3–0 5 | 0 07 | 0 07 |
| 2 *Am. Ry. Eng.* | | | | | |
| O-H., 85 to 110-lb. | 0.45–0.55 | 0 8–1 1 | 0 1 min. | 0 10 | Not over 0.07 |
| Bess., 85 and over | 0.62–0.77 | 0 6–0 9 | 0 1 min. | 0 04 | Not over 0.07 |
| 3 *British* | 0 35–0 50 | 0 7–1 0 | 0 1 max. | 0 07 | 0 07 |

For the ordinary steel, a minimum silicon content is specified, instead of the usual maximum content. It is provided that the carbon may be increased 0.02 per cent above the limits specified, on condition that for each 0.01 per cent increase in carbon the phosphorus will be reduced 0.005 per cent below the specified limit. Further, it is desired that the carbon percentage shall average as high as the mean percentage between the upper and lower limits specified. A summary of the specifications is given below.

Ingots are to be kept in vertical position until ready to be rolled or until the metal in the interior has had time to solidify. Sufficient material must be discarded from the top of the ingot to insure sound rails. In section, a variation of $\frac{1}{64}$-in. less or $\frac{1}{32}$-in. greater than the specified height and $\frac{1}{32}$-in. in width of base will be permitted, but no variation will be permitted in the inclination of the fishing surfaces.

Cold straightening must be minimized and rails will be liable to rejection if the gag leaves its impression on the head or base. Rails must be straightened at such a temperature as will permit of their being handled with bare hands. In the straightening presses, the distance between supports must not be less than 36 in., except when it is necessary to straighten the rail within 36 in. of the end. In rolling, a variation from 0.5 per cent under to 1 per cent over the calculated weight will be permitted; but only this latter weight will be paid for. The calculated weights per yard of the normal sections, without bolt holes, are 60.22 lb., 70.14 lb., 80.30 lb., 90.38 lb. and 100.48 lb.

*Rail Tests*—From each ingot a piece of rail not less than 4 ft. or more than 5 ft. long shall be cut from the first portion of the rail. This will be placed head uppermost upon supports 3½ ft. apart, the upper surfaces of the supports being curved to a 3-in. radius. The test will comprise one blow delivered midway between the supports by an iron block weighing 2,240 lb. and having its face curved to 3-in. radius. The height of drop to be 17, 19, 20, 21½ and 22½ ft. for the five sections of 60 to 100 lb. respectively.

If the test piece fails, the first rail will be rejected and an additional test made on a piece cut from the last rolled portion of the first rail. If this piece fulfills the requirements the remaining rails from the ingot will be accepted. Should the second piece fail, another piece cut from the last rolled portion of the second rail shall be tested, and so on until each rail of the ingot has been tested. The temperature of the test pieces is to be between 60 and 100 deg. F. When the impact test indicates, in the opinion of the inspecting engineer, that the rails are too soft or too hard, he shall inform the contractor, who will direct such variation in the chemical composition, within the prescribed limits, as will improve the steel so as to obtain the desired results.

For tensile test, from any selected rail cut a test piece from as near the top of the head as possible. This will be machined parallel for a length of 2¼ in. with a length of 2 in. between gage points, and turned to a diameter of 0.564 in. This will be tested to destruction and the results recorded. [No tensile strength is specified.—EDITOR.]

Six-bolt joints are used, with angle splice bars (see drawing) having a uniform length of 30 in. and a bolt spacing of 5 in., with 1-in. bolts for 100- and 90-lb. rails, $\frac{7}{8}$-in. for 80 lb. and $\frac{3}{4}$-in. for the others. For 1-in. bolts, the bolt holes are 1⅛ x 1⅛ in. for the splice bars and 1⅛ in. in diameter for the rails. All the bars are slotted for spikes, but they are kept clear of any bearing on the ties, as shown. The calculated weights per pair of splice bars are from 59.75 lb. for the 60-lb. rail to 96.90 lb. for the 100-lb. rails.

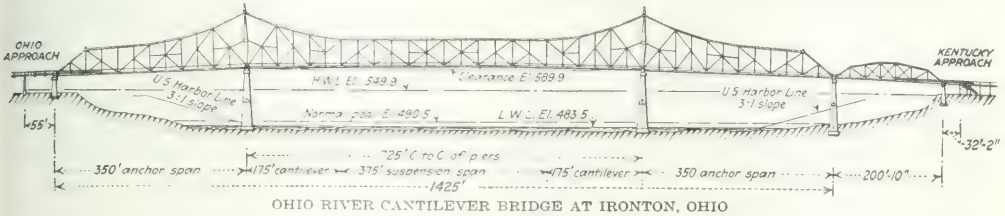
Splice bars are to be made from basic open hearth or acid bessemer steel: Carbon, 0.40 to 0.53 per cent for the former and 0.35 to 0.45 for the latter; phosphorus not to exceed 0.04 and 0.07 per cent respectively. For both kinds of steel the manganese is to be 0.55 to 0.85 per cent; silicon not less than 0.05, and sulphur not exceeding 0.70. Carbon may be increased in proportion to decrease of phosphorus, as already noted in the rail specifications. Test pieces 0.564 in. in diameter and 2¼ in. long, with a gage length of 2 in., must show an ultimate tensile strength of 80,000 to 107,000 lb. per square inch, with an elongation of not less than 15 per cent.

## Track Tanks for Railway Water Supply

Although the extensive use of track tanks on English railways is commonly considered as a means of increasing the length of non-stop runs, other purposes of equal or greater importance are noted by the *Railway Gazette*, London. Thus, the track tank permits of relatively small tenders, with a reduction in weight of train. It may also enable heavy freight trains to avoid stops for water at unfavorable points, as at the foot of a long grade. In some cases the tanks are installed within 20 miles of large stations or terminals, in order to limit the use of city water which is expensive and may not be satisfactory for boiler purposes.

## New Cantilever Bridge Begun on the Ohio River

A cantilever highway bridge now being built over the Ohio River from Ironton, Ohio, to Russell, Ky., will divide the present stretch of 240 miles of river between the bridges at Cincinnati and Parkersburg. The channel span will be 725 ft. c. to c. of piers, with a 375-ft. suspended span carried by 175-ft. cantilever arms, while the anchor arms will be 350 ft. long. A clear channel width of 705 ft. between piers will be provided and at the center of the span there will be a clearance of 40 ft. above high water or 99 ft. above normal pool level. This main part of the structure will consist of riveted through trusses spaced 29 ft. c. to c.




OHIO RIVER CANTILEVER BRIDGE AT IRONTON, OHIO

At Ironton, there will be an approach of plate girders on steel bents, ending with a curve and connecting with a timber trestle approximately at right angles to the bridge. At Russell, there will be a 200-ft. through truss shore span, followed by 500 ft. of steel trestle. The grades are 4 per cent and 5.36 per cent on the Ohio and Kentucky sides respectively, 4 per cent on the anchor arms, 3 per cent reducing to 1 per cent on the cantilevers, and thence 0.3 per cent to the center.

Three reinforced-concrete river piers carrying the cantilever and shore spans will have shallow foundations on sandstone rock. There will also be two piers on the banks. The structure will have a 20-ft. roadway with 6-ft. raised sidewalk. For the roadway, 3-in. shiplap oak planking will be laid diagonally on yellow pine sleepers, with concrete reinforcing and fireproofing over the railway tracks spanned by the Ironton approach. Live-load stresses were computed for the following loads on a 90-ft. length of roadway and sidewalk: two 45-ton electric cars on a 10-ft. width next the sidewalk; 30 tons on the remaining 16 ft. of width, or an 18-ton road roller anywhere.

Wind forces were figured at 350 lb. per lineal foot on the bottom laterals, and 150-lb. on the top laterals considered as a moving force. The sidewalk is inside the trusses and carries the same load as the balance of the roadway; the idea being that this roadway might be widened at some future date.

Most of the Ohio River bridges have piers built as solid rectangular blocks with either round or triangular ends. The Ironton piers have been designed similar to those for the bridge over the Mississippi River at Burlington, Iowa, built in 1917, using the I-beam cross-section (see *Engineering News*, March 8 and 22, 1917, pp. 382 and 466). The advantages are in economy of material, certain architectural effects, and placing of the mass of the concrete directly under the footings. This also gives considerable strength as against overturning.

This project originated with the Chamber of Commerce, at Ironton, Ohio, and funds were raised by public subscription under the direction of its secretary, E. B. Adams. The Ironton-Russell Bridge Co. was then incorporated in Ohio. The former town has a population of about 15,000, and Russell, Ky., with 1,500, has the shops of the Chesapeake & Ohio Ry. At present there is a ferry between the two towns. A bridge between Ironton and Ashland was commenced some years ago for an extension of the Cincinnati, Hamilton & Dayton R.R., but the project was abandoned after the substructure had been built and the river piers were afterward removed.

The bridge was designed by E. F. Barkow, assistant engineer of the Wisconsin Bridge & Iron Co., Milwaukee, Wis., under direction of Victoire Guillemin, chief engineer, and with some suggestions from J. F. Jackson as consulting engineer. The company also has the contract for both substructure and superstructure. The Dravo Constructing Co., which is building the substructure, commenced work on the foundations in July, 1921. The estimated cost is $250,000 for the substructure and $450,000 for the superstructure.

## Reconstruction in France

In an article in *Engineering News-Record*, July 15, 1920, p. 101, a summary was given of French reconstruction work that had been done to April 1, 1920. Reconstruction work that has gone on in the intervening year has restored the devastated regions almost entirely. A few of the salient points in the work are reproduced herewith from statistics supplied by the Minister of Liberated Regions of France.

The population of the ten destroyed departments as of Nov. 1, 1918, was approximately 1,944,000, but by May 1, 1921, it had risen to 4,165,153, or 88 per cent of the 1914 population.

Since the armistice 2,172,167 persons have been housed in buildings either repaired or newly constructed. The distribution of these is as follows: In repaired houses, 1,573,080; in wooden huts, 253,603; in permanent structures, 82,717; in semi-permanent structures, 159,214; in temporary stone houses, 103,553.

The area of land over which the fighting took place amounted to 3,337,000 hectares. On May 1 the surface from which projectiles had been removed amounted to 2,934,128 hectares, a total of 21,370,800 tons of projectiles found in the devastated regions having been destroyed. The surface of the land from which projectiles and barbed wire nad been removed and on which all trenches had been filled was 2,787,120 hectares.

Earth used to fill trenches amounted to 239,666,481 cu.m. Of 2,164,727 hectares of land under cultivation in 1914, 1,851,039 hectares were made unfit for cultivation during the war. On the first of May, 1921, 1,754,693 hectares had been completely cleared and made fit for cultivation.

Of 52,734 km. of highway which were in a state of

complete disrepair at the time of the armistice, 43,995 km. were reconstructed by May 1, 1921. Of 3,220 bridges destroyed or damaged, 2,945 have been completely rebuilt.

Of 4,701 industrial establishments destroyed during the war, up to May 1, 3,645, or 77.5 per cent, had been reconstructed. Compared with 1914, on May 1, 1921, the personnel employed on production in these industrial establishments was 45 per cent. The total number employed in 1914 was 816,716, and the total employed in May 1, 1921, 371,337. In addition, 75,000 were employed in these industrial establishments though not on production but on reconstruction work.

## Waterfront Bulkhead Construction at Two Lake Cities

### Timber Round and Sheet Piling with Timber and Steel Wales and Rock Filling — For Park and Harbor Works

ROCK-FILLED pile bulkheads now under construction at Chicago and Milwaukee are representative of a type of structure used extensively in marine engineering work to form the waterfront of a dock, wharf or park, this structure serving to retain the filled or made land behind it. Different combinations of round and sheet piling are used in the Chicago work, while that at Milwaukee has only close-driven rows of round piles. In the former case also there is the unusual feature of piling driven in curved lines laid out as part of the landscape engineering for the park.

To create the new Lake Front Park, at Chicago, there will be several miles of fill extending into deep water and retained by bulkheads, with concrete retaining walls at certain points. The first work will be the filling from the present shore to a bulkhead forming what will be eventually the west side of a lagoon or protected waterway. This bulkhead, however, will be exposed to wave action and storms of the open lake until the later work is undertaken of filling for the made land between the lagoon and an outer bulkhead. The latter bulkhead will be on a harbor line established by the U. S. War Department and the type of its construction has not been decided. The filling for this park, connecting Grant Park at 12th St. with Jackson Park at 57th St., about ten miles, will require several years (see *Engineering News-Record* Aug. 21, 1919, p. 360).

Construction of the bulkhead along the west line of the future lagoon from 12th St. to 24th St. has been commenced. The structure consists essentially of two rows of close-driven round piles 18 to 20 ft. apart, with sheet piling and rock filling, as shown by Fig. 1 The work is in water 12 to 16 ft. deep and for some years it will be exposed to the open lake, as noted above. This type of construction was adopted as being best suited to the comparatively soft clay bottom and costing considerably less than a crib, stone mound or concrete-caisson bulkhead. The completed work will provide an inclosed area for the deposit of city waste and rubbish, which now averages from 750,000 to 1,000,000 cu.yd. annually. To protect the uncompleted fill, the piles are left about 5 ft. high above the water, but eventually they will be cut off at or below the water level.

The round piles are 40 to 50 ft. long, having butts not less than 12 in. in diameter. On the front row, a heavy waling timber is placed along the rear side of the piling, and a steel front wale along the outside, this being an 8-in. channel upon which the nuts of the tie rods and waling bolts take a bearing. These nuts also secure splice plates over the joints in the channels.

*Sheet Piling*—Triple-lap wood sheeting is applied, in different ways. In Section 1 (see Fig. 1) this sheeting is placed against two lines of waling timbers along the rear or land side of the inner row of piles. These piles will carry the toe of a future concrete retaining wall 20 ft. high, the earth filling being deposited against the sheeting and wall. The rock-fill bulkhead, with top 5 ft. above water, will protect this wall from the force of the waves. In Section 2, a part of the bulkhead will be

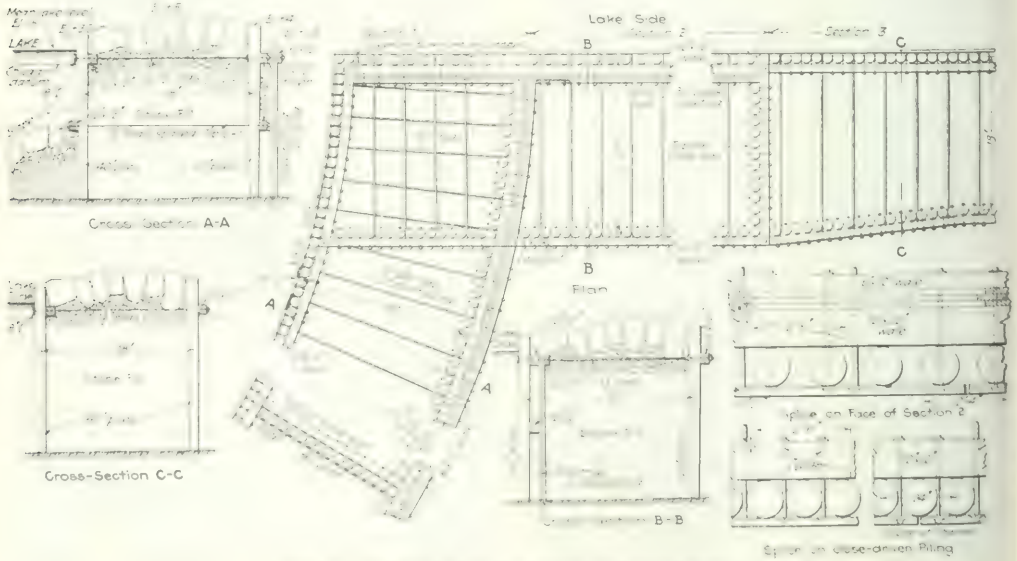



FIG. 2. BULKHEAD FOR HARBOR AT MILWAUKEE

capped with concrete paving 3 ft. above the water, to form a landing wharf or dock. At this point the sheeting is placed inside of the outer row of round piles, these piles not being close-driven but spaced about 18 in. c. to c., while the inner or rear row is driven close. Here the rock fill will be deposited against the sheeting, with the earth fill behind the rear line of piles.

For the greater part of the work, however, the present rock-fill bulkhead will form the toe of a riprapped, or unpaved sloping bank, so that the close-driven lines of round piling will be relied upon to hold the rock and

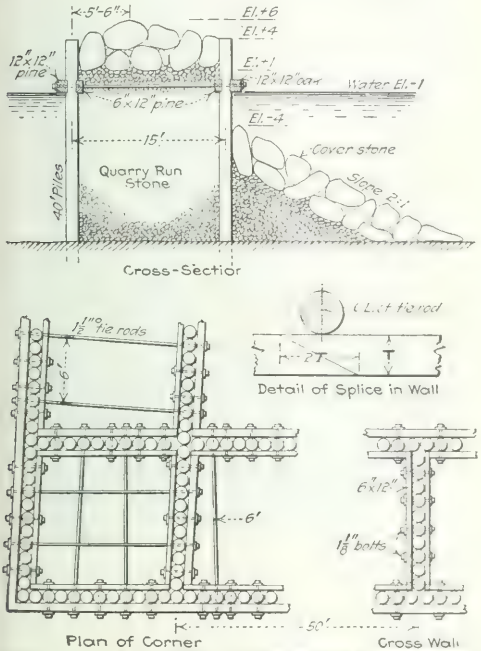



FIG. 1. PILE-AND-ROCK BULKHEAD FOR LAKE FRONT PARK, CHICAGO

the earth fill. Paving will be employed only at boat houses and landings. Pile cross-walls will be driven at intervals of about 250 ft., so that rock filling can proceed in some sections while piling is being driven for others. This construction would not be practicable if it were to be exposed permanently to the lake, as the earth slopes would soon be cut away by the waves. As a considerable part of the bulkhead will be on curved lines to conform to the outlines of the lagoons, it is provided that the thickness of the timber wales may be built up of two or more pieces in order to allow of bending them to the required curves.

*Bolts and Splices*—Different arrangements of bolts and tie rods are employed, as shown. In the close-spaced front piling both bolts and rods pass between the piles, except that where this piling is backed by sheeting the bolts pass through the piles, there being a bolt to every pile. In the rear row, the tie rods pass between the piles, but all bolts pass through them, each pile being bolted. Where the sheeting is on the back of the bulkhead, the tie rods pass through the main waling timber only, being placed in advance of the sheet piling. When this sheeting has been driven it is secured by a lighter waling piece bolted through each third pile. No bolts are used for the lower wales, which are held only by the tie rods.

Splices in the upper wales are cut diagonally and framed as shown, the splice being secured by through bolts. The lower wales, however, are not spliced but are lapped at least 2 ft. at the ends, alternate sections being above the others. These lower wales are held in position previous to the placing of the tie rods by means of upright sticks fitted between the two lines of wales.

*Rock Fill*—Limestone is specified for the bulkhead filling, the largest pieces being of 1-ton weight and the remainder graduated in size so as to practically fill all voids and make a compact mass. Not more than 5 per cent of the stone may be so small that it will pass through the crevices between the close-driven round piles. After the rock fill has settled to a permanent bearing and has been leveled up where necessary with additional material, it will be covered with a layer of limestone blocks having a minimum size of 1 cu.yd. It is expected that all this material will be taken from the old spoil banks along the rock sections of the Chicago drainage canal.

This bulkhead construction and park development has been planned under the direction of Linn White, chief engineer of the South Park Commissioners, Chicago. The Great Lakes Dredge & Dock Co., Chicago, has the contract for the present work.

## Harbor Bulkhead at Milwaukee

For the waterfront of filled land at Jones Island, in connection with harbor work of the city of Milwaukee, Wis., bulkheads are used consisting of two rows of close-driven round piles with rock filling, as shown in Fig. 2. The width varies from 7 to 15 ft. according to the depth of water. Piles 20 to 45 ft. long are cut off at 4 ft. above city datum or approximately 5 ft. above mean water level. If openings occur wide enough for the escape of the stone filling, they are to be closed by piles driven on the inside. At the water line are 12 x 12-in. oak wales on the outside and 6 x 12-in. pine or fir wales on the inside, with bolts through alternate piles and threaded tie rods 6 ft. apart. The wales are in lengths of not less than 12 ft., with splices cut diagonally and bolted through the piles.

Quarry-run stone is filled in to about 2 ft. above the water and covered with blocks having a minimum weight of 2 tons and a minimum average weight of 3 tons each. On the lake side is riprap of quarry-run stone deposited along the foot of the bulkhead and covered with blocks of 3 tons minimum weight. This cover has a minimum thickness of 4 ft. at right angles to the surfaced slope of 1 on 2. Cross-walls at 50 ft. intervals consists of close-driven piles with 6 x 12-in. wales on each side at the water line. At corners, each inner line of piles is continued through to the outer line, forming a closed rectangular chamber with tie rods in both directions. Test piles 60 to 90 ft. long were driven at a few points along the bulkhead line in order to ascertain the conditions to be expected for future foundations of harbor structures.

No particular kind of stone is specified for the filling, but it must have a crushing strength of 18,000 lb. or more on 2-in. test cubes, and must be "hard, close-grained, angular quarry stone, approximately cubical in shape, and of durable quality that will not disintegrate." The quarry-run stone is to vary in general from 4-in.

to 2-ton blocks. A limited amount of smaller stone is permitted, provided that stone of less than 4-in. size does not constitute more than 10 per cent of the total quarry-run material, and that stone from dust to ¼-in. does not exceed 5 per cent of the total in any shipment. The stone is dumped from scows along the lake side of the piling and a dipper dredge then places it in the bulkhead. Hydraulic dredging will be employed for filling behind the bulkhead, under a contract which calls for 430,000 cu.yd. of material to be dredged from the Kinnickinnic River and filled in to about 5 ft. above city datum.

This work is being done for the Board of Harbor Commissioners, Milwaukee, Wis., and is in charge of F. A. Kaiser, senior engineer. The Great Lakes Dredge & Dock Co., Chicago, has the contract for the bulkhead, and the Cleveland Engineering Construction Co., Cleveland, Ohio, has the contract for dredging.

## New Application of Pitot Tube in Testing Pumps

### Tube Extending Entirely Across Pipe Affords Advantages in Accuracy, Convenience and Economy

By Arthur L. Collins
Civil and Electrical Engineer, San Francisco, Cal.

A NEW application of the pitot tube principle to the measurement of flow in pipes, which has recently been developed for testing irrigation and reclamation pumping plants in California, eliminates several major disadvantages of the ordinary pitot tube methods, and, although it requires only equipment that can be assembled at low cost, can be depended upon for very accurate results in the hands of operators not specially trained in testing work.

The development of this method came about through greatly increased rates for electric power in California irrigation districts, immediately followed by a demand for pump tests and careful checks on pump efficiency. The primary conditions which had to be met were (1) a simple and inexpensive means of determining the quantity of water passing through pipes of various sizes and (2) the head against which the water is delivered. The method has a special field in pump testing because in addition to measuring volume of discharge, it can be used to determine the direction and velocity in different parts of a scroll casing. However, it is not limited to the pumping field and should prove very useful wherever data on the rate and quantity of flow in pipes are desired.

As applied to the needs of the California agricultural districts, the apparatus consists of a small diameter tube (usually ½ to ⅝ in.) that extends entirely through the pipe to be tested. The tube has a diaphragm at its center, on opposite sides of which, and facing in opposite directions, are two pitot openings through which the impact of the stream flow, whether positive or negative, registers in two manometer tubes. Thus "upstream" and "downstream" pitot readings can be taken simultaneously. The tube is made of sufficient length so that by sliding it in the packing glands at the pipe walls the pitot openings can be brought outside the pipe for inspection. Advantages of having the tube extend entirely through the pipe are that there is no vibration or unbalanced pressure due to an "overhung tube," and no danger of injury to pitot openings due to their being accidentally jammed against the far side of the pipe. The device is patented by the author of this article.

With the apparatus set up ready for testing, the tube is slowly revolved until the position giving maximum deflection in the manometer columns is noted. When this position has been found, revolving the tube another 180 deg. should reverse the high and low readings on the manometers. This constitutes a check on the accuracy of the instrument and shows at once if the openings are clogged or if air bubbles or other obstructions have lodged in the connecting tubes.

PITOT TUBE PERMANENTLY INSTALLED IN 30-IN. SUCTION PIPE OF 24-IN. CENTRIFUGAL PUMP

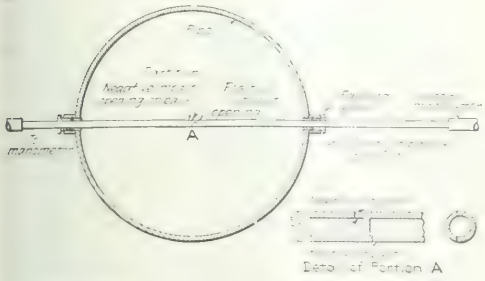
A permanent installation where the instrument is being used on a 30-in. pipe is shown in the accompanying illustration. Indicators are installed in this plant on each of five 24-in. centrifugal pumps. The capacity is about 30 sec.-ft. and the differential pressure is 30 in. of water, or each inch is 3¼ per cent of the velocity head, amounting to about 1.6 per cent variation in capacity. An operator can read the water columns to within ¼ in., so that this variation represents about 0.2 per cent of the capacity; that is, when the capacity of the pump varies 0.2 of one per cent the operator can detect the change.

This is believed to be the first installation of a pitot tube on a pipe so large and under vacuum where the operator can readily and accurately measure the water flowing in the pipe. With apparatus such as was heretofore ordinarily used for this purpose, such measurements have been possible only when conducted by engineers or skilled operators. An advantage of such a permanent installation is that the plant operator at once detects the fall in capacity when sticks lodge in the runner or when the efficiency of the pump is otherwise affected for any reason.

The simplicity of the equipment and methods of test described in the foregoing are such that a complete

outfit, including everything required for testing pumps of all sizes, ranging from a few inches up to 100 in., and taking power readings on motors up to 1,000 h.p., can be easily loaded into a light auto truck.

In pumping plants where the efficiency has fallen very low it is often desirable to ascertain the angle at which the water emerges from the impeller and the vel-




ARRANGEMENT OF TUBE IN PIPE AND DETAIL, SHOWING PITOT OPENINGS

ocity in the shell or case, and with these data to redesign and improve the equipment to secure higher efficiency. In both these operations the final degree of accuracy with the testing device here described depends only upon the care taken by the operator. The direction of flow is determined by placing a protractor on the end of the pitot tube and then revolving it as in measuring velocity. As many as nine tubes have been used for simultaneous readings in measuring velocities in the scroll case of a 42-in. pump.

# Reclamation Service Reports on Colorado River Problem

## Recommends Unbiased Board to Allocate Costs and Benefits of Power and Irrigation Development—Plan for Greatest Dam

[*Washington Correspondence*]

ALL existing data bearing directly upon the problems of the lower Colorado River have been condensed in a single report prepared by the Reclamation Service. Since the publication of a preliminary report a year ago by the Irrigation Committee of the House of Representatives, further investigations have been made by and embodied in the report, which comprises six volumes. The recommendations, which form a part of the report are as follows:

(1) That through suitable legislation the United States participate in the construction of the Boulder Canyon Reservoir and the High Line Canal from Laguna dam to the Imperial Valley, in proportion to the interests of the public lands and the Indian lands as set forth in the report.

(2) That the Secretary of the Interior be authorized to enter immediately into contracts with such states, counties, municipalities and other interests as may desire to participate in the benefits of the construction herein recommended, providing that each participating agency furnish funds with which to defray its proportionate share of the expense, as allocated by a board to be appointed.

(3) It is recommended that there be appointed a board of three competent persons who shall not be resident in any of the states affected by the decisions of the board and who shall have no financial interest in these decisions, one being an irrigation engineer, one a power engineer and one learned in irrigation law, to allocate the cost and benefits of the proposed construction and assess the cost upon those receiving the benefits in proportion to such benefits. The decisions of this board should supersede the preliminary allocation recommended in this report and contract should be entered into with all participating parties to abide by the decisions of this board and to supply funds for construction in proportion to benefits as determined by the board.

(4) That the Secretary of the Interior be authorized to proceed with the work development as rapidly as the funds are made available from any of the sources provided.

The report shows the quantity and regularity of water-supply for irrigation; data pertaining to flood control; data concerning storage facilities; information as to the amount of land available for irrigation, and the canal systems which will be required.

### Boulder Dam Very Large

The report points out that since the preliminary examination was made borings have been prosecuted at the proposed dam site in Boulder Canyon and the cross-section of the canyon has been worked out fairly completely. Additional borings are necessary to develop the entire foundation of the proposed dam and it is expected that these will modify its location. Similar information is necessary for the cofferdam which must precede the main construction and must be of a substantial character. The borings indicate the maximum depth to bed-rock to be 133 ft. below the low water level. As a result it is pointed out that foundation work will be difficult and expensive.

The opinion is expressed in the report that "the investigations at Boulder Canyon have shown the feasibility of a high dam at that point. The amount of storage which would be furnished by this dam has been computed at Contour elevations ranging from 750 ft. to 1,300 ft. showing that the capacity would range from 58,750 acre-feet to 31,600,000 acre-feet. The canyon walls extend to the 2,000-ft. contour or 700 ft. higher than the contour which would result in a capacity of 31,600,000 acre-feet

The entire matter is to be taken up at a public hearing before the Secretary of the Interior in Washington on October 27. It had been hoped to conduct this hearing in San Diego on October 17 but Secretary Fall found it impossible to conduct the hearing while in the West.

## Fighting Flies with Fire and Ferment

Fly breeding in horse manure in Mesopotamia is controlled in the rainy season by the destruction of maggots through the heat of fermentation of the manure on piling it in mounds 9 to 12 ft. in diameter and 20 to 25 ft. high, built up on hard ground. Maggots escaping from the surface of the mounds are trapped in shallow trenches surrounding the mounds. Except in the rainy season the manure is first sun dried by spreading it on the ground in thin layers. It is then used as the staple fuel for burning garbage, offal, etc., and latrine stuff. Details of this and other fly-prevention matters, according to *Public Health Engineering Abstracts* for Aug. 27, are given in the *Tropical Diseases Bulletin* for July 15, 1921.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Blames Inspector for Chester Accident

Sir—In your issue of Sept. 22, p. 469, you have an article entitled "Penalty of Botch Work." In this article you say, "The blame for the wholesale drowning rests solely on the man who botched the repairs." I do not agree with you. The blame rests solely on the man or men who inspected and passed such a piece of work. EDGAR PIERCY.

Elyria, Ohio, Sept. 26.

## Locomotive Fuel Oil Stations

Sir—Relative to fuel oil station design of the Texas & Pacific Ry., I am attaching a print showing in detail the unloading troughs, which are different from those shown in your issue of Aug. 4, Page 154. The pipe layout as given on page 183, Fig. 1, showing double line to the elevated tank is incorrect. There is only one line between the storage and elevated tank, the oil being by-passed through the pump by valves. Sometimes a gravity flow is obtained which materially reduces our pumping cost. The oil column shown on page 186 as used by the Texas & Pacific Ry. is a specially designed oil column and not a "water column adapted to this purpose." R. L. HOLMES,

Engineer Water Supply, T. & P. Ry.

Dallas, Tex., Sept. 26.

[In the drawing sent by Mr. Holmes, the longitudinal timbers carrying the rails at the oil troughs are increased in length to 10 ft. 8 in., their ends being cut away to fit under the cross ties at the ends of the trough. These ties are bolted to the timbers. The oil column mentioned is of the Sheffield type.—Editor.]

## Granite Block Paving Specifications

Sir—Your editorial comment on a recent bulletin of the U. S. Bureau of Public Roads, respecting desirable qualifications for granite paving blocks (See issue of June 30, p. 1102) gave considerable pleasure to the writer, authoritatively justifying his attitude on the subject of specifications for such material during his term of office as engineer of highways, Borough of Manhattan, New York City.

To the present chairman of the Transit Commission, the Hon. George McAneny, formerly borough president of Manhattan, belongs the credit for initiating the practice and securing the necessary appropriations to carry out on a large scale the repaving of Manhattan's heavy-traffic streets with modern-type, smooth granite block pavements. As his engineer of highways, the writer was besieged by amateur faddists and interested salesmen to specify for this work only types of granite which could meet certain extreme laboratory tests on small specimens as to hardness, crushing strength, wear and toughness. A series of tests was made on samples from all available sources for New York stone paving block material and from European streets, the results being given in the writer's annual report for 1914. These tests showed that it would have been necessary to reduce the stone paving program if we had adopted as our criterion the proposed laboratory tests. Samples from nearly all the quarries that were producing satisfactory block failed to meet the required limits, as did those from first-class streets of Europe. At the same period an inspection of the World's best stone paved streets showed that proper dressing and laying were the real desiderata, and that, as one might expect, uniform wearing quality and not extreme hardness was the prime necessity.

HENRY WELLES DURHAM,

Lima, Peru, Aug. 10. With the Foundation Co.

## Curved Wall-Girder Fails When Collision Knocks Out Middle Posts

Sir—A peculiar accident took place in Springfield early in the morning of Aug. 31, of which I happened to see the result. A trolley train of three loaded freight cars left the track and struck the corner of a hotel building at State and Dwight Sts. This building is of brick with stone trim and wooden interior framing. The walls are self-supporting. The street floor of the building is occupied by stores, while the upper four floors are occupied by the hotel. The corner of the building is rounded, and the masonry walls were carried at the second-floor level by a curved girder, evidently supported at the ends and by two columns near the center. The force of the impact from the cars knocked out the center supports of the curved girder, and the girder rotated about its ends, letting down the whole corner of the building. The first two cars were absolutely destroyed by the collision and the falling masonry. Although the hotel contained a hundred guests at the time only one seems to have been injured at all and this one only slightly. The motorman was carried right into the building with his car, but was practically uninjured. A messenger in the cars was buried beneath the debris but not hurt. That all these people could escape serious injury seems incredible. W. W. BIGELOW.

CURVED GIRDER AT SECOND FLOOR FAILED

Boston, Sept. 2.

## Be Sure Reinforcement Is Correctly Placed

Sir—The description of the failure of a section of roof slab at Atlantic City in your issue of Aug. 18, brings to mind a need which is realized by some engineers, but overlooked by the many. This is the need for inclusion in specifications for reinforced-concrete buildings of requirements that reinforcement be supported in the position intended for it. In other words, chairs shall be used, of such construction that steel may be held rigidly in place. These devices should be shown on shop and erection drawings in detail, that the designer may know exactly what is intended by the builder. Too often this is left to the discretion of the contractor who may or may not use steel supports as he sees fit.

The engineer, on visiting the structure he has created, is horrified at what he sees and feels that next time he will use a larger factor of safety. He sees, more often than not, reinforcing lying flat on the forms before concrete placing has commenced. Then he sees a laborer, who knows nothing at all of stresses in concrete members, lift his carefully figured steel from the forms. That is, he lifts it whenever he happens to remember to do so. The amount by which it is raised is also at the discretion of the man with the hoe. Is it not a matter for wonder that concrete failures have not been more frequent?

There is another danger in the use of mesh reinforcement when proper precautions for supporting it have not been

observed. Expanded metal and wire meshes are usually lapped at whatever points may be necessary, without regard to the location of laps in the span. Should the mesh rest on the forms, with insufficient protection underneath, there is a danger of failure through slipping at the lap because of want of bond. The steel, of whatever grade and in whatever shape, must have covering enough to develop the required bonding strength to make the lap effective. Unless this can be done by placing it in its right place in the slab, a clamp or some other form of mechanical tie must be used, or mesh reinforcement discarded altogether. The writer knows of one failure of a slab reinforced with mesh which could be explained only on such conditions, as examination revealed that the steel in the fallen slab was barely covered with concrete.

Mesh reinforcement is, pound for pound, the best to be had, but careful designers will use it with caution as long as its position is left entirely to chance. Manufacturers would do well to devise ways for holding it in place till concrete has set.

FRANK W. CHAPPELL,
Consulting Engineer.

Dallas, Texas, Sept. 2.

## Old Hawaiian Trail Teaches Road Subgrade Lesson

Sir—Crossing the Koolan Mountains near Makapuu, Hawaii, between Honolulu and Waimanalo, is an old trail, the remarkable feature of which is that it is paved to a thickness of at least 1 ft. with lava rock. Since the route was constructed about 1840, before there could have been any heavy vehicle traffic, and was used principally by pack animals, a question arose as to the reason for so heavy a pavement on such a route. An examination of the soil showed that some sort of pavement was essential to keep the trail open during and after heavy tropical rains, but why adopt so costly a pavement instead of draining and laying gravel or coral-rock road?

HAWAIIAN ROAD BUILT WITH 12-IN. BASE

When the writer began his duties in Hawaii as department engineer on the staff of the commanding general in 1916, engineers believed that conditions were favorable for macadam roads, and many roads of this type were built, using both water and oil for binding purposes. The condition which demanded the heavy pavement on the old trail seems to have been lost sight of and considerable expenditures were made for new roads before it was rediscovered.

About 1915, Professor Keller, of the College of Hawaii constructed through the college grounds a test road made up of sections of the following types: Water-bound coral; Warrenite; oil-bound lava macadam in two lengths using different oils; the same with a seal coat; plain concrete; and reinforced concrete. In 1916 every section had failed with the exception of the reinforced concrete, but all were continued in service by means of repairs. The manner of failure, however, was not the same in all cases.

The simple coral roadway proved too soft to withstand the wear of motor-truck traffic. The Warrenite, softened by the tropic sun, rolled into waves and valleys and finally failed utterly. The oil macadam failed in spots wherever water penetrated to the subsoil, and even the seal coat sections failed in the same way, but after a greater lapse of time. The plain concrete cracked into large pieces which soon lost their proper positions, some settling, some heaving up, and all disrupting badly until replaced. The reinforced concrete cracked in several places, but the large pieces retained their relative positions and so long as the writer observed them (three years) were still serviceable and apparently not in need of repair.

About this time a concrete pavement in the basement of the college building nearby failed by heaving and breaking. Investigation led to the conclusion that the pressure was due to expansion of the soil caused by water. This expansion was found to be a characteristic of the soil in many parts of the island.

A concrete pavement laid by the city near the college failed likewise about three months after completion, although not subjected to heavy traffic. The cause was believed to be the same. It is possible that a uniform upheaval of a large area of pavement might not disrupt the pavement, but where the moisture affecting the subsoil is the result of percolation from the roadsides it is not to be expected that uniformity will be the rule, and the upheaval occurs in spots, with disastrous results.

With two important exceptions, the writer was unable to find any road pavement on the island not constructed of reinforced concrete which had endured as long as one year. One of the exceptions was the block on Fort St., a heavy oil-bound macadam. The other was the pavement on Beretania St., where a 2-in. bitulithic surface was laid on a 5-in. plain concrete base. In both cases the gutters, curbs, sidewalks and adjacent buildings afforded probably complete protection against percolating water from the surface and drainage against ground water.

Having become convinced that heaving was the true cause of the general failures of pavement of various kinds, the writer made several visits to the old trail near Makapuu and found that the soil there was subject to expansion and contraction to a marked extent. It would be interesting to know what was the original construction of the trail and what were its failures until its builders realized that only a massive pavement would endure under the existing conditions. The lesson had to be learned again by modern engineers. Apparently some of the oldest inhabitants were well aware of the facts, but engineers coming from the mainland assumed that since frost was not to be encountered protection against upheaval would not be necessary.

R. R. RAYMOND,
Colonel, Corps of Engineers, U. S. A., Retired.

Cambridge, N. Y., Aug. 22,.

## Problems in the Chlorination of Water

Sir—I have been greatly interested in the articles in *Engineering News-Record*, Sept. 8 and 15, pp. 393 and 444, on "Problems in the Chlorination of Water." Several operators mentioned the use of ortho-tolidine as an indicator to determine the free or residual chlorine remaining after the use of chlorine. There is grave danger in making this test, since it has been found that numerous waters which have not been treated with chlorine will give a positive reaction with ortho-tolidine. While the ortho-tolidine test is very valuable, its use should be thoroughly investigated before any hard-and-fast standard is established.

When a solution of ortho-tolidine is added to a water to which chlorine has been applied, if there be any so-called "free or residual chlorine" present, a distinct yellow color will be produced within five minutes. It is necessary in most cases to have a positive reaction in order to be sure of a satisfactory bacterial reduction. The causes of this reaction cannot be removed by passing the water through quantitative filter paper. In several cases, however, it has been found that sand filtration will remove the cause, producing a water that is negative to ortho-tolidine. If water

be treated with sulphate of alumina and passed through filter paper, the ortho-tolidine will give a negative result. If chlorine is applied to raw water with sulphate of alumina before filtration, ortho-tolidine will give a positive reaction, since coagulation and filtration do not remove chlorine.

Recent tests of water from Brandywine Creek, Wilmington, Del., Susquehanna River, Harrisburg, Pa., Cadorour Creek, York, Pa., Chemung River, Elmira, N. Y., Mohawk River, Cohoes, N. Y., and Hudson River, Albany, N. Y., gave positive reactions, while the water from the Niagara River at Niagara Falls, N. Y., gave a negative reaction. All of the waters named are polluted. The water at Wilmington, Del., after passing through the slow sand filters, gave a negative result. Water from the wells at Green Island, N. Y., containing manganese and iron, gave a positive reaction. Stored surface water from Sebago Lake, Portland, Me., did not react. Water from the upper and lower service reservoirs at Troy and Kingston, N. Y., gave positive reactions.

These reactions are more noticeable during the summer months when the temperature of the water is high and algae are present in large numbers.

Operators using this test should in all cases examine the untreated as well as the treated water. If such tests are not made serious troubles are sure to arise, since unsterilized water will be delivered to consumers.

JAMES M. CAIRD,
Troy, N. Y., Sept. 15 Chemist and Bacteriologist.

## Electrolysis Only In Wet Concrete

Sir—Relative to the articles on corrosion of reinforcing steel in concrete noted in your issue of Sept. 29 and other issues preceding, it may assist engineers who investigate this difficulty to realize that electrolysis from outside currents is of no moment, *provided the concrete is dry.* If the concrete is wet, electrolysis is self-engendered, even without stray currents; and chlorides or other catalyzers present assist such action materially.

But if concrete is dry, the reinforcing rods would carry up to their conducting capacity without damage, Numerous instances coming under the writer's observation have confirmed this beyond question; and it may save others a great deal of fruitless investigation if this point is borne in mind.

New York City, Sept. 30. NATHAN C. JOHNSON.

## Solid vs. Pneumatic Tires for Trucks

Sir—I was greatly interested in the letter from H. W. Slauson, in your issue of July 28, p. 161, in which he makes the very definite statement that "road damage, rutting and the like, is entirely a factor of weight per square inch of road contact." Without wishing to controvert Mr. Slauson's statement or to argue in favor of pneumatic truck tires as against solid tires, I should be particularly interested to know upon what data the statement is based.

It has always seemed to me that speed of the vehicle, gradient of the road and density and smoothness of the road surface all have a very important bearing upon the life of the road under traffic. For instance, a road that has not a smooth surface is subjected to a succession of blows as each wheel falls from a higher spot to a lower spot on the surface. Of course, the potential intensity of the blow upon each square inch of road-surface would be determined by the weight per square inch of contact, but its actual destructive effect upon that surface will be greatly modified by the resilience of the tire and under such circumstances it would seem that a pneumatic tire would be less destructive than a solid tire.

Furthermore, few road-surfaces, except new concrete or sheet asphalt, are even nearly perfectly smooth; if they were, steel tires would give practically as good service as any rubber tires, and this means that unless the tires are very resilient the load will momentarily be supported upon very small areas of road-surface. This, of course, will result in much greater weights per unit of area and a much greater destructive effect upon the road. Here again the pneumatic tire would seem to have the advantage by reason of its ability to mould itself in conformity with every irregularity of the road-surface and thus maintain a constant area of road contact. While this characteristic of the pneumatic tire seems to recommend its use for front wheels which simply roll over the road surface, it is an argument against the use of pneumatic tires for rear, or driving, wheels and, I think, a better argument than the one advanced by Mr. Slauson. This very ability of the pneumatic tire to mould itself to the road aids materially in the formation of a vacuum under the tire that has a very decided tendency to tear out the finer particles from any but the most thoroughly bound road-surfaces.

Palmer, Mass., Aug. 19. CHARLES F. DINGMAN.

## Hinge Action in Exterior Concrete Columns

Sir—In *Engineering News-Record,* Sept. 1, p. 348, is a description of the design used on a long span garage in New York City. This article describes certain steps taken in the construction, provided to take care of *possible* settlement of the foundations. The design, however, fails to provide for several very definite actual conditions present in this structure.

Ten years or so ago, when little had been published in America dealing with the distribution of the total moment in a concrete frame, there was some excuse for a designer to assume that the connection between a concrete beam and column was hinged, as has been done in this case. In several standard text-books now on the market this subject is treated at some length.

In this particular case the designer has used a 12 in. thick by 18 in. wide column under the end of a 66-ft. span girder. Without considering the possible effect of unequal settlement, but simply combining the bending and direct stresses actually occurring in this column, extremely high conditions of stress will be found. If the unequal settlement contemplated in this design actually does occur, a great increase in the stresses in the exterior column might result.

Near the face of the exterior column, the bond stress on the steel in the girder is within the allowable limits, but no adequate anchorage to produce this necessary bond resistance is provided. The illustration shows four girders G1 at each end which, one would gather, are all the same, while the load on two of the four is clearly much less than that on the other two. Bars 1¼ in. sq. appear to be spaced 2¾ in. on centers in the bottom of a 4 ft. deep girder, giving ¾ in. of concrete between the sides of the bars—if this concrete actually gets there. This would appear rather inadequate to develop proper bonding of the steel and concrete.

The writer's opinion is that this design is poor from the viewpoint of economy in concrete design, but more important it is a good example of how long span concrete construction should not be designed.

W. STUART TAIT,
Chicago, Ill., Sept. 15. Civil Engineer.

[This letter has been submitted to the designer of the building in question, and he has replied as follows: Editor]

Sir—Obligingly Mr. Tait has taken the time to compute the actual bending moments in the exterior columns and combined stresses resulting from these moments with the direct loads and has found extremely high conditions of stress in those columns. Simultaneously Mr. Tait has found out that the bond stress on the steel in the girder near the face of the exterior column is within the allowable limits, but that no adequate anchorage to produce this necessary bond resistance is provided.

Evidently Mr. Tait is not aware of the fact that if there is any moment in the exterior column there must be a negative moment at the end of the girder and that the bond stress must be reckoned on the top bars, of which there is none shown in the design.

I perfectly agree with Mr. Tait that for any given condition of loading it will be a simple matter to find out the moments in any part of a concrete frame if we know the conditions of restraint at the ends and also the effective cross section at any part of the frame. Having this particular framing in mind, I confess that I did not know either

the conditions of restraint at the bottom of these exterior columns nor the actual effective cross section at any part of the girder. How Mr. Tait knew of these conditions is a great deal more than I can guess. What about the effect of pouring lines?

There can be no question about the fact that there is a certain amount of bending moment on the exterior columns of this building which must be provided for directly or indirectly. The fact that the building is completed and these exterior columns are doing their work without any sign of weakness is the best proof that they are well taken care of.

In the last three years I have designed and supervised the construction of several concrete buildings with unusually long span girders. One of the principal lessons I have learned by my experience and observation is that the pouring line at the bottom of girders resting on exterior columns can be assumed as a hinge, providing the girders are designed consistently and provided for amply. By all means the unit stresses in the exterior columns must be kept 10 to 20 per cent below allowable stresses for direct bearing, depending upon the circumstances.

New York City, Sept. 21. MISSAC THOMPSON, Consulting Engineer.

## Cast-Iron and Other Materials for Water Pipe

Sir—The letter from Thos. F. Wolf in your issue of Sept. 29th, p. 538, gives the impression that my recent paper and your editorial comment were adverse to the use of cast-iron pipe. So far as I am concerned, I am thoroughly convinced that for general all around purposes cast-iron pipe is the most practicable and best article for water supply on the market today. Occasionally there are conditions that would fully warrant the substitution of wood pipe; other cases suggest wrought-iron or steel pipe; and in some other cases, concrete pipe; and in very rare cases possibly the use of vitrified clay pipe; but to every one of these installations there would probably be twenty of cast-iron pipe. Cast-iron pipe, like all other good articles, has its objections, the most serious of which is tuberculation, which, as Mr. Wolf truly says, is not universal. With many waters cast-iron pipe does not tuberculate and in these situations it is ideal for water-works purposes.

While pipe cleaning is an effective remedy for tuberculation it is seldom adopted on account of the practical difficulties and the general opinion that when once started the cleaning has to be frequently repeated, so that most water-works operators prefer to continue with the old cast-iron pipe and its greatly reduced discharging capacity.

The writer believes that there are great possibilities in the improvement of water-works pipe which will overcome the troubles of tuberculation and corrosion; these may be the result of metal cast under conditions inhibitive to rust or in the use of some other material than iron. For such a pipe the intelligent water-works owner would be willing to pay a much higher price than that for cast-iron pipe in situations where it is subject to tuberculation.

Philadelphia, Oct. 1. J. W. LEDOUX, Consulting Engineer.

## A Device To Prevent Splitting Failure in Framed Timber

Sir—The article in the Sept. 29 issue by H. K. Phelps on "Splitting Failure in a Wooden Truss" is a very good example of the indifference with which minor structures and structural members are often treated. Such details as the construction of a wooden roof truss are occasionally left to the judgment of a carpenter boss, whose lifelong experience, as stated by himself, gives him the confidence to design "weak" structures.

As to the cause of failure cited by Mr. Phelps, I can but point out that were the readers of your worthy paper to take advantage of the helpful hints found therein such failures would be greatly lessened. The writer has reference to a device illustrated and described in your columns some time ago, which insures a direct distribution of stress to the various interconnecting members in timber framing. It consists of a steel plate with serrated edges turned alternately to one side and the other, normal to the plate, forming prongs. It is introduced between the jointed members, and when these are bolted together the prongs enter the timber on both sides, thus preventing slipping.

While the writer does not as a rule advocate leaving these "minor" details to the guesswork of the carpenter, it occasionally does happen that temporary structures of this sort must be erected at snap decision when in the field. However, with the application of a little judicious thought, such weaknesses as pronounced wedge-shaped joints could be eliminated. The contractors for this type of work would undoubtedly find the above-described product to be of material assistance and all that the manufacturers claim for it. European technical publications have advocated its use for quite a number of years, the results of its extensive use in timber framing of all description warranting this.

New York, Oct. 1. HERMAN J. SCHOENFELD, Structural Engineer.

## Eyebar-Head Stress Analysis

Sir—Josef Beke in his interesting article on Stresses in Eyebar Heads, in your issue of Aug. 11, p. 234, uses loadings which I have had occasion to use in computing stresses in large circular pipes. In comparing my equations with his, omitting his normal stress terms, I find that though the $X_o$ equations agree, the $M_o$ equations do not agree in two of the terms. I get

$$M_o = -\frac{P_c}{2\pi}\left(\frac{W}{4\sin W} + \tfrac{1}{4}\cos W + \tfrac{1}{2} W \sin W + \frac{4}{\pi} - \pi \sin W - 1\right)$$

instead of his

$$M = -\frac{P_c}{2\pi}\left(\frac{W}{4\sin W} + \tfrac{1}{4}\cos W + \tfrac{1}{2} W \sin W + \frac{4}{\pi} - \tfrac{1}{2}\pi \sin W\right)$$

This looks to me like a typographical error in his article, as these equations were derived by two entirely different methods.

As the radius of his circle is small in comparison to its thickness he is correct in using his $Z$ term instead of the usual $I$. For his example, where $d/a = \frac{3}{4}$ and $x/a = \frac{3}{4}$, this gives flexural stresses of $S = 10.53\ M/bx^2$ for the inner edge, and $S = 3.24\ M/bx^2$ for the outer edge, instead of the usual $S = 6\ M/bx^2$ for rectangular sections. Working from my equations with these factors I get for maximum stress, $S_x = 2.33\ T$, tension at inner edge, instead of his $2.57\ T$; $S_x = 0.16\ T$, tension at outer edge, instead of his $0.20\ T$ *compression;* $S_z = 0.58\ T$ instead of his $0.79\ T$; $S_y = 0.81\ T$ instead of his $0.76\ T$.

My greatest stress is 10 per cent less than his, which is caused by my neglect of the work of direct stress. This is probably an extreme variation, as some work which I have done on arch dam deflections showed a difference of less than 2 per cent. It seems to me that the work of direct stress should be included in curved beam problems only when the $Z$ term differs materially from the beam moment of inertia; that is, when the depth of the section is greater than three-quarters of the radius of the neutral axis. Love's "Theory of Elasticity" gives a rigorous method of handling these problems, but it is too difficult for the ordinary engineer to use, on account of the advanced mathematics involved.

Mr. Beke is certainly to be complimented on the thorough analysis which he made of his problem.

San Francisco, Sept. 3. JAMES M. PARIS.

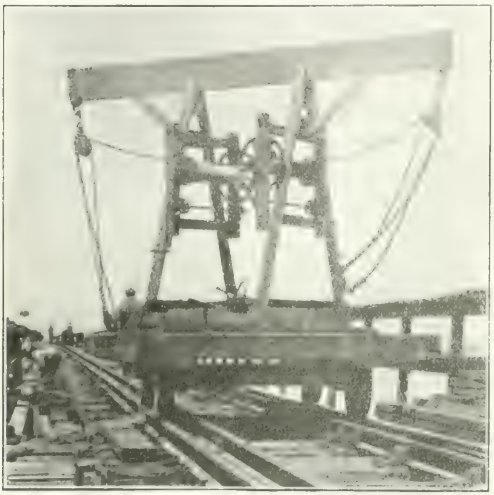
## Manganese Bronze for Valve Stems

The article by William Conard, "Manganese Bronze for Water-works Valve Stems," in *Engineering News-Record*, Oct. 6, p. 575, should have been credited as an abstract of a paper read before the recent convention of the New England Water Works Association.

# HINTS FOR THE CONTRACTOR

## Crane on Push Car Handles Stringers

IN REDECKING 11.8 miles of trestle on the Lucin cutoff, on the Southern Pacific R.R., a push car was equipped with a crane and hand-operated winches for handling stringers which are 8 x 17-in. timbers, 30 ft. long. The crane and winches are mounted as a self-contained unit on a platform which is simply lifted and placed on a push car. By shifting the position of this platform on the push car the center line of the crane can be made to take any desired angle with the rails, thus varying the distance from track center line to the blocks suspended from the crane ends.



RAISING A STRINGER WITH THE PUSH CAR CRANE

Stringers being removed from the deck are first shifted to a position just outside the ends of the ties where they are picked up by the block and tackle. Two hand-operated winches are mounted on the A-frames, one for each pair of blocks, which consist principally of the gears taken from old hand cars and shafts or drums 6 in. in diameter on which the rope is wound. The push car is ordinarily moved when a stringer has been picked up on each end, thus balancing the weight on the crane. The stringers are lifted with rope slings whose loops can be spread enough to maintain balance and keep the stringers in a horizontal position while being lifted and carried.

The superstructure, or crane proper, consists chiefly of two A-frames steadied by bracing around the bottoms and whose tops are connected by a 3 x 12-in. timber set on edge and from each end of which a pair of blocks is slung. This main beam of the crane is 14 ft. long and stands 7 ft. above the platform.

## Two Trucks in Lieu of Truck and Trailer

ABOUT 180 tons of steel girders and sections of oil pipe ranging up to 40 ft. in length recently had to be delivered by motor truck from Rodeo, Cal., to Oleum, a distance of 1½ miles. The length of the pieces was so great that they could not be loaded on a single truck and R. O'Connell, the contractor, had no trailers available. Delivery was made promptly, however, by loading the material on two 5-ton trucks, backed up end to end, in which position they moved over the road, one going ahead and the backing. Thirty loads were transported in this way, averaging about 6 tons each.

Two advantages over the use of truck and trailer were found in using the two trucks (1) in climbing the grades which ranged up to 12 and 14 per cent the combined power of the two motors made it possible to maintain better speed, thus reducing the time required for the trip and (2) it was possible to turn very sharp corners by making a half turn as is done on a railroad "Y." Obviously careful attention was required in steering the truck which was operated backward, but with skilled drivers this was successfully managed. Other than the load and the chains used to hold it in place the two trucks were not directly connected.

AN ELBOW COUPLED BY LOAD OF LONG PIPE

# NEWS OF THE WEEK

New York, October 13, 1921

## Pueblo Arranges for Study of Flood Protection

Pueblo has arranged for an engineering study of its flood exposure and the possibilities of flood protection. The city and the county, with the advisory assistance of a citizens' committee of twelve, have employed the Dayton Morgan Engineering Co. as chief engineer of flood protection. B. M. Jones, heretofore resident engineer of the Lockington dam of the Miami Conservancy District, will be resident engineer, assisted by W. J. Smith as field engineer, up to the present assistant engineer on the Taylorsville dam of the Miami Conservancy District.

The provision of adequate state legislation under which flood protection work embracing a large area can proceed will be the first necessity of the work, and such legislation is already being prepared.

## Propose Freight Transport in New York Subway

Co-operation in the solution of New York's port and transit problems was sought at a conference last week between the New York and New Jersey Port and Harbor Development Commission and the New York Transit Commission. A suggestion that the express tracks of the subway system be used for freight transport from 1 to 5 a. m. was considered, and referred to a committee on which the engineer members are Robert Ridgway, chief engineer, and D. L. Turner, consulting engineer of the commission.

## Building Material for France To Come from Germany

Between now and May 1, 1926, France will receive from Germany, according to the terms of an agreement signed Oct. 6 by representatives of the two nations, building material to the value of seven billion gold marks.

## Urge Passage of Zoning Law To Stimulate Building

An early passage of the proposed zoning ordinance by the board of commissioners of Dallas, Texas, is being urged by the metropolitan development association of the Chamber of commerce in order to stimulate the building industry. A zoning ordinance has been under consideration for some time and many are reluctant to build until the various zones are definitely located. The city at present regulates the location of business and industrial buildings by requiring the consent of three-fourths of the property owners living within a radius of 300 ft. of the center of the proposed structure, but this ordinance is unsatisfactroy.

## Highway Departments Announce Policy on Letting Next Year's Contracts This Fall

**"Engineering News-Record's" Inquiry Regarding Prospects for 1922 Road Construction Program Elicits Varied Replies**

*Following the announcement in the Sept. 29 issue of this journal of New York State's acceptance of the principle of letting next year's highway contracts this fall, as advocated recently by Herbert Hoover, Secretary of Commerce, Engineering News-Record requested from each state highway engineer a concise expression of the policy of his department. Some of the replies thus far received follow:*

**Massachusetts**—"This State is going to let this fall all the contracts that can be let without overdrawing the appropriations that have already been made. We have several projects which would be let this fall if there were funds available. The large number of contracts let this year, however, used all the funds that are available before another session of the legislature."

*—By A. W. Dean, chief engineer, Division of Highways, Department of Public Works.*

**Rhode Island**—"This department anticipates contracting this fall for practically the entire amount of the construction work involved by our 1922 program."

*—By I. W. Patterson, chief engineer, State Board of Public Roads.*

**New Hampshire**—'All of our work is a state-aid proposition, town and state contributing jointly to the fund for the construction and maintenance of the highways. It is impossible for us to anticipate just what any town will do in regard to appropriations until after the annual town meeting in March. As soon after that time as possible, we will let our contracts for the 1922 construction.

"Our climate is such that it is impossible to do any work during the winter months and it is generally the first of May before any work may be begun. Nothing would be gained in our case, therefore, in letting the contracts in the fall, if it were possible."

*—By F. E. Everett, Commissioner, State Highway Department.*

**Maryland**—"The State of Maryland has no funds for the further construction of roads, and will have none unless and until federal aid passes, and then only a small amount, approximately $1,500,000. The legislature convenes in January; and we expect a substantial appropriation for construction next year.

"It has been the universal experience of this commission over a period of 15 years' successful road construction that better prices are obtained in the spring than in the fall. Actually, no road work is done in the winter except at tremendously increased costs, so that no advantage in actual construction accrues by reason of fall letting, and if it makes for higher prices, there is no advantage in it. Do not let us be fooled into believing that unemployment can be relieved by the awarding of contracts. It cannot be."

*—By John N. Mackall, chairman and chief engineer, State Roads Commission.*

**Delaware**—We expect to let next month two small grading jobs. Since our program for next year is but a tentative one at this time, we do not expect to advertise for bids on any other

## Am. Soc. C. E. Casts Decisive Vote for Amended Constitution

A decisive vote in favor of the adoption of the amended constitution of the American Society of Civil Engineers was canvassed at the regular meeting in New York, Oct. 5. Of the total of 1,700 ballots counted, 1,367, or about 80 per cent, were affirmative. Changes in the constitution of the society must be approved by two-thirds of all votes cast so that, to carry, the amended constitution needed 1,134 ballots. The results showed a margin in favor of the passage of the amendments of 233 votes above the necessary two-thirds.

In comparison with the number of ballots cast by members on the previous questions affecting the society's policy, the present vote is light. A tabulation of the ballots is given herewith:

| | |
|---|---|
| Total ballots counted | 1,700 |
| Voting "Yes" | 1,367 |
| Voting "No" | 326 |
| Invalid ballots | 7 |
| Required for carry | 1,134 |
| Carried by | 233 |
| Percentage "Yes" | 80 |

## Colonel Woods To Co-ordinate Employment Effort

Secretary of Commerce Herbert Hoover last week appointed Col. Arthur Woods, former New York City police commissioner, as head of a special committee of the National Conference on Unemployment at Washington, D. C., to co-ordinate efforts in providing work for jobless men and to serve as a clearing house through which methods used in various centers may be exchanged for mutual benefit. A number of cities have reported that they are organizing to meet the unemployment situation along lines suggested by the conference.

work until after the first of the year." —*By C. D. Buck, Assistant to Chief Engineer, State Highway Department.*

**Kentucky**—"The State Highway Department has already awarded contracts on a part of next year's construction program and will during this fall probably award all projects that will be under construction in 1922. I heartily agree with the recommendations made by Herbert Hoover, Secretary of Commerce."—*By Joe S. Boggs, State Highway Engineer.*

**North Carolina**—"We quite agree with the fall letting of contracts and we expect to hold a letting every ten days from now until the first of the year, putting under contract between $1,000,000 and $1,500,000 worth of work each month.

"We appreciate the great advantages of fall lettings and are attempting to take advantage of these points."—*By Charles M. Upham, State Highway Engineer.*

**Ohio**—"The Department of Highways and Public Works is now letting all work which can possibly be carried on during the fall and open season of the winter. We are sparing no pains to place all bridge work and grading work under contract and are holding sales continually at the present time, the first sale falling on Oct. 8.

"We are also preparing to sell during the winter paving work which could not be carried on during the cold weather for operation at the earlist possible moment in the spring.—*By Leon C. Herrick, Director of Highways and Public Works.*

**Georgia**—"I agree thoroughly with the idea of letting contracts in the fall of the year. In Georgia our best construction season is in the fall and up to the middle of December. We can also get more labor at this season of the year.

"We are, however, dependent upon funds for new construction, and the availability of state funds is contingent upon federal-aid appropriations. We have expended all the federal funds appropriated to date and are waiting the action of Congress.

"We have plans and surveys completed to let at least $3,000,000 worth of work within six weeks after federal appropriation has been made."—*By W. R. Neel, State Highway Engineer.*

**Mississippi**—"Regarding the letting of contracts for next year's program, this fall, the State Highway Department is so far behind with its work, that we are unable to do so."—*By H. C. Dietzer, State Highway Engineer.*

**Wisconsin**—"Our determination is not to let any of our 1922 work until on or about Jan. 15. We are arranging to push the completion of plans as fast as our forces permit, and we hope to complete our lettings on or about March 1, or as soon therafter as plans and specifications can be prepared.

"Even if we had the plans ready, we would let no contracts for work

year's work at this time. In a climate such as Wisconsin has, where the field work on construction cannot start until April 15, there are no great advantages in fall lettings, and there are very radical disadvantages in the letting of contracts so far in advance of the actual performance. Of course, if contracting is to be made even more of a gamble than it is now, the letting of contracts

## *State Highway Engineers Announce Policies on Fall Lettings of Next Year's Road-Building Contracts.*

for work to be done several months in advance, is advisable.

"I can also understand why the contractors' associations are anxious to secure contracts. I believe that next spring's prices, especially on early lettings, will be lower than present prices, and we expect to take advantage of the low market."—*By A. R. Hirst, State Highway Engineer.*

**Maine**—"The State Highway Commission does not plan to let contracts this fall against next year's construction program. Thinking to expedite work we let two large contracts two years ago this fall. One of the jobs was not completed until the first of September of this year and the other one is just done now. When we let the work in the fall of 1919 it was with the expectation that both jobs would be completed during the construction season of 1920 but we have been unable to see that early letting expedited the completion of either one of these jobs.

"We usually have snow from about Dec. 1 until March 20. This snow varies in depth from 1 ft. in the southern part of the state to 4 or 5 ft. in the north, so that it is practically impossible to do any kind of road work during this closed season."—*By Paul D. Sargent, Chief Engineer, State Highway Commission.*

**Kansas**—"The State Highway Commission, while in favor of letting fall contracts, has not sufficient authority under the laws of Kansas to bring about any extensive program. The award of contracts on federal-aid road work is vested in the board of county commissioners, subject to the approval of the highway commission.

"We recognize a number of advantages in the fall awarding of contracts, although in a number of instances the contractor, after receiving a fall contract, has delayed until spring getting ready for the work and in the end nothing was accomplished. It largely depends upon the attitude of the contractor as to whether the fall awarding of contracts will prove satisfactory. It is a difficult proposition at this time to determine whether it will be a saving for the community to award these contracts in the fall, on account of the present downward trend of prices. A great many of our local officials are of the opinion that delaying until spring for the awarding of the contract will constitute a decided saving for their community and it is almost impossible to combat this argument as it has recently been shown that contracts are being awarded at a lower rate than a few months ago."—*By M. W. Watson, State Highway Engineer.*

**Connecticut**—"This matter has been agitated for some time by Secretary Hoover informally through letters to the Governor. After a conference with our Governor we decided to get out all the work possible during the present fall, so that the unemployment situation might be somewhat relieved.

"It is my personal opinion, however, that the solution of the unemployment situation does not lie entirely with the employment of unskilled labor. There are many men without positions at the present time who are not qualified, either by desire or ability, to do manual labor. Nevertheless, wherever it has been possible for us to do so, we have cut considerable red tape in order to take care of the employment of labor where it was badly in need of money. We are at the present time letting contracts just as fast as we can procure the plans for the work.

"To my mind, the desire for relief in the unemployment situation should in no case work to reduce the quality of construction put into our highways or into other public works. The amount of work that we can do is, of course, limited by the appropriations made by the legislature during the past session."—*By C. J. Bennett, State Highway Commissioner.*

**South Carolina**—"At present we are letting contracts just as rapidly as we can get plans in shape and financial arrangements made to pay for the work. Most of the work we are letting, however, will be commenced immediately and will be prosecuted through the winter months.

"In South Carolina we now have much idle labor and are more concerned with furnishing immediate employment to this labor than with getting contracts ready for next year's work.

"We do not believe that any considerable gain could be effected by letting contracts at the present time for next year's work. All through the early part of last year the State Highway Department exerted its influence to retard rather than accelerate road improvement work, because it was felt that nothing would be lost by waiting.

"Material prices from our point of view are still high, however, particularly in the case of cement, and we are inclined to postpone construction where these materials are to be used. We are, therefore, grading roads and constructing temporary surfaces of local materials and will use the high-priced materials only for necessary bridge and drainage structures, except in a few cases.—*By Charles H. Moorefield, State Highway Engineer.*

## Conferees Agree on Federal-Aid Highway Bill

**Prospects Hopeful for Enactment Before Nov. 1—Appropriation Left at $75,000,000**

(Wash'n after Conf. Speedier)

All indications are that the highway bill, carrying an appropriation of $75,000,000, will have become a law by Nov. 1. After extended sessions on Oct. 6, 7 and 8, the conferees of the Senate and of the House of Representatives agreed upon a conference bill not greatly different from the one passed by the Senate. A separate vote must be taken in the House on the appropriation. There was some discussion of increasing the appropriation to $100,000,000, but it was believed to be better to submit $75,000,000 to the House.

One of the important changes in the bill was the increase from 1½ to 2½ per cent in the amount which may be expended for administering the act.

The conference bill provides that $25,000,000 of the appropriation is to become available immediately, while the remaining $50,000,000 is to be available Jan. 1. In the bill passed by the Senate the $50,000,000 was not to become available until six months after the passage of the act. Other changes agreed to in conference are as follows:

The provision that the act is not to apply to streets in municipalities having a population of 5,000 or more was changed so as to apply to a municipality with a population of 2,500.

The definition of "state highway department" was altered so as to provide that it must be formally organized.

A radical change was made in the language of Section 7, so as to make clearer that important part of the bill. As agreed on in conference, the section now reads:

"That before any project shall be approved by the Secretary of Agriculture or any state, such state shall make provisions for state funds required each year of such state by this Act for construction, reconstruction and maintenance of all federal-aid highways within the state, which funds shall be under the direct control of the state highway department."

The paragraph of the bill providing for maintenance by the federal government in cases where the state fails to do it was changed so that the state highway department is to have ninety instead of sixty days in which to act.

The paragraph of the bill which has been criticized as an effort to override state constitutions was changed in conference so as to read: "That in any state where the existing constitution or laws will not permit the state to provide revenues for the construction, reconstruction, or maintenance of highways, the Secretary of Agriculture shall continue to approve projects for said state until three years after the passage of this act, if he should find that such state laws conflict with the provisions of this act."

### Two More Members for Federation

The executive board of the American Engineering Council, at its meeting in Washington, Sept. 30, approved applications for membership in the Federated American Engineering Societies of the Vermont Engineers' Society and the Associated Engineers of Spokane.

### Kalamazoo Votes to Continue Under Commission-Manager Plan

A majority of 708 votes in a light total were cast at Kalamazoo, Mich., Oct. 4, against abandoning the commission-manager plan of city government, in effect for some three years past.

### Saskatchewan Water District Plan May Be Revived

The urban governing bodies in the Saskatchewan Water District, Canada, are advocating a revision of the $6,000,000 water-supply project, defeated by rural votes on July 27, and another vote on the scheme. A. J. McPherson, consulting engineer, Regina, Sask., is chairman of the Saskatchewan Water Supply Commission. An outline of the project appeared in *Engineering News-Record*, April 22, 1920, p. 837

### Ridgway and Holland Return

Robert Ridgway, chief engineer of the New York Transit Commission, which is charged with the construction of all New York subways, and Clifford M. Holland, chief engineer to the New York and the New Jersey tunnel commissions, which are responsible for the vehicular tube project under the Hudson River, have recently returned to New York City from Europe. Mr. Ridgway and Mr. Holland went abroad to study subway and vehicular tunnel practice in England and on the continent.

### New York Section, Am. Soc. C. E. Announces Program

Confining itself largely to a discussion of problems relating to engineering in the metropolitan district, the New York Section, American Society of Civil Engineers has issued its program of meetings for the 1921-22 season. Several of the sessions will be held jointly with sections of the other national engineering societies and the number of invited speakers on each occasion has been limited to from 5 to 7, to allow opportunity for discussion from the floor.

The program committee, of which E. J. Mehren is chairman, announces as the subject for the first meeting on Oct. 19, "Financing Public Utilities and Large Engineering Projects."; A. B. Leach of A. B. Leach & Co., bankers, will be the principal speaker. Topics for future meetings include the St. Lawrence Ship channel, the Zoning law, traffic handling, removal of solid wastes the Port of New York, the proposed Hudson River bridge and regional planning.

## Serves 50 Years in City Water Department

**Walter H. Richards Retires as Engineer and Superintendent at New London, Conn.**

After completing 50 years of service with the New London (Conn.) waterworks, Walter H. Richards, who began his professional career as a pupil of Col. J. T. Fanning, the noted hydraulic engineer, and rose from the position of rodman to engineer and superintendent of the Board of Water and Sewer Commissioners, retired from active practice Oct. 1. He grew up with the department, for in 1872, when the city began to build its water-works system, he served as construction engineer under Mr. Fanning, the consulting engineer. When the work was completed Mr. Richards was appointed engineer and superintendent of the department and, with the exception of two years, has been engaged in those duties continuously.

STUDIES MICROSCOPIC GROWTHS

His early work in the '70's led him into what was then a new field—the study of microscopic growths in water and the disagreeable tastes and odors caused by them. In 1879, in association with the late Prof. William Ripley Nichols, he began an investigation of tastes and odors in water and continued his researches, afterward, with Profs. Albert R. Leeds and William T. Sedgwick.

The usual duties of a water-works superintendent occupied Mr. Richards' time until 1886, when it was decided to construct a sewerage system from general plans prepared by Rudolph Hering, consulting engineer. Mr. Richards' previous services in building the water-works had made so favorable an impression upon the appointing powers that he was selected as engineer of the sewer department, which has, ever since the beginning, been under his direction. In administering the combined water and sewer departments he has had charge not only of the design and execution of engineering work, but the collection of all money, payment of bills, and ordering of supplies.

In his 50 years with the department he has witnessed many changes in water-works practice. On the original system for New London it was decided to use a 24-in. vitrified pipe with cement joints; no vitrified pipe was being made in the United States at that time and it was necessary to purchase the pipe in Scotland. Mr. Richards recalls also the necessity in the early days, of purchasing Portland cement in England. While the New London work was in progress nitroglycerine had just come into use for blasting purposes; it was

## Hetch Hetchy Tunnel Progress for September

A total heading advance of 3,295 ft. was made in the rock tunnel of the Hetch Hetchy aqueduct of the San Francisco water supply during September. The August record of 776 ft. in a single heading, made at Priest Portal (see p. 464) Sept. 15 issue), was not equaled; 20 shifts were lost in that heading on account of timbering, so that only 70 shifts were worked, making 738 ft. of advance. The performances in the seven other headings ranged from 301 ft. to 489 ft. For all headings a total of 529 shifts was worked, with an average advance of 6.23 ft. per shift.

## A. S. M. I. Issues Convention Program

The program for the twenty-seventh annual convention of the American Society of Municipal Improvements at Baltimore Oct. 25-28 has just been issued. A business meeting will be held on the morning of Oct. 25 and the afternoon will be devoted to subjects of street lighting, city legislation and utilities. There will be a dance in the evening.

Committee reports and technical papers are scheduled for the morning of Oct. 26. In the afternoon there will be an inspection of Baltimore harbor. A business session is announced for the evening.

The morning and afternoon of Oct. 27 will be devoted largely to paving matters, while an entertainment at the Press Club is scheduled for the evening.

Reports of committees and descriptive papers will close the convention on Oct. 28.

(Continued from preceding page)

purchased at a Government experiment station, carefully transported by water, landed outside the city and carried over selected roads to the work. In contrast to these precautions Mr. Richards recalls having seen nitro-glycerine often poured into a drill hole from a kettle.

Mechanical equipment for construction purposes has made startling progress since the early days of the New London water-works. Then the trench pump, now so common, was unheard of and a pipe trench through a swamp often required 100 men bailing with pails. The common tools and plant used today by contractors were not then available, although Mr. Richards remembers that men could be had in plenty at 15c. per hour.

During his half-century of service at New London Mr. Richards has been in charge of the construction of four dams and reservoirs, one distribution reservoir, two high service systems, the entire city sewerage system and the maintenance of all these works after construction. He read the first paper before the New England Water Works Association in 1884 on the subject "Service Pipe" and is an honorary member of that organization.

## Welcome Fritz Medal Delegation

Present and past officers of the four (founder) national engineering societies, the Engineering Foundation, the United Engineering Society and the Federated American Engineering Societies at a dinner in New York Oct. 10 welcomed home the delegation of twelve engineers who last summer presented to Sir Robert Hadfield and Eugene Schneider the John Fritz medals awarded them, respectively, for the years 1920 and 1921.

Members of the delegation described the ceremonies in London and Paris, while cablegrams of greeting were read from the leading British engineering societies, from the Société des Ingénieurs Civils de France, Viscount Bryce and Eugene Schneider and Sir Robert Hadfield. Sir Robert urged close relations between all English-speaking engineers, and proposed that there be formed an international engineering council. M. Schneider also endorsed the idea of international organization among engineers.

### Daily Rate for Concrete Paving Averages 733 Feet

*On a concrete paving job recently completed in Tehama Co., Cal., a daily average of 733 lin.ft. of 15-ft. pavement was maintained for 98 working days, according to the California Highway Commission. The contract, which was for 13.8 miles and was held by H. J. Kaiser, was started March 21 and finished Sept. 16. The average progress was 3.58 miles per month. The pavment is 5 in. thick and is reinforced.*

John R. Freeman, as a representative of the civil engineers' group in the delegation, described a trip made by him and Robert A. Cummings with some forty French engineers through southeastern France, inspecting the extensive water power developments there and the work of extending the harbor of Marseilles. A new industrial district is developing in that section, far from the German frontier.

Captain G. H. Armstrong, British Consul-General at New York, and Gaston Liebert, French Consul General at New York, expressed the appreciation of their nations for the co-operation of American engineers in the war and of the honor carried to their countries by the conferring of the John Fritz medals. M. Liebert, on behalf of the French Government, then presented to the chairman of the delegation, Ambrose Swasey, to the chairman of the civil, mechanical, electrical and mining groups in the delegation and to the presidents of those four societies medals commemorative of the visit of the delegation.

Prof. Jacques Cavalier, rector of the University of Toulouse, exchange engineering professor, spoke briefly.

J. Vipond Davies, president of the United Engineering Society, presided.

## Army Engineers Against Ohio-Lake Erie Canal

### Rivers and Harbors Board Believes Cost Not Now Justified by Traffic Prospects

After considering the report of a special board of negineers on canal routes connecting Lake Erie with the Ohio River, the Board of Engineers for Rivers and Harbors, of the Corps of Engineers, U. S. Army, is not convinced that sufficient commerce would develop over any of the routes considered to justify such an undertaking. The matter is being held open, however, for 90 days.

The special board which made the report consisted of Cols, William. V. Judson, William W. Harts and Edward M. Markham. In connection with the further consideration of this project, the board has issued the following statement:

BOARD'S STATEMENT

"The special board states that Route 1 (Pittsburgh to Ashtabula) is the shortest, will be the cheapest of construction, and the one offering the greatest prospective commerce, and is preferred by that board. It recommends some further investigation of its economic features. It believes that if the improvement is undertaken over any of the routes the states or other local interests concerned should co-operate to the extent of paying 70 per cent of the first cost, leaving the United States to pay 30 per cent of the first cost and all charges for subsequent maintenance and operation.

"This report has, in accordance with law, been referred to the Board of Engineers for Rivers and Harbors for consideration and recommendation. This board is not convinced of the advisability of the United States undertaking the construction of any canal between Lake Erie and the Ohio River at the present time for the following reasons: The least expensive route, and apparently the most promising, is the Pittsburgh-Ashtabula route, which is estimated to cost the large sum of $120,000,000. Moreover, the existence of obstructive bridges across the Allegheny River near its mouth further militates against the advisability of constructing a canal along this route. The Cincinnati-Toledo route is estimated at $195,000,000 and with the Lake Michigan branch at nearly $400,000,000 and the intermediate routes at $175,000,000 to $225,000,000. These large sums could be justified only by an assured commerce of great magnitude estimated by the special board at not less than 20,000,000 tons a year. The Board of Engineers of Rivers and Harbors is not convinced that such a commerce would develop over any of the routes considered and, as there is doubt of the ultimate economic success of the undertaking and every effort is now being made to reduce national expenditures, it does not feel justified in recommending the improvement at such great cost at this time."

## Support San Francisco Bay Bridge Project at Army Hearing

On Oct. 7 Col. Herbert Deakyne, Corps of Engineers, U. S. A., representing the War Department, conducted a public hearing in San Francisco on the question of bridging San Francisco Bay. Ralph Modjeski presented the tube-and-bridge project recently recommended by J. Vipond Davies and himself and then plans for twelve other projects were filed, after brief explanation by proponents and discussion of each. The projects ranged from tunnels 200 ft. below water to cantilever bridges 200 ft. above, with locations ranging from Dumbarton Point, 30 mi. south, to Telegraph Hill, nearly a mile north, of Market St. Speakers from all parts of the Bay region expressed a desire to see agreement on some feasible plan.

In opening the hearing, Col. Deakyne said the War Department would be concerned with questions of whether any proposed structure would answer its purpose without unreasonably obstructing navigation or reducing the tidal prism to such an extent as to effect the channel through Golden Gate. In closing the hearing he said: "I shall recommend to the War Department that some policy be adopted as to the location and type of structures that would be approved so that those interested can proceed with studies."

## Changes in Labor Policy Needed in Canal Zone, Says Commission

Radical changes in the policies of the Federal government toward the employment, pay and working conditions of labor in the Canal Zone at Panama are recommended in a report which a commission, consisting of Brig.-Gen. W. D. Connor, formerly of the Corps of Engineers, Capt. A. B. Fry, of the Treasury Department, F. A. Molitor, consulting engineer of New York and H. A. Wilson, New York business man, has just submitted to the Secretary of War.

Among the recommendations contained in the report are that the Governor of the Canal Zone deal with labor, not through labor organizations, but through committees of employees; that the open-shop principle be put into effect on the Isthmus; that the Canal administration be free as to its policy in employing union, non-union or tropical labor; that free housing, light and heat be discontinued; and that the operation of the Panama Canal and the Panama railway and steamship lines be separate and distinct.

President Samuel Gompers, of the American Federation of Labor, according to his own statement is "astounded" by the "proposal to displace citizen American workers with alien workers at a labor wage rate on a non-union basis."

The Connor commission reports that an estimated annual saving of $5,000,000 would result from following its recommendations.

## Buffalo Takes Over Hog Feeding from Garbage Contractor

The City Commission of Buffalo, N. Y., voted on Oct. 6 to buy, operate and improve the plant of the Huff Feeding Corp., contractor for disposal of the garbage of the city by feeding to hogs. The City Commission has appropriated $200,000 for the feeding plant and hogs and the proposed extensions and improvements.

## Dallas Awards Garbage Contract

Dallas, Texas, has recently awarded a contract to the Superior Garbage Incinerating Co. for the building of four incinerators in different sections of the city to replace refuse dumps that are now in use. The total cost will be $162,643 and the largest plant will have a capacity of 40 tons in 12 hours. The money for the construction of the incinerators is provided by a 200,000 bond issue voted last April.

## Seattle's Right to Restaurant Garbage To Be Tested

The legality of an ordinance recently passed by the city council of Seattle, Wash., providing that the city may sell all garbage produced in restaurants in that city and naming the Pacific Meat & Packing Co. as its sole authorized agent for the collection of this garbage, is to be tested in the courts. The restaurant keepers, who formerly sold their garbage or fed it to hogs on their own ranches claim that the ordinance, by depriving them of this privilege, violates their property rights under the constitution of the United States.

## Bids for 300-Ton Garbage Plant Wanted at Montreal

The Administrative Commission of Montreal, Que., invites bids until Oct. 20 for a 300-ton garbage and refuse incinerator. Included in the contract will be a steam heating plant, supplied by the incinerator and able to heat the building to 60 deg. F. when the outdoor temperature is —30 deg. F.

## To Extend Canadian Railroad at Cost of $3,500,000

The Ontario Government has decided to proceed with the extension of the Temiskaming & Northern Ontario Railway from its present terminus at Cochrane to a point 70 miles north known as Tin Can Portage on the Abitibi River. The cost is estimated at $3,500,000. In addition to opening up a good agricultural district for settlement the construction of the line will make it possible to develop at least 300,000 hp. at intervals along the river. The main development it is estimated will furnish about 200,000 hp. Preliminary surveys show that a fall of over 200 ft. can be established at Tin Can Portage, while an additional 111,500 hp. can be generated at other points within 7 mi.

## Hiram F. Mills, Hydraulic Engineer, Dead

**Was Honorary Member of Am. Soc. C. E.—Lawrence Experiment Station Largely the Result of His Efforts**

Hiram Francis Mills, noted hydraulic and sanitary engineer, honorary member of the American Society of Civil Engineers, a leader in the development of the art of water purification and sewage treatment, and responsible, in large measure, for the establishment of the Lawrence Experiment Station of the Massachusetts State Board of Health, whose committee on water supply and sewage he headed, as chairman, for many years, died Oct. 4, at his home in Hingham, Mass., after a long illness. He was 85 years old, and in 1917, on account of advancing years, had retired from active practice as chief engineer of the Locks & Canals Co. at Lowell.

Mr. Mills was born in Bangor, Me., Nov. 1, 1836, and was graduated from Rensselaer Polytechnic Institute in 1856. Much of his early engineering work was in the hydraulic field; he served on the Bergen tunnel of the Brooklyn water-works, on water power measurements at Cohoes, N. Y., and Lowell, Mass., and on the construction of a dam across the Deerfield River. For a time he was resident engineer at the east end of the Hoosac tunnel and on railway location in Nova Scotia. It is said of Mr. Mills that, as a young man, he resolved, during the first ten years of his professional work following graduation, to serve only under the most distinguished engineers, and it is worth noting that in those days he was associated with such leaders as Charles S. Storrow, James P. Kirkwood, James B. Francis, and William E. Worthen.

### Hydraulic Research Work

In 1869 he became chief engineer of the Essex Co. which controls the dams, locks and water power on the Merrimac River at Lawrence, and in 1894 he was selected as chief engineer of the Locks & Canals Co. of Lowell, holding both positions simultaneously. At Lawrence he carried on an extensive program of hydraulic experiments on methods and instruments for the measurement of water power furnished to the mills and brought the efficiency of the pitot tube to a point never before reached.

Mr Mills is, perhaps, most widely known for his work as a member of the Massachusetts State Board of Health from the time of its reorganization in 1886 until it was legislated out of existence in 1914. Serving without remuneration during that long period as chairman of the board's com-

## Engineering Societies

### Calendar

**Annual Meetings**

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, [illegible]

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL [illegible] New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

**The American Water Works Association, New York Section,** at its noonday meeting at the Hotel McAlpin, New York City, Oct. 14, will be addressed by Lt.-Col. Theodore A. Leisen, on the "Public Works of Detroit."

**The Albany (N. Y.) Society of Civil Engineers** and the **Albany Chapter, American Association of Engineers** held a joint meeting Oct. 4, which was addressed by Herbert S. Sisson, state highway commissioner on "The Progress and Development of the Highway System of New York State."

**The Technical Club of Dallas, Tex.,** at a recent meeting, launched a constructive program whereby members will make a concerted effort to encourage building and construction activities. The club is urging that bond money be [illegible] projects in order to aid the unemployed. The activities of the club were the subject of a commendatory editorial in a recent issue of the Dallas *Daily Times-Herald.*

**The Texas Section, Am. Soc. C. E.** will hold its fall meeting **Oct. 28** and 29, at which the Technical Club of Dallas will entertain the members and ladies.

**The Providence, R. I., Engineering Society,** Municipal Section, at its meeting Oct. 25, will be addressed by Almon L. Fales, of Metcalf & Eddy, Boston, Mass., on "The Relation of Stream Pollution in the Problem of Sewage Treatment."

---

[illegible]

mittee on water supply and sewerage, he inaugurated a comprehensive system of examinations of water supplies in Massachusetts and took a leading part in the establishment of the Lawrence Experiment Station, the work of which is well known to every sanitary engineer in this country and abroad.

In 1892 Mr. Mills planned and had general oversight of the construction of the slow-sand water filter at Lawrence which has been characterized as "the first large scientifically designed municipal filter in America" by H. W. Clarke, for years chemist of the health board. This filter plant practically eliminated water-borne typhoid at Lawrence and stimulated filter construction throughout the country.

Among the important public enterprises with which Mr. Mills has been connected in a position of high responsibility may be mentioned the preliminary studies for the improved sewerage and drainage of the Boston metropolitan district, the water supply of the Boston metropolitan district, the damming of the Charles River, and various lines of investigation in connection with the general subject of public health. Mr. Mills continued in the active practice of his profession until he had passed the age of 80.

## Personal Notes

M. M. WYCKOFF has organized the Wyckoff Engineering Corp., New York City, to engage in general engineering and contracting.

CLARK E. JACOBY, consulting engineer, Kansas City, Mo., has been elected president of the National Drainage Congress.

HARDY CROSS has been appointed professor of structural engineering in the College of Engineering, University of Illinois. He received the degree of B. S. in Civil Engineering from Massachusetts Institute of Technology in 1908 and the degree of Master of Civil Engineering from Harvard University in 1911. Prof. Cross was for six years assistant professor of civil engineering and instructor in structural engineering at Brown University and has specialized in structural and hydraulic engineering with consulting engineers since 1908.

CLYDE P. PYLE, since 1913 engineer with the McClintic-Marshall Co., bridge builders, has been appointed assistant professor of structural engineering at the University of Illinois. He received the degree of Master in Civil Engineering from the University of Pennsylvania in 1917.

C. K. MATHEWS, recently engaged in engineering and contracting on municipal improvements with Burns & McDonnell, consulting engineers, Kansas City, Mo., has been appointed instructor in civil engineering, University of Illinois. He was graduated from the University of Kansas with the degree of B.S. in Civil Engineering in 1919.

WALTER T. MORROW, who since his graduation from the University of Colorado with the degree of B.S. in Civil Engineering, has been engaged in structural engineering with the New Jersey Zinc Co. and the Semet-Solvay Co., has been made instructor in structural engineering at the University of Illinois.

RAYMOND A. WARNER, formerly with the city engineer of Detroit, Mich., has been appointed assistant city engineer to H. R. O'Mara at Mt. Clements, Mich.

PETER C. SPENCE, since 1911 engineer and specialist in building construction, ventilation and accident prevention in the New York State Department of Labor, has been made manager of the construction department of the National Lime Association, Washington, D. C.

C. J. CONLIN, for 3 years road engineer of Cuyahoga County at Cleveland, Ohio, has been appointed construction engineer for the North Carolina State Highway Commission, District 4, at Durham, N. C.

R. L. JONES, formerly chief engineer of the Sutter Basin Co., Sacramento, Cal., has been appointed office engineer, division of engineering and irrigation, State Department of Public Works.

F. D. HUDGINS, formerly senior highway engineer, U. S. Bureau of Public Roads, with headquarters at St. Paul, has been appointed state highway engineer of South Dakota, with headquarters at Pierre.

COL. CHARLES W. KUTZ has been designated to take charge of the work of the Corps of Engineers in the central division, with headquarters at Cincinnati.

E. E. S. MATTICE, formerly general contracting engineer, Dominion Bridge Co., Ltd., has been appointed managing director of the Phœnix Bridge & Iron Works, Ltd., Montreal, Que.

D. W. HAYS, consulting engineer, of Spokane, Wash., and at one time general manager of the Canada Land & Irrigation Co., Medicine Hat district, has been appointed supervising engineer of the United Irrigation District, Alberta, Canada.

ROLAND A. MEENSTER, formerly engaged in road work in Dallas County, and, for a time, city engineer of Austin, has been appointed assistant county road engineer of Bell County, Tex.

WALTER E. MILLER has recently completed for the Tennessee Eastern Electric Co. and the Johnson City Traction Corp. valuations of their properties at Johnson City and other points in eastern Tennessee, and has returned to his private consulting engineering practice in Madison, Wis.

J. W. CALDER, city engineer of Swift Current, Sask., has been dismissed by the city council, due to a policy of retrenchment.

HENRY C. McMORDIE, formerly chief engineer for the Trussed Concrete Steel Co. of Canada, Ltd., has entered private engineering practice with offices in Windsor, Ont.

GEORGE E. WATTERS has been appointed engineer of the Board of Water and Sewer Commissioners, New London, Conn., succeeding Walter H

Richards, who on Oct. 1 completed [illegible] years of service, as noted more fully elsewhere in this issue.

CHARLES D. CONKLIN, JR., formerly New York and Philadelphia district engineer for the Austin Co., has been appointed chief engineer in charge of construction with the W. P. Cameron Engineering Co., Philadelphia, Pa.

F. H. JOYNER, formerly road commissioner for Los Angeles County, Cal., has been employed by the California Highway Commission as assistant highway engineer in charge of general inspection for the southern district. Mr. Joyner's territory will include all of southern California and the territory east of the Sierra Nevada Mountains, including Mono and Inyo Counties.

A. W. VINCENT has been appointed city engineer of Albany, Ga.

C. A. MARTIN has been appointed construction engineer on paving and sewer work for the city of Puyallup, Wash.

## OBITUARY

GEORGE A. FLETCHER, former city engineer and water-works superintendent, died recently in Pitcher, Okla. He was 57 years old.

WILLIAM J. DAVIS, engineer, Wayagamack Pulp & Paper Co., Three Rivers, Que., died Sept. 2. He was born in Lachine, Que., 1884. He was connected with the Dominion Bridge Co. for about 8 years as draftsman, checker of details, chief draftsman of the Winnipeg plant, and, later, construction engineer supervising all work of a construction or engineering character and acting as assistant to the Western manager.

WILLIAM H. GAMBLE, for more than 26 years a maker of copper plates for the U. S. Geological Survey maps, died in Washington, Sept. 15. He was born in Philadelphia in 1835. In his younger days he served as a topographic engineer and in 1882 he accompanied a private expedition into Labrador.

## BUSINESS NOTES

THE NATIONAL PAVING BRICK MANUFACTURERS Association has added to its staff Stanley A. Knisely as economist. His work will consist in making economic studies of the service rendered by brick pavements. Mr. Knisely has had experience on a number of financial and technical journals as an investigator and writer on banking and industrial problems, and comes to the association from the Cleveland *Plain Dealer*, where he was a writer on economic subjects.

THE SCHAEFER ENGINEERING & EQUIPMENT CO. [illegible] the combining of its administrative, sales and manufacturing departments in its new general offices adjacent to the factory in Pittsburgh, Pa.

THE METALS COATING CO. OF AMERICA, manufacturers and distributers of the Schoop metal-spraying process, by means of which metallic coatings of any kind may be sprayed onto any surface, are now installed in their new plant at 495 North Third St., Philadelphia, having removed from their former location in Boston and Woonsocket, R. I.

THE STERLING WHEELBARROW CO., Milwaukee, Wis., manufacturers of equipment for contractors and foundries, has appointed George H. Lambkin, who has been associated with the company for the past twelve years, manager for the New York territory.

THE ARTHUR SACHSSE CORP., New York, has been formed by Arthur Sachsse, and Felix F. Wiener, to promote the sale of patents, formulas and processes. The corporation will deal principally with the exploitation of inventions and developments made during the war in Germany and will offer manufacturers' rights to American firms. Associated with them are several patent attorneys.

THE CENTRAL STEEL CO., the National Pressed Steel Co. and the Massillon Rolling Mill Co., all of Massillon, Ohio, have been merged into a single organization. The name of the new concern will be the Central Steel Co. The total production of the combined mills is approximately 450,000 tons annually. The officers of the new company are: Chairman of the board of directors and president, E. Bebb; vice-presidents, F. J. Griffiths, C. B. Chase, and H. M. Naugle; secretary and treasurer, T. E. Stuart.

THE YEOMANS BROTHERS CO., Chicago, manufacturing sewage ejectors and drainage pumps, announces the following new representatives: P. E. Fallon, Gazette Bldg., Little Rock, Ark.; Morton McI. Dukehart & Co., McComas and Race Sts., Baltimore, Md.

EARL F. HELMFELT, formerly chief engineer Edison Portland Cement Co., Stewartsville, N. J., has resigned to enter the sales force of the M. J. Dougherty Co., piping fabricators and engineers, of Philadelphia, Pa.

F. V. SHANNON has resigned as vice-president and secretary of the Massey Concrete Products Corp., and G. H. Redding has been elected secretary of this and affiliated companies. The position of vice-president will remain vacant for the present. David A. Hultgren has been appointed resident manager at Chicago.

R. K. SWIFT has resigned as manager of the New England sales branch office of the Ingersoll-Rand Co. He was connected with this company for 10 years as a salesman and 8½ years as general manager of the New England office.

## EQUIPMENT AND MATERIALS

### A New Line of Hoists

The Treadwell Engineering Co., Easton, Pa., has placed upon the market a new line of both steam- and electric-driven hoists. Heretofore the Treadwell Engineering Co., though a long-established manufacturer of rolling-mill equipment, has not been so closely identified with the building of hoists. Thomas O. Werner, formerly chief engineer of the hoist department of the S. Flory Manufacturing Co., has been secured as the chief engineer of the hoist department for the Treadwell Engineering Co. The Treadwell hoist is a machine that will meet practically any operating conditions with an arrangement from 100 to 300 hp.

### Clay Tunneling Winch and Hoist

Compactness in construction and accessibility to various parts are two of the outstanding characteristics of the Model A clay tunneling winch recently placed on the market by the Miller-Selden Electric Co., Detroit, Mich. A natural accompaniment of this winch is the Model B hoist, distributed by the same concern. Both pieces of equipment are essentially the same in most particulars and all parts, with the exception of the drum and shaft, are interchangeable. In the case of the winch, the diameter of the drum is 6 in., its length 7¾ in., and the diameter of the flanges is 16 in. The drum of the hoist has a diameter of 4½ in., its length is 21½ in., and the diameter of the flanges is 16 in. The winch is arranged for direct connection by means of a flexible coupling to any type of electric motor. The winch is 22 in. wide, 24 in. high and 5 ft. 3 in. long.

### Principle of Rapid Computer

The Keuffel & Esser Co., Hoboken, N. J., manufacturers of mathematical and surveying instruments, have made objection to the following sentence used in an article on "An Improved Rapid Computer," which appeared in this section in the issue of Sept. 1, 1921: "In graduations it is like the original instrument, being built on the principle of the polyphase duplex slide-rule." The statement of the Keuffel & Esser Co., regarding the matter follows:

"The words 'polyphase' and 'duplex' are registered trademarks of ours and refer to a K. & E. slide-rule, which in construction and principle is very much unlike the computer it is compared to in your article. Through the manner in which the polyphase duplex slide-rule is mentioned in the sentence quoted above, the reader might gain the impression that both these calculating devices are made by the same firm, which, by misleading the public, might give our competitor a certain advantage derived from the good will which we have built up with our renowned, trade marked product."

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Public Bond Sales in September Heaviest in 22 Years

Municipal bonds sales in September totaled $86,477,162, as against $106,396,153 in August, and $102,700,291 in July, according to the *Commercial and Financial Chronicle*. This is the heaviest September in the last 22 years, the September, 1920, total being only $49,820,768, and $26,025,969 for September, 1913. The output of the last nine months was $756,166,681, against $489,176,223 for January-September, 1920. The following partial list of public bond sales sketches the general situation.

PUBLIC BOND SALES OF AUGUST AND SEPTEMBER, 1921

| Size | Purpose | Amount | Maturity | Rate per Cent | Sold for | Date |
|---|---|---|---|---|---|---|
| Delaware | Highways | $500,000 | 1962 | 4½ | 92.18 | Jan. 1, 1921 |
| Oregon | Highways | 1,000,000 | 1925 | 6 | 100.51 | Oct. 1, 1921 |
| County | | | | | | |
| Haverhill, Conn. | Bridge | 250,000 | 1931 | 5½ | 113.025 | Oct. 1, 1921 |
| Tillamook, Mich. | Road | 53,844 | 1936 | 5½ | 101.11 | Oct. 1, 1921 |
| Hardin, Ohio | Bridge | 79,250 | | 6 | 100.00 | Oct. 1, 1921 |
| Marshall, So. Dakota | Drainage | 101,000 | 1930 | 7 | 100.00 | Sept. 1, 1921 |
| Scott, Mo. | Road | 106,000 | 1925–1937 | 5 | 100.00 | Sept. 1, 1921 |
| Stevens, Minn. | Highway | 85,000 | 1931–1939 | 6 | 102.89 | Sept. 1, 1921 |
| Sweetwater, Wyo. | Road | 400,000 | 1931–1941 | 6 | 100.00 | Aug. 1, 1921 |
| Albany, N. Y. | Highway and Bridge | 504,000 | | 5 | 100.00 | Sept. 1, 1921 |
| Geo. Dk. | Bridge | 75,000 | 1931–1941 | 6 | 93.60 | Sept. 1, 1921 |
| Santa Cruz, Cal. | Highway | 209,000 | 1922–1941 | 6 | 102.61 | Aug. 1, 1921 |
| Township | | | | | | |
| South Orange | | | $2,000 (1921–22) $3,000 (1923–63) | 6 | 100.044 | May 1, 1921 |
| Lyons Co., N. J. | Park | 125,000 | | | | |
| Municipality | | | | | | |
| Newark, N. J. | Water | 978,000 | 1923–1961 | 5½ | 102.31 | Sept. 15, 1921 |
| | Street Cleaning Dept. | 75,000 | 1922–1926 | 5½ | 100.208 | Sept. 15, 1921 |
| | Asphalt Plant | 50,000 | 1922–1931 | 5½ | 100.10 | Sept. 15, 1921 |
| Atlanta, Ga. | Street Improvement | 136,500 | 1931 | 6 | 102.30 | Sept. 1, 1921 |
| Blair, Neb. | Paving | 24,993 | 1930 | 7 | 100.00 | Dec. 1, 1920 |
| Casa Grande, Ariz. | Light and Water | 120,000 | 1921–1941 | 6 | 100.00 | |
| Cedarburg, Wis. | Water and Sewage | 85,000 | 1921 Annually | 6 | 104.14 | Sept. 15, 1921 |
| Fairport, N. Y. | Drainage | 115,000 | 1922–1931 | 6 | 100.01 | July 1, 1921 |
| Frankfort, Ky. | Sewer | 75,000 | 1941 | 6 | 105.18 | Jan. 1, 1921 |
| Franklin, N. H. | Water Works | 80,000 | $6,000 (1922–26) $5,000 (1927–36) | 5 | 98.80 | Oct. 1, 1921 |
| Asbury Park, N. J. | City Improvement | 50,000 | 1923–1972 | 4½ | 100.00 | Sept. 27, 1921 |
| Happy Valley Irrigation District, Shasta Co., Cal. | Irrigation | 100,000 | Interest Semi-Annually | 6 | 96.00 | July 1, 1921 |
| Jessamine, Ky. | Paving | 10,000 | 1940 | 7 | 100.00 | June 1, 1920 |
| Long Beach, N. Y. | Municipal Improvement | 240,000 | 1925–1949 | 6 | 100.68 | Sept. 23, 1921 |
| Pinellas, Iowa | Lighting | 27,000 | 1925–1931 | 6 | 100.00 | July 1, 1921 |
| Stevens Point, Wis. | Sewer and Pavement | 75,000 | 1924–1940 | 6 | 103.68 | Sept. 21, 1921 |
| East Newark, N. J. | Sewer | 107,000 | 1922–1941 | 6 | 100.79 | July 1, 1921 |

## Legality of Income Tax from Loan Associations to Be Tested

James A. Devine, secretary of the Ohio Building and Loan Associations League, will soon start suit in the U.S. Courts to test the legality of the income tax as it applied against building and loan associations in Ohio that lend money to non-members on endorsed notes or real estate security. Under a ruling of the Internal Revenue department all building and loan associations that make loans other than to members are subject to the payment of income tax on income accruing from such loans. Ordinarily Building and Loan Associations are exempt from payment of income and excess profits taxes. The action follows a thorough discussion of the matter. With the loan companies relieved of the tax, money would undoubtedly be easier and this would stimulate home building.

## Lumber Advances in Five Cities

One of the remarkable changes that has occurred during the week in the prices of construction materials has been an advance in lumber, reported simultaneously from five widely-separated American cities. The increases are from $1 to $3 per thousand feet. Details concerning these and other price changes can be found on page 632 of this issue, both in the table and in the discussion below it.

## Westinghouse Receives $7,000,000 Railway Contract from Chile

The Westinghouse Electric International Company announces confirmation of a contract to supply the equipment to electrify the Chilean State Railroad between Valparaiso and Santiago and the Los Andes branch. The contract, which has a total value of $7,000,000 was awarded the American firm in competition with German and European companies. The contract covers railway electrification of 116 miles now under steam operation which connect Valparaiso with Santiago. The Los Andes line is 28 miles long and forms the Chilean State Railway section of the transcontinental line to Buenos Aires.

The equipment to be furnished includes 11 local passenger locomotives, 15 freight locomotives, 7 switching engines and 5 sub-stations of 4,000 kw. capacity each.

## New York-Atlantic City Hard Paved Route Opened

Completion last month of 37 miles of continuous concrete pavement in New Jersey between Berlin and Absecon makes it possible by means of State Highway Route 3, or the Whitehorse Pike, to motor from New York to Atlantic City via Trenton and Camden over a smooth hard pavement, winter and summer. About 350 motor cars formed in line of parade at the Philadelphia-Camden ferries, whence they proceeded over the new highway to Atlantic City, where a ceremonial was arranged by the Hotelmen's Association and the Chamber of Commerce.

The pavement is of concrete, 1:2:3 mix, 6 in. thick at the sides, 8½ in. at center. Approximately 26 mi. of the new road is 18 ft. wide and 10 mi. is 20 ft. wide, both stretches having 3-ft. gravel shoulder on each side. Reinforcing was considered unnecessary since the pavement is laid on a porous sandy soil, providing an excellent foundation with little danger of heaving by frost. Thorough marking for distance, direction and danger points add to the safety and convenience of motorists.

## Building Material Supply Firms in Cincinnati Indicted

Indictments were recently returned against fifteen firms and thirty individuals engaged in the supply of building materials in Cincinnati. The indictment charges that through their combination these dealers were able to control the purchase of cement in the Cincinnati market.

## Steel Corporation Tonnage Grows

According to the monthly unfilled tonnage report of the U. S. Steel Corporation, unfilled orders on the company's books as of Sept. 30 totaled 4,560,670 tons, an increase in the month of 28,744 tons.

## Cement Production in 1920 Highest on Record

The production of Portland cement in 1920 was 100,023,245 bbl., exceeding the next highest year, 1917, by 7,209,043 bbl., according to the U. S. Geological Survey. The 1920 production is an increase of almost 20,000,000 in excess of the 1919 production.

The shipments in 1920 amounted to 96,311,719 bbl. valued at $194,439,025, and in 1919 85,612,899 bbl.

## California Highway Commission Receives Cement Bids

The following item comes from the California Highway Commission:

The California Highway Commission has awarded the contract for furnishing 1,815 bbl. of portland cement to the Old Mission Portland Cement Co., San Juan Bautista. The commission received three bids: From the Pacific Portland Cement Co., Santa Cruz Portland Cement Co., and the Old Mission. The bids were identical: $2.98 per barrel delivered at Ceres, Stanislaus County.

The commission also awarded a 504-bbl. purchase to the Santa Cruz Portland Cement Co. On this item there were only two bidders, the above company and the Pacific Portland Cement Co. Both bids were identical—$2.84 per barrel, delivered at Ignacio, Marin County—although the plants of the two companies are far apart.

The purchase of 6,400 bbl. was awarded to the Riverside Portland Cement Co. for delivery at Goleta in Santa Barbara County at $2.66 per barrel. Here there were five bidders, all southern California plants and all quoting different prices ranging from $2.66 to $2.88 per barrel.

## Contractors Attack Oklahoma Eight-Hour Law

Contractors in Oklahoma have attacked one section of the eight-hour law of the state, providing that "no less than the current rate of per diem wages in the locality where the work is performed shall be paid to laborers, workmen, mechanics, etc., doing public work." A demurrer of the defendant contractors has been sustained by the county court at Pawhuska in Osage County, "on the ground that the current rate of wages provision of the law related only to time worked in excess of 8 hours, the judge holding that the law was passed for the purpose of regulating hours and not the price of labor in the state." The courts of Oklahoma have never passed upon this section of the labor law.

The above-mentioned case is being prepared for presentation to the criminal court of appeals for determination. —*Monthly Labor Review.*

## Decrease in Retail Food Costs in Ten Principal Cities

Through the Bureau of Labor Statistics the United States Department of Labor has completed compilations showing changes in retail cost of food in September in ten principal cities of the United States. During the month closed Sept. 15 there was a decrease in all but one of the cities, Richmond being the exception. In Baltimore and Chicago there was a decrease of 3 per cent; in Manchester, 2 per cent; in Bridgeport, Butte, New York, and Providence, 1 per cent; in Peoria and Washington, D. C., there was a decrease of 0.4 per cent.

## Pennsylvania Lets Road Contracts—Bids Received by New York

Contracts for the construction of about 16 miles of reinforced-concrete roads were let during the past week by the Pennsylvania Highway Department, calling for the expenditure of more than three-quarters of a million dollars. There are eleven projects involved.

Bids were also received during the week for road work by the commission of highways of New York State. As most of the bids that New York has received this year have been satisfactory, it is undoubtedly true that before many days the low bidders named in this week's issue of *Engineering News-Record* will be awarded the contracts. The total mileage involved is 42 and the total low bid on the 42 miles is in excess of $1,250,000.

## Oil Company Cuts Wages

Effective Oct. 10 the wages of employees of the Bayonne plant of the Tidewater Oil Company were reduced 18 to 24 per cent. In a statement made public recently by the oil company it was set forth that the reduction was necessary inasmuch as the company had been operating at a loss since Jan. 1, 1921. The scale now effective is comparable to that existing in 1918. Through the resumption of deferred construction work it is hoped that all of the employees, who have been operating on part time, will be given full-time employment.

## Unemployed About Four Million

The committee on unemployment statistics of the president's conference on unemployment has found that, owing to the steady improvement which has taken place during the past two months, the survey on unemployment presented to Congress early in August by the Department of Labor should be revised on the basis of later estimates made by that department, the Bureau of the Census and other agencies, to determine the present status of unemployment. The latest statistics available indicate that the number of unemployed at this time, measured in terms of the reduction since January, 1920, in the number of workers on payrolls, exclusive of agriculture, is not less than 3,700,000 or more than 4,000,000.

## Pennsylvania To Repair Cars

According to a recent announcement made by President Samuel Rea of the Pennsylvania R.R. that railroad has a plan on foot for the repair of approximately 45,000 idle cars which have been stored without being repaired and none of which is now required for use. However, it is felt that by putting them in order now the road will be prepared for any sharp revival of business in the spring, and also that the general employment situation will be improved.

## Unemployment in the Lumber Industry

According to a recent issue of the *National Lumber Bulletin* employment in the lumber industry throughout the United States is approximately 66 per cent of normal. The average is secured from the following individual percentages: California pine mills, 50 per cent; California redwood mills, nearly normal; Pacific Northwest, 62 per cent; Inland Empire, 55 per cent in the saw mills and 40 per cent in the woods; Lake states, 40 per cent; South Atlantic states, 60 to 70 per cent; Gulf states and Arkansas (roughly), 80 per cent; and the central states, 50 to 60 per cent.

## Yearly Wage Loss $6,500,000,000

Wage losses to workers in the United States through involuntary idleness have been approximated at $6,500,000,000, in an estimate prepared by the economic experts of the national conference on unemployment. The estimate covers the loss in wages because of unemployment of all the jobless in the country from July, 1920 to August 15, 1921 and was based on an approximation of normal pay levels rather than on the scale at the peak of high wages.

## How Construction Has Alleviated Unemployment in Canada

In order that it might have all the supporting data possible upon which to work, there was provided for the sub-committee on construction of the unemployment conference held in Washington last week information concerning public works that had been prosecuted in Canada as a means of mitigating seasonal unemployment. The information contained in this item was supplied to the unemployment conference by the Canadian Employment Service.

Eight out of thirty-six Canadian cities reported a definite policy to lay sewers and water mains during winter months; thirteen others had done so at one time or another to relieve unemployment. The kinds of work which were reported as adaptable to winter construction were sewer work in rock tunneling, deep excavating, heavy cuts and fills and grading work, concrete construction in large bulk and construction work in swamp and muskeg sections. The degree of the success naturally was dependent upon the preparations made in the fall for continuing the work in severe weather, also upon the character of supervision.

In the comparative cost of doing the work in good and bad weather, in tunneling there was no difference, in rock work less than 25 per cent in excess, and in ordinary sewer construction from 25 to 100 per cent excess. The general conclusion was drawn that winter construction apparently cost about 25 per cent more than construction in milder weather. As these figures apply to Canadian cities, it is natural to assume that the experience would be

ditional cost, runs the report, would be offset by certain financial advantages including the fact that contractors would be able to spread their fixed annual overhead over twelve months' operation instead of nine; they would be together; and they would be able to get better work from men inasmuch as men can work faster in cold weather.

Fabrication of many kinds of material used in public structures can be concentrated in winter months and transported to places where needed. Another suggestion of relieving unemployment was through a concentration rather than the distribution of the purchase of certain government supplies. By concentrating purchases more in the slack season it was pointed out that seasonal fluctuations in private industry might be ironed out in part. In 1913 $1,800,000 of Canadian Government printing and $1,036,000 of Dominion and municipal purchases of textiles were so concentrated. The recommendation was made that this practice be extended as a regular policy.

# Weekly Construction Market

only the chief cities are quoted.

quotations for all construction materials and for the

| | | | Dallas | Chicago | Minne-apolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| **Steel Products:** | | | | | | | | | |
| Structural shapes, 100 lb | | | | | | | | | |
| Structural rivets, 100 lb | | 5.25 | 5.50 | | 4.15 | 4.25 | 5.50 | 5.00 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | | 3.20 | 3.50 | | 3.18 | 3.57½ | 2.35 | 3.75 | 3.75 |
| | | | | | | | 51.8% | 55% | |
| Cast-iron pipe, 6 in. and over, ton | | 40.50 | +54.30 | 44.10@ 46 | 1047 80 | 52.00 | 60.00 | 55.00 | -60.00 |
| **Concreting Material:** | | | | | | | | | |
| | 2.50 | | | 1.97 | 2.26 | 3.10 | -2.84 | 3.10 | 3.10 |
| | 2.00 | 2.13 | | 1.65 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| | 1.25 | 1.35 | | 1.05 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 3.20 | | 2.25 | 3.50 | 2.25 | -3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under | | | 35.00 | +48.00 | 34.00 | +50.00 | +29.00 | +22.00 | 120.00 |
| Lime, finishing, hydrated, ton | | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 25.40 | +27.50 | 21.00 |
| Lime common, lump, per bbl | | 1.60 | 2.75 | +1.50 | 1.40 | 2.95 | -1.90 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | +18.90@ 19.40 | 10.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| | | | | | | | | | |
| | | | .124 | | | 09 | | 10 | |
| Hollow partition tile 4x12x12, | | | | | | | | | |
| | | | .124 | | | 10 | .14¾ | -.11 | |
| Linseed oil, raw, 5 bbl. lots, gal | -.73 | | —.93 | | | | | .79 | |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@ .80 | | | | | .50@.55 | — .75 | —.50@.60 | |
| Common labor, non-union, hour | | .30 | .50@.45 | .50@.40 | | .35@.40 | .50@.55 | .50—.25@.30 | |

Chicago

Minne- quotes

of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered Gravel, sand and crushed stone quote at pit.

Denver

sand at pit, stone on cars, lime, brick,

Atlanta quotes sand, stone and gravel per

Dallas

per 180-lb bbl. Steel, cast-iron pipe and

delivered. San Francisco quotes on Heath houses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at

Seattle

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds.

## Changes Since Last Week

Structural steel shapes and plates are quoted at the Pittsburgh mills at $1.60 @ $1.65; with reinforcing bars at $1.60 per 100 lb. Smaller tonnages, however, have been quoted at $1.75 for plates and shapes and $1.65 per 100 lb. for bars. Mill shipments, New York, are quoted at $1.98 @ $2.13 for structural shapes and plates; bars at $1.98 @ $2.03 per 100 lb. Shipments of steel shapes from the mill via all rail to Minneapolis are quoted at $2.51; by lake and rail, $2.45 per 100 lb.

Cast-iron pipe has advanced slightly in Dallas and Chicago and declined in New York and Montreal.

Dallas quotes cement at $2.55 as against $2.80 per bbl.; with sand and gravel both at $2.25 per cu-yd. San Francisco reports a reduction of 5c. per bbl. in cement and Seattle quotes a drop of 50c. per cu.yd. in crushed stone.

Long leaf yellow pine, base sizes, has advanced $3 in Atlanta; $2 in Chicago and $1 per m. ft. in Denver, San Francisco and Seattle.

Hydrated finishing lime is quoted at $27.50 as against $24 per ton, in Seattle. Common lump lime is up 10c. in Chicago and down 35c. per bbl. in San Francisco.

Common brick is quoted at $15.50 @ $16. per 1000, wholesale, in New York. Slight declines in hollow tile are reported in Atlanta and Seattle.

Decreases ranging from 2c. to 8c. per gal. are shown in linseed oil prices in six of the principal cities of the United States; but Montreal quotes an advance of 2c. per gal in 5 bbl. lots.

Common labor is now available in Montreal at [illegible] per hr. and labor unions are also reported as being in process of formation there.

In Boston, carpenters are receiving 75c. as against 90c. and common labor 40c. as compared with 55c. per hr., formerly. The wage scale in San Francisco is reported as follows: Brick layers, $1.16; carpenters, hoisting engineers and pile drivers, $1.03; structural iron workers, $1.16; hod carriers, 92c. and common labor, 75c per hour. Pile-drivers, in New York are receiving $1 as against $1.12½ per hr.; making the present rate $8 as compared with $9 per day, formerly. The State Industrial Commission has approved the building trades' wage reduction schedule in Colorado. Contractors at Colorado Springs, however, have delayed putting the new scale into effect until October 20.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
*Editor*

Volume 87 — NEW YORK, OCTOBER 20, 1921 — Number 16

## Will It Be War?

LET us not disguise the fact that if the railroad workers tie up the country Oct. 30, it will be WAR—not the war of powder and shot, but a rebellion in which one section of the community will claim the right to deprive the rest of us of food and fuel and work. That is war. It is stoppage of the blood stream of the nation. If the men will not listen to reason, if they refuse to accept the working of the machinery provided by law, by the Transportation Act, there can be only one answer—the country will have to commandeer every able-bodied man who believes in law and order, and then, painfully and slowly, while the highways function as an emergency measure, get the railroads back to work with new forces. Any group that conspires against the whole public must be taught that it cannot prevail.

## The Club Will Not Do

THERE is some feeling that the brotherhoods are using the strike call as a club; if they fail to secure a modification of the 12-per cent reduction ordered by the War Labor Board, they will recall the strike order and find some way of saving their faces. There is no value on speculating on this surmise. It is worth recalling, though, that they have precedent in expecting good results from using the nation-wide strike threat. They used it in 1916—and won. Supported by President Wilson, they forced from Congress the 8-hr.-work-for-10-hr.-pay Adamson law, with its inherent overtime abuses. A country on the verge of war, a country more sympathetic to the demands of labor then than now, allowed the President to put the law through. If we are correct in our view, often expressed in these columns, that labor's excesses during and since the war have lost for it the sympathies of millions, the public will not again—at least, not now—sanction an abject capitulation to the brotherhoods. The club of 1916 has, under the withering sun of public distrust, dwindled into a reed.

## Wrong Time To Strike

THERE are other reasons, other than the heavy loss in sympathy, why public disapproval of the threatening walkout is to be expected. Wages and salaries everywhere are on the down grade. The public, while accepting reductions, will not be tolerant of those who cripple the country in order to maintain their own wages. Secondly, the strike is not against the carriers, but against the government, against the decision of the War Labor Board, which was established by Congress—by the very Congress which the brotherhoods and the President clubbed into giving them the silver-lined Adamson law. They love Congress on the way up, but reject it on the way down. Finally, in a time of unemployment, aye, in the very week in which the government has terminated a conference that has made unemployment relief dramatic, the railroad workers not only decide to increase the unemployed ranks by quitting work themselves, but complacently proceed to throw out hundreds of thousands of others through the inevitable consequent stoppage in mines and factories. In the wake of a railroad stoppage, too, must follow further distress through the rise of food and fuel prices, adding so much more to the burden of the unemployed. Surely, this is no time to strike. Conditions at the present have stacked the cards against the brotherhoods. They are sure to fail.

## Meeting the Crisis

AS WAS to be expected, plans are already under way for meeting the strike. It is apparent that outsiders will have to be impressed, at least temporarily, into railroad service, and that the highways will have to be used to the utmost until the railroad wheels are again moving normally. The highways and the motor truck saved the situation during the English railway strike. They will be almost as effective here, though, obviously, in our stretched-out West and South, their service cannot be as helpful as in compact England and in our own thickly settled East. Of volunteers for any work there will be no shortage. We will do as well in this respect as England did. No class there was found wanting—the essential requirement is effective organization. Men and highway transport will not be found wanting.

## Railway Obstacles to City Growth

CONTROVERSY over track arrangements has arisen in many cities as a result of permission or encouragement given the railways in earlier days to lay their lines where and how they pleased, the municipal authorities acting without due consideration for the city's probable future growth. Aggravated cases occur in streets as well as on private right of way. The problem of securing removal of tracks or abandonment of right of way within city limits is a problem distinct from, but frequently related to, that of separation of grades in order to eliminate street crossings at grade. In "city planning" projects such difficulties are frequently encountered. For this reason it is of interest to record the successful inauguration at Dallas, Tex., of a policy for clearing the streets of railway tracks and also improving the facilities for both street and railway traffic. In that city, the usual haphazard development of trackage by several railways during a term of years has cut up the business section and hampered its growth seriously, main lines and sidings having been laid in some of the streets. As the occupancy was covered by franchises it was not easy to get the tracks removed. Co-operation rather than coercion has been the principle of action. Recognizing the rights of the railways, a site for a new industrial district adjacent

to the business section was secured, rights-of-way on this being offered to the railways in exchange for their abandonment of certain lines. This offer has been accepted by one road and is under consideration by others. Undoubtedly the results will be of mutual benefit to the railways, the business interests and the public. Utilization of abandoned railway rights-of-way for new streets and boulevards is an unusual and particularly interesting phase of the improved project.

### Imhoff Tanks at Baltimore

SWEEPING conclusions against Imhoff tanks should not be drawn from the fact that Baltimore has returned to primary settling and separate sludge digestion tanks for extensions to its sewage-works after trying both kinds alongside. The entire record should be studied to learn how far local conditions militated against Imhoff tanks at Baltimore and to what extent the same general conditions are likely to prevail at any other place where Imhoff tanks are under consideration. These remarks are prompted by the article on extensions to the Baltimore sewage-works, in this issue, and the much more detailed article on nine-years' operating results in our issue of July 14, p. 50. There should also be considered an article entitled "The Truth About Imhoff Sewage Tanks at Baltimore," in our issue of July 11, 1918, p. 84, and resulting correspondence, Aug. 22, 1918, p. 374. These three articles, by as many men with intimate knowledge of the subject, leave no doubt as to the conviction of their authors that primary settling and separate sludge digestion tanks are better than Imhoff tanks for Baltimore conditions. The Baltimore experiences while adding to the growing body of testimony against Imhoff tanks, should be studied in detail before being made the basis for sweeping generalizations.

### Doubting Thomases Satisfied

THERE were many doubting Thomases when the President's Unemployment Conference was announced. Previous general conferences had come to naught, therefore, little was expected from this one. The results, however, are encouraging. One cannot record now a definite lessening of unemployment due to the conference, but it is of record that within one week of the passing of the recommendations regarding emergency relief thirty-one cities had organized suitable committees; this number has by now been much increased. The conference has definitely succeeded in throwing back on the local communities a problem that is properly theirs, but which some wanted to pass on to the federal government, and others were neglecting out of ignorance of its seriousness and of effective methods of attack. On the functioning of the local committees, of course, depends the results, but here, again, the conference has done what it could by erecting an activating and stimulating agency in the Department of Commerce. The doubting Thomases are being well satisfied regarding the Unemployment Conference.

### In a Spirit of Good Will

SECRETARY HOOVER, in closing the unemployment conference, gave voice to a thought that is worth passing along—that this was the first time, except under war pressure, that extremes of social thought had been brought together under government supervision, and had departed in a spirit of good will. Disagreements in detail there necessarily were, while from one of the committees majority and minority reports, not acted on by the conference, were received. But in the sincere search for fundamentals, the controversial points were, as a rule, put aside. As a result, there was agreement on views that make a worth-while contribution to the solution of the problem in hand. It is an instance of what can be done under tactful, purposeful, and broad leadership—a leadership in this instance furnished by Mr. Hoover.

## Lessons in a Penstock Break

THE interest that naturally attaches to any failure in engineering work because of the opportunity of learning something therefrom is increased in the case of the accident to the Big Creek No. 8 penstock because hammer-welded pipe is in use under high heads in many other western plants. If there had been foundation for the early rumors that a joint in the welded pipe had failed, it would have engendered apprehension concerning all welded high-head pipe now in service. Fortunately the accident constitutes a testimonial to the strength of welded pipe, as the steel plate of the penstock shell tore parallel to and across welds without developing any weakness in them. The defective spot where the break is believed to have started is found to have been an interior flaw in a steel casting used as a manhole frame, and not a welding fault.

In the light of this incident it is safe to say that steel castings, because of the dangers of hidden defects to which they are subject, are now a thing of the past in high-head penstocks except where they can be used with a safety factor sufficient to make the unit stresses very low. Where the size and shape of the special work make it feasible to use steel forgings, these will doubtless be standard practice henceforth.

The entry of the human element unfortunately does not permit of equal assurance that other causes, which were more or less important factors in the accident, will not be repeated. There is every indication that this was a clear-cut case of being in too much of a hurry to finish the job. The development was rushed at highest possible speed from the outset. Under such conditions even in the best organizations there is danger of overlooking things essential to safe operation. If the rush had ended when the time for testing-out came, everything might have been well. Good practice in plants where long penstocks and high heads are used calls for tests, inspections and adjustments; they take time, but they are as important as the selection of proper materials or correct design. For example, in testing out such a plant it is advisable to begin with the opening stroke of the governor set slow enough to eliminate any danger of breaking the water column. Western conditions call for unusually slow governor opening—as much as 45 or 60 seconds is advisable under the characteristics of some plants. By placing pressure gages at various points along the pipe line and carefully studying the characteristics it is possible to adjust the governor so the hydraulic gradient will never be likely to approach the danger point.

The Big Creek No. 8 plant had just been put on governor control at the time of the accident, but no official statement has been made as to what governor setting was used. The conditions stated in the article in this issue lead to the conclusion that the gates were opened

quickly and then suddenly closed. If the opening stroke of the governor was as rapid as 3 or 4 seconds, for example, there would be grave danger, on such a plant as this, of a pressure rise in the penstock amounting to perhaps several hundred per cent and this would endanger even a pipe line in perfect condition.

As to the conditions at the upper end of the penstock, it is only necessary to call attention to the fact that, as operated at the time of the accident, a long penstock 8 ft. in diameter at the top was served by a temporary connection 6 ft. in diameter and with only a 6-in. air vent. The 6-ft. pipe was supplied by a long tunnel driven with not much more slope than the hydraulic gradient. This constitutes a hydraulic combination which, in the event of any rapid velocity in the penstock, would permit the hydraulic grade line to drop to a point where a break in the water column might occur.

To summarize: First, adequate time must be allowed for testing out and adjusting automatic control features of a high-head plant before they can be expected to function properly. Second, steel castings should not be used where the cost of forgings is within reason, or, where the former are used, the unit stress should be kept low. Third, adequate surge chamber and air vent provisions constitute a penstock protection when other safeguards fail and should never be neglected.

## New Developments in Impact

SOME of the most troublesome problems in engineering must be attacked by mass experimentation. Bridge impact is a problem of this kind, and the English tests reported in some detail on another page represent mass experimentation of prime character. They come as a most pleasant surprise in a field where experimental study has been dormant for a long time. Moreover, furnishing almost the sole data on the subject we possess outside the tests conducted by Prof. Turneaure for the American Railway Engineering Association, they have great weight and merit the most careful study.

Taking a broad survey of the work, as the easiest way to become oriented in a large mass of facts, it will appear from the summary sheets that the numerical results of the new tests are quite as erratically scattered as those heretofore obtained. Erratic results, however, are not a satisfactory basis for the development of laws or of safe working rules, until a sufficient number of data has been accumulated to define the range of variation fairly definitely. A glance at the composite plot of the results compared with those of the A. R. E. A., reproduced directly from Maj. Mount's report, suggests at once that in spite of the great number of tests conducted by his committee, their principal effect is to point out the need for further experimentation.

In this particular field—a remarkably complex one—much depends on primary conceptions. What does the term impact mean? In substance, we may say, it implies weighing the traffic service of a bridge in pounds: estimating the effect of moving trains in terms of dead weight. Such weighing is an obvious prerequisite to the possibility of proportioning railway bridges with proper regard for the relation of strength of materials to service. Major Mount goes more directly to the point in this respect than some prior writers, by defining impact as "the effect produced upon any member of a structure by a moving load which results in stress exceeding the static stress." He might as well have written the last words "ideal static stress," since, in actual practice, comparisons between live-load effect and calculation are made on this basis. The elementary calculations of bridge stress are, as a matter of fact, made without regard to such practical factors as stiff joints, or crookedness or eccentricity of members—secondary actions, so called. But it is not certain that all engineers will be prepared to accept Mount's definition. It would mean much for progress if agreement could be reached on these fundamental conceptions.

Special value attaches to the Ministry of Transport measurements on account of the instrument used. It is the first photo-recording extensometer applied to this class of testing, so far as we know, and the results of its working are instructive despite what the report says about deficiencies of the device. The extensometer apparently proved itself highly sensitive and free from inertia.

For this very reason it is the more significant that the final results are erratic. The fact seems to prove what many have heretofore suspected, namely that the phenomena of impact are essentially complex and erratic, being not a single action but the chance sum of several chance effects. If this is the case, however, no refined formula to express impact values for purposes of bridge design is worth while, or, for that matter, is possible.

One of the special features of the Mount tests is that very short spans were tested. The results with these supplement prior data in an essential way—perhaps not so much in their bearing on the proper impact formula as in their applicability to the proportioning of such details as flange rivets and connections of floor members. The short-span figures would be of utmost importance with respect to the determination of the proper formula, could we be certain that the results for varying span lengths are necessarily a consistent, continuous series. But this has not been established by test data, nor is it axiomatic, if impact is a composite of several actions.

In the observation of what the report calls "high-frequency vibrations" we have probably the most important new fact developed by this test series. The data are not wholly convincing as to the existence of such vibrations, yet it may prove that the phenomena is real and important. The bridge engineers of India, who are attacking the subject of impact with special vigor and to whom the revival of interest in the problem seems largely due, regard it as so essentially a matter of vibration that the recent report of C. W. Lloyd Jones on his study of impact practice in the United States is entitled "The Vibration of Railway Bridges."

Incidentally, the Lloyd Jones report suggests that it may be found most suitable to treat impact as an engine excess, since most of the impact arises from the engine and much smaller amounts are due to the wheels of the following trains, an observation well supported by H. S. Sales' report on the preliminary Indian impact measurements, which has just appeared. Major Mount's committee, on the other hand, recommends a formula of the Pencoyd type, but with higher values for very short spans and lower values for long spans than the formula current here. In view of these significant tendencies abroad it will be interesting to observe what contribution to the subject will be made by the American committee now considering bridge specifications.

*Practical Hints on Operation and Maintenance*

# Central Mixing for Concrete Roads

By C. S. Hill
Associate Editor Engineering News-Record

*There are brought together in this article the conclusions of about two years' experience in concrete road construction by central mixing and wet-batch haulage. These conclusions are based on studies by the editors of many central mixing plant operations supplemented by opinions and data from highway engineers and contractors who have employed central mixing. The studies have been largely confined to the four states, Illinois, Wisconsin, Iowa and Minnesota, where the new practice is most common. They are of particular interest in view of the fact that outside of this group of states wet batch haulage has gained little favor and is forbidden by some highway departments.*—EDITOR.

ILLINOIS in 1920-21 had a dozen central mixing plants employed in concrete road construction. In Wisconsin, Iowa and Minnesota the number of installations was smaller, but some of them were on unusually large operations. Except for occasional street-paving operations, the practice of central mixing in these states began in 1919. In that year a few plants were installed, almost experimentally by contractors, and approved by highway officials, with the mental reservation that the product should be rigidly scrutinized. Their operation disclosed no serious objections; in fact they made converts to central mixing of many contractors and highway officials. Two year's further experience has cooled the first enthusiasm and the engineer can now review the results in fair perspective.

General conclusions may be drawn as follows:

1. Where conditions favor their use, central mixing and wet-batch haulage are an economical method of concrete road construction.

2. The product has been accepted generally as meeting the requirements of prevailing specifications but it is considered necessary to keep careful watch of its quality.

3. The proportions and consistency of mixture which best endure transportation require investigation and a quantitative means of determining consistency is needed.

4. Mixing plant and hauling equipment practice has not been worked out and requires improvement in plan, co-ordination and details.

Of these conclusions the second and third are obviously the constants of the central mixing problem. Suitability of the method and, to a smaller extent, the plant equipment are determined by local conditions, but quality of product and means of ensuring this quality are invariable requirements. They determine the service value of the road while the other two factors only affect its construction costs. Discussion of product is, therefore, of most immediate importance and it separates into a consideration of (1) segregation, and (2) proportions and consistency.

## Segregation

Segregation is a danger which obstructs all ways of transporting wet concrete. It is not peculiar to road construction. It calls for care in chuting the material a few scores of feet and it is a positive danger in carrying the material greater distances in trucks, cars and other containers. Therefore the road engineer has in segregation the common problem of all concrete construction but it is made more difficult by the greater distances which the material has to be transported. This thought is emphasized because there has been a disposition to magnify segregation into a danger peculiar to concrete road construction by central mixing.

When segregation occurs during transportation the only positive remedy is remixing. If, however, the separation of aggregates and liquid mortar is not excessive, methods of placing may remedy the condition sufficiently to overcome practical objections against the concrete being used. This is an important fact in concrete road construction. The placing of the concrete in a thin layer open to view permits minor conditions of segregation to be remedied in spreading and the use of the finishing machine, a practical necessity with concrete dry enough to be hauled a long distance, still further helps by its violent churning action to secure uniformity.

Concrete is hauled longer distances—one to three miles—in road construction than in other operations. It has been hauled five and six miles but there is reasonable doubt whether a longer haul than 2½ to 3 miles is economical if a considerable quantity has to be handled. Some engineers set the economic limit at a 40-min. haul. Because of the distance hauled, nearly always a jolting trip in trucks over rough roads, segregation is particularly likely. Its extent is determined by the following factors:

1. Time of haul and character of the road: the longer the batch is traveling and the more jolting it receives, the greater is the separation of the aggregates and the more firmly they are compacted in the bottom of the container.

2. Character of aggregate: a gravel mixture segregates more easily than does a broken stone mixture.

3. Consistency: segregation is least in dry mixtures.

4. Proportions: Proportions which give a well-graded and, therefore, a dense mixture, reduce segregation.

## Consistency and Proportions

In actual road construction other factors than segregation control the character of the aggregate, the consistency of the mixture and its proportions. First, the aggregate which is economically available has to be used. Second, the proportions in most specifications are limited to 1:1½:3 and 1:2:4. More variation in consistency is practiced, but stiff mixtures are most common. Practically, the difficulty of placing and furnishing a dry mixture sets a constructional-economic limit to dryness for the mere purpose of decreasing segrega-

tion. With these general facts in mind, the results of experience with respect to consistency and proportions for wet-batch haulage can be stated as follows:

1. A dry mixture is best for wet-batch haulage. Dry concrete is a relative term but there is for concrete a certain consistency which endures transportation without serious segregation. A quantitative definition of this consistency has not been determined. A descriptive definition is about as follows: The concrete should not flatten out when dumped from the mixer into the truck but should stand slightly heaped, possibly 8 to 10 in., in the ordinary four-bag-batch container, and flatten out only after the truck has traveled several hundred feet. This consistency gives about a 1-in. slump, in the regulation test, for an ordinary gravel mixture. It makes about as stiff a concrete as is workable a concrete too stiff for hand finishing and requiring a finishing machine.

The standard slump test is not sufficient for determining the safe consistency of mixture for wet-batch haulage. It is indicative and should be retained but with skilled foremen and inspectors a closer check can be held on the mixture by its appearance as it is discharged from the mixer or from the truck at the end of the haul. The slump of a gravel concrete is different than that of a stone concrete. Also, the gradation of the mixture and the size of the aggregate effect the slump. Therefore, the slump of a concrete is not a close enough measure to detect the narrow zone of variation in wetness between a mixture which will segregate and one which will not. A few quarts of water will make a safe mixture unsafe in respect to segregation.

2. The proportions of the mixture are significant in west-batch haulage only as they affect gradation. Well-graded materials, that is, a dense mixture, decrease the tendency to segregate. The opinion sometime expressed by hauling crews that a 1:2:4, or some other, mixture cannot be hauled wet, is based on misapprehension. If a mixture is well graded it makes little difference in its tendency to segregate what its numerical proportions may be. In Iowa, where the use of pit-run gravel has been highly perfected, proportions as odd as 1:2½:1 have been hauled wet.

### Construction Difficulties

Wet-batch haulage involves construction difficulties which do not exist when the mixing is done on the road. More weight has to be hauled and more work is required to place and finish the concrete.

With mixtures showing a 1 to 2-in. slump, trouble has been experienced generally in securing a dump body which will discharge all its contents. On short hauls and with ideal conditions the mixed concrete will dump without adhering, however, the major part of the time it is necessary to pick or dig a portion from the truck regardless of the type of body used. The packed material when loosened requires more work to secure uniformity in placing than where the concrete is distributed directly from the mixer onto the subgrade. The water in the mixed concrete of course, adds to the weight hauled compared with dry batch haulage.

A concrete dry enough to be hauled wet ordinarily cannot be finished economically by hand. With finishing machines little difficulty is experienced. During extremely hot weather it is necessary to wet the sand as well as the stone or gravel sometime in advance of the mixing. Enough water to saturate the sand is required. If it is not soaked the material will absorb water while the batch is being hauled and there will be trouble in dumping and finishing. Under normal conditions little difficulty is experienced in machine finishing concrete which has been hauled three or four miles, but in very hot weather the concrete is sometimes too stiff, after being hauled several miles, to be finished easily.

Roads built of concrete hauled from central mixing plants have not been long enough in service to indicate conclusively whether they are inferior or superior to roads built of concrete mixed on the grade.

Observation generally does not indicate that there is any difference in the strength of the concrete. This conclusion is supported by tests at three months of field specimens from a number of concrete road jobs in Iowa. On five jobs carried on in 1920 using 1:2:3½ sand- and gravel-concrete, the mixing was done on the road for three and at a central plant, with wet batch haulage, for two, and the results of crushing tests were as follows:

| | |
|---|---|
| Average of 19 specimens, road mix | 3,660 lb |
| Average of 24 specimens, road mix | 3,870 lb |
| Average 30 specimens, road mix | 3,990 lb |
| Average of 21 specimens, central mix | 3,600 lb |
| Average of 26 specimens, central mix | 3,160 lb |

There is radical difference of opinion respecting the uniformity of the concrete secured when central mixing and wet-batch haulage are employed. The extreme opinions may be summarized as follows:

1. In no case has it been possible to secure a uniform concrete when wet concrete was hauled. It is believed that unless the concrete is remixed after reaching the road a non-uniform pavement will result.

2. The concrete which is delivered by wet-batch haulage provides a satisfactory road.

### Conclusion

In three of the four states whose experience has been reviewed central mixing with wet-batch haulage is considered a satisfactory construction method, when the work is carefully directed. In the fourth state inability to secure uniformity of product has raised the question whether the method should not be discontinued.

The complete success of wet-batch haulage required that some means of controlling segregation with more precision than is now practicable must be developed.

## Power Gas from Birmingham Sewage Sludge

Promising results from the utilization of gas derived from sewage sludge are indicated by experiments conducted under the direction of John D. Watson, engineer of the Birmingham sewage-works, England, according to a paper presented by him to the Engineering Section of the British Association for the advancement of science, about the middle of September. Notwithstanding various drawbacks, including the lack of a gasholder, gas was produced at low cost, says the London *Surveyor* of Sept. 23. The engine used is described as "a standard town gas engine, capable of giving 34 brake horsepower maximum with town gas having a calorific value of 500 to 550 B.t.u." The tests indicated that sewage sludge would yield a gas of 650 to 700 B.t.u. Mr. Watson estimated that the 9,000 (long) tons of dry solids in the sewage sludge produced yearly at the Birmingham sewage-works could be made to yield 320,000,000 cu.ft. of gas, equal to 16,000,000 hp.-hr., taking 20 cu.ft. per brake horsepower. This would give 4,400 hp. per day of 10 hours.

# Concrete Girders Jacked Up To Replace Settled Bridge Pier

By William J. Titus

Bridge Engineer, Indiana State Highway Commission.

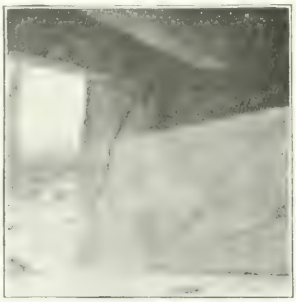
BY SUPPORTING two concrete girder spans on jacks while a settled pier was removed and replaced, the Indiana State Highway Commission was able recently to repair a damaged bridge at a cost of about $1,800 when a new one would have cost $15,000.

The bridge, on Road 33, about 2½ miles west to Waynetown, Fountain Co., consists of a four-span reinforced-concrete deck girder bridge with a 17-ft. roadway and total length of 100 ft. face to face of abutments. It was built less than 10 years ago, but the west pier had never been founded upon the solid limestone which existed only a few feet below the bottom of the old

TWO SPANS AT LEFT WERE JACKED UP AND THE PIER CARRYING THEM REPLACED

foundation. This pier had settled about 6 in. on one end and 8 in. on the other, seriously cracking the pier and so cracking the adjacent girder spans that it was feared that it would be impossible to raise the spans without destroying them.

The program, therefore, was to raise these spans to their original position, blast out the old pier, excavate the foundation to the bedrock and replace the pier with a new one of concrete. The adjacent spans consist of five reinforced concrete T-beams 12 in. wide and 2 ft. 4 in. deep on the underside of the 6-in. roadway slab. A 10-in. handrailing 3 ft. 7 in. high existed on each side of the old bridge. The contractor first excavated at each end of the old pier and built timber grillages about 10 ft. square. On top of these grillages he placed some heavy timbers to distribute the load and then placed two 10-in. 25-lb. I-beams on each side of the pier. At each end of each pair of these I-beams were placed four screw-jacks and a man was placed to operate each jack continuously until the spans were raised to their proper position.



CRACK IN PIER DUE TO SETTLEMENT

The total load to be supported was approximately 132,000 lb. so that each jack had to carry approximately four tons. A little computation makes it evident that the I-beams were very seriously overstressed, to almost 45,000 lb. per square inch. In fact a measured deflection in these I-beams of 2½ in. very quickly developed. Contrary to our fears the stress in the I-beams was not beyond the yield point and no additional deflection developed. It had been suggested to the contractor that larger beams would be necessary but he was sure that "four 10-in. beams would hold up almost anything."

The blasting out of the old pier, the excavation to bedrock about 8 ft. below low water level, and the placing of the new pier proceeded without any unusual incidents. The weight of the spans was lowered on to the new concrete, the centering removed and the bridge opened Aug. 28, about sixty days after work started.

# Sewer Grades and Sewage Disposal

## A British View on Dilution Standards, Activation by Spiral Movement, Low Sewer Velocities and Sewage Utilization

ACTIVATED sludge as a means of sewage treatment, sewage disposal by dilution with special reference to dilution standards and to experience with the Chicago Drainage Canal, some of the high points in a report on sewerage and sewage disposal for a South American city, with special reference to the permissibility of low sewer grades and to sewage disposal by dilution or possible use of the sewage for irrigation in the future, were features in the second annual presidential address of Arthur J. Martin, consulting engineer, London, England, before the Association of Managers of Sewage Disposal Works some months ago.

In reviewing briefly the activated-sludge process in England and the United States, Mr. Martin referred to the adoption of a process for the treatment of the sewage of Worcester and Reading in England and of Milwaukee and a part of the Sanitary District of Chicago in the United States. Mention of Chicago naturally led up to the Chicago Drainage Canal and to the remark that "no greater or more daring experiment in the disposal of sewage by dilution has ever been made." Mr. Martin then characterized the results as "far from satisfactory" and gave the following comparisons of standards of dilution in terms of the amount of clean water in cubic feet per minute required to dilute the sewage of 1,000 people, as follows:

| | |
|---|---|
| Chicago (originally considered necessary) | 2nd |
| Chicago, Howard Soc[illegible] | 1st |
| Chicago (actually used) | 168 to 218 |
| Proposal by Committee of American Public Health Association | 240 to 720 |
| Proposal by Dibdin, Royal Commission | 1167 |

After noting that the dilution proposed by the Royal Commission is 4½ to 7 times that proposed by the American Public Health Association and 8 to 10 times that actually used in Chicago, Mr. Martin says that obviously the commissioners did not intend their recommendations to be applied too literally, since nothing is said about the strength of the sewage. Account also must be taken of the conditions governing the admixture of the sewage in the water. Mr. Martin added: "I have seen the sewage from a tank floating in an unmistakable layer on the surface of the sea, although the volume of the latter must have been many million times" that of the sewage. "For these and other reasons," Mr. Martin stated, "a very liberal margin of safety must be allowed" in all proposals for sewage disposal by dilution.

Mr. Martin's outline of a sewage disposal problem in South America with which he had to deal (apparently in 1920), in the course of which he made some interesting remarks on sewer grades and on final disposal of sewage, were in part as follows:

A population of 100,000, rising to a quarter of a million; a city occupying some 1,700 acres of land; bounded on the north by a range of hills, on the east by a large tidal river, on the west by a long tortuous arm of the sea, on the south by a low level plain stretching far down the river. The natural level of the ground in the city below high-water mark of the highest tides; the improved portions 3 or 4 ft. higher. A water supply of 8.8 Imp. gal. per head per day, to be increased shortly to 44 Imp. gal. No manufactures likely to affect the composition of the sewage. A rainfall confined to the period from December to June, with frequent falls at the rate of 1 in. per hour or over and a recorded fall of 6 in. in 1 hr. and 50 min. No existing sewers other than a few surface water drains, receiving also some sewage.

The combined system was out of the question, for to carry the largest recorded rainfall with a velocity of 3 ft. per second a tunnel 47 ft. in diameter would have been required. It was impracticable even to provide sewers to carry the rain water from the back slopes of the roofs and the inner courts of the houses.

Recourse to pumping seemed to be inevitable, for the sewage must be carried clear of the furthest limits of the future city. The heads of some of the sewers will be more than six miles from the outfall; and fall is woefully scanty. The only hope of avoiding pumping lay in the rise and fall of the tides, which range from 6½ to 12½ ft. Self-cleansing velocities were of course a *sine qua non*.

### A Heretic on Sewer Gradients

I am, as some of you may be aware, a bit of a heretic in the matter of sewer gradients. We are told in the textbooks that a sewer cannot be relied on to keep itself clear if the velocity of the sewage is less than 2, 2½ or even 3 ft. a second. As a matter of fact I doubt whether there is a town in England without many sewers in which the lowest of these velocities is seldom, if ever, attained. True, the sewers are laid at gradients which give the desired velocity —on paper; but the flow in them is ordinarily so small in relation to their capacity that the velocity is nowhere near that which the gradient is tabled to give. And yet, in defiance of the prophets, these sewers persist in keeping themselves clear. I know one such sewer in which, through the scantiness of the present water supply, the ordinary velocity is about 1 ft. per second, but from which no trouble has ever been experienced.

Undoubtedly many flat sewers do silt up, or even choke, and for this the gradient has generally to bear the blame. Many an innocent man has been hanged on this kind of evidence. I have not the slightest doubt that, if every case of chokage could be investigated, the trouble in 19 cases out of 20 would be found to be due, not to the flatness of the gradient, but to faulty laying, and in particular to the infusion of jointing material into the pipe. I therefore attach far more importance to workmanship than I do to gradient.

At the same time, when one goes to a foreign country, one has to forget a great deal that one has learnt at home, in order that he may approach the new conditions with which he is confronted with an even and unbiased mind. I was prepared to find that with the higher ground temperatures which prevail in the tropics it might be advisable to use velocities somewhat greater than had proved sufficient in one's home experience. Accordingly, I took the opportunity afforded by a stay of a few days at Cristobal (at the northern entrance to the Panama Canal) to obtain some information concerning the sewerage of that city. I found that the gradients of the sewers were uniformly flat—much flatter in fact than are used in the majority of English towns. Several 6-in. sewers, for instance, are laid with falls of 1 in 330. They receive no special treatment in the matter of flushing; and they give no trouble. To be strictly accurate, one of these flat 6-in. sewers did choke; and it had to be relieved of a couple of overalls and a shirt. But you could hardly blame the gradient for that.

The standard which I set before myself was a maximum velocity of 2 ft. per second at the hours of greatest flow, and more where practicable; and I resolved if possible to secure such velocities by gravitation. The outlook was not encouraging, but by collecting the sewage as quickly as possible into large trunk sewers which could be laid at very flat gradients, so as to economize fall for use in the branches, I was able to give every sewer a self-cleansing gradient without recourse to pumping. As an additional safeguard, means will be provided for flushing most of the sewers at high tide from the river or from the tidal creek to the west of the city.

An oval cross-section is frequently used for the purpose of getting a better velocity with small flows than can be obtained in a cricular sewer; and it occurred to me that this might be done with advantage in the case of my outfall sewer. But on going into the matter I found that, so far from the velocities being better with an oval sewer, they were worse with all depths of flow. This unexpected result was due to the flattening of the gradient through the fall absorbed by the greater height of the cross-section.

The question of disposal presented but little difficulty. The river which flows past the city drains an extensive watershed, large tracts of which are covered with perpetual snow; and the dry-weather flow in one of its tributaries which has been gaged would more than satisfy the requirements of the committee of the American Public Health Association in connection with the discharge of crude sewage. And over and above this there is the mighty volume of salt water which sweeps up the river at every tide. The current is very swift; and there are no towns, and but few houses, on the banks of the river below the city. It was clearly a case for disposal by dilution. The outfall will be three miles below the present boundary of the city, and the sewage will be stored while the tide is rising, and during the period of high water, and discharged on the falling tide.

Regarded merely from the point of view of disposal, discharge into the river is undoubtedly the best method which can be adopted; but there is another consideration which should not be lost sight of. The country lives by its agriculture. Year by year it makes a heavy draft on the fertility of the soil. The reserves of productiveness are doubtless immense. But should we be justified in squandering the enormous amount of plant food which the sewage of a quarter of a million people contains? And apart from its manurial value, 50,000 cu.m. of water per day, in a country where no rain falls for six months at a time, is an asset not to be despised. The Incas who ruled the country before its conquest by the Spaniards carried out some admirable irrigation works, most of which have long since fallen into decay.

It would be a simple and inexpensive matter to pump the sewage from the outfall sewer on to the land along its course. During the rainy season, when the soil receives from the clouds all the moisture which it can profitably utilize, the sewage would pursue its course to the river.

### Crops for Tropical Sewage Farm

You may be interested to know the kind of crops which a high authority on tropical agriculture recommends for a tropical sewage farm. I quote from his letter:

"I should say that the greatest benefit from the sewage would come from its water content rather than from its fertilizer content. . . . The land would become very much more valuable than it is at present, as paying crops could be planted. Chief among these I would place the cocoanut palm, which would yield exceedingly well if they could be kept irrigated during the dry season. Some fruits such as mangos and avocados, and several annuals such as maize and beans, and also cotton, which is grown in these climates as a perennial. All of these could be used as catchcrops between the cocoanuts until they came into bearing."

I may add that the soil is a stiff clay. It contracts and cracks when dry, and it will not readily absorb water. My

correspondent is of opinion that it will take sewage during the dry season at the rate of 3,000 gal. per acre per day. Should a sewage farm be established, skilled management would of course be essential.

Mr. Martin did not even consider it necessary to screen the sewage, at least for years to come. If, later on, some treatment of the liquid portion of the sewage of the city in question became desirable, "the activated-sludge process would have strong claims to consideration, possessing as it does the great practical advantage that the treatment may be varied in amount, or even suspended altogether, according to the needs of the moment."

### Activation by Spiral Flow in Outfall

Should the activated-sludge process be ultimately adopted in this South American city, Mr. Martin said that it might be possible to utilize the long outfall sewer, 5 ft. in diameter and three miles in length, in place of the usual activated-sludge tank by putting into effect a principle that he had suggested in his address a year earlier. This was to cause "sewage to travel in a spiral direction in a long tubular chamber at a velocity sufficient to keep the sewage, the air and the sludge intimately intermixed." In the case of the outfall sewer just mentioned, "the rotation of the sewage would be affected" by centrifugal pumps, "a due proportion of air being drawn into the suction pipes and thoroughly churned up with the sewage in the pumps." Reinforcement of the spiral motion would probably be necessary at intervals along the outfall and "the requisite amount of sludge would have to be pumped back" from the lower end to the head of the outfall. While "it may be that the purification effected in this way will be less complete than that obtained by means of diffusers, the circumstances are not such as to call for a high degree of purification."

On the future of sewage disposal, Mr. Martin said, at the conclusion of his address:

The whole history of sewage disposal forbids us to believe that finality has yet been reached. There was some excuse for thinking so ten years ago, for the bacterial purification of sewage followed nature so closely—her share in the work was so large, and man's so small—that it did seem as if we were at last on the right lines. And now forced aeration has taken the foremost place, and finality seems as far off as ever.

There are two processes of sewage treatment, and only two so far as I am aware, of which it is safe to say that they will never be superseded, purification by dilution, and purification by means of land.

It is proverbially dangerous to prophesy; but I venture to predict that among the developments of the near future will be a fuller utilization of the manurial constituents of sewage, and a more general recovery of grease. We were all spendthrifts before the war. But now the need for economy is urgent; and the sewage-works manager must do his part.

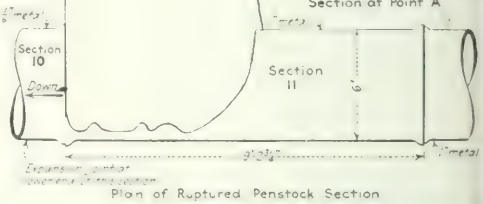
### Jackson Lake Reservoir Full for First Time

For the first time since 1916 when it was raised to its present elevation the Jackson Lake reservoir in Wyoming was filled in June to its designed capacity of 847,000 acre-ft. Water from the run-off of the 820 sq. miles of area tributary was available in 1917 and 1918 but leakage in the 4,500-ft. earth dike made it inadvisable to fill the reservoir to its full height, according to the *Reclamation Record* for September. This reservoir supplies water to 750,000 acres of land in the Snake River Valley in Idaho, one of the largest areas in the world irrigated from a single reservoir.

# Penstock Bursts During Tryout of High-Head Turbine Plant

## Six-Foot Pipe Under 560 Feet Head Ruptures After Heavy Short-Circuit—Structural and Operating Conditions

THE hydroelectric plant known as Big Creek No. 8, which was recently completed in California by the Southern California Edison Co., was put out of commission on Aug. 20 for twenty-three days by the bursting of the penstock at a point about 200 ft. from the power house. The break occurred immediately after a short circuit on the transmission line that caused a surge in the penstock, and the fracture occurred in a steel manhole casting which proved, on later examination, to have a defect in the form of a slag pocket. Because of the solid rock and well-founded concrete saddles supporting the pipe where the break occurred,




RUPTURED PENSTOCK SECTION AND SLAG POCKET IN MANHOLE RING CASTING

neither the shape nor the alignment of the penstock was disturbed on either side of the section that burst, though the upper part collapsed under external pressure as the water rushed out. The break was repaired by cutting out the damaged portion with a torch and fitting into place a sleeve which was then riveted to the two open ends after the necessary rivet holes had been drilled. The section removed was about 19 ft. long.

The Big Creek No. 8 plant operates under a head of 680 ft. and has a penstock 2,800 ft. long varying in inside diameter from 8 ft. at the top to 6 ft. at the power house, and in thickness from ⅜ in. to 1⅛ in. The upper part is riveted pipe, the lower part hammer-welded, with riveted joints between sections. The rupture occurred one length above an expansion joint in the welded pipe, and passed close to a manhole on the upper side of the pipe. Th static head at this point is about 560 ft.

*Conditions at Time of Accident.*—The single unit installed at this plant has a capacity of 22,500 kw., but up to the time of the accident it had not been carrying a load in excess of 15,000 kw. The plant had been under test for four days and on the night previous to the break was put on governor control for the first time. The unit was then developing approximately 10,000 kw. and was operating at about ¼ gate opening.

As nearly as the facts can be established from available data, at the time the short circuit occurred, shortly before 6 a.m., the gates opened and the unit took on a

additional load; some accounts estimate this additional load as high as 10,000 kw. Immediately thereafter, it is stated, the short cleared and the turbine gates closed.

Attendants at the plant describe the rupture of the pipe as a progressive occurrence. With the first report, presumably marking the first escape of water through the weak spot of the manhole-ring casting where the slag pocket was later found, a small stream of water, apparently from the top of the pipe and under extremely high pressure, shot high in the air and passed entirely over the power house. This was followed by a rapidly broadening stream of larger volume that struck the temporary end wall of the power house squarely and swept into the structure. The broader stream is believed to have marked the longitudinal ripping of the pipe, which occurred for a length of 8 to 10 ft. Later still a circumferential tear laid the ruptured section wide open. In its final position this portion of the side wall of the pipe was almost flattened down on the ground. The circumferential tear and the large opening it caused were on the side away from the power house, and the larger volume of water was diverted away from the structure during the remainder of the flow.

Gages and other instruments in the plant were damaged by the stream of water entering the plant, so that complete operating data are not available. It is stated, however, that the short circuit caused a sudden draft of water resulting in a drop in pressure in the penstock of about 30 lb. per sq.in., which may have caused a break in the water column. On this analysis the closing of the turbine gates, upon clearing of the short circuit, retarded the lower water column to such an extent that it was rammed by the upper water column, thus producing a destructive pressure rise.

*Construction Incomplete.*—When the break occurred the plant was operating without forebay or surge chamber. Construction on that feature of the development had not been completed, and a by-pass or temporary direct connection between tunnel and penstock was being used. This connection consisted of a 6-ft. pipe and was about 150 ft. long. The air-vent at the upper end of the penstock consisted of a 6-in. pipe.

At the time of the break the sudden release of water under spouting velocity emptied the pipe quickly, collapsing the riveted pipe at the upper end of the penstock for a distance of approximately 450 ft. The collapsed section of the pipe has since been restored to approximately the original shape by filling the pipe and subjecting it to a slight additional pressure, a temporary bulkhead in the lower end of the collapsed section being used meantime to hold the water. This collapsed section extended down to an expansion joint in the first length of welded pipe. The expansion joint was pulled open by the collapse of the pipe above.

*Break Not at Welds.*—The line of break of the ruptured section of pipe passed along the manhole-ring casting but did not cut across the ring, as may be seen in the plan sketch herewith. Except at this manhole, the break did not follow welded joints but went through the metal. The longitudinal tear crossed a circumferential weld, and the circumferential part of the break occurred about a foot beyond that weld. There was some 5,000 lin.ft. of welded joint in the penstock, none of which gave any evidence of weakness in the stress of the accident.

*Slag Pocket in Manhole Casting.*—Early reports stated that near point *A* (see sketch) of the pipe a discoloration about $\frac{1}{2}$ x $2\frac{1}{2}$ in. on the fracture face indicated a defect in the welded joint between plate and manhole casting. Closer examination showed this spot to be outside the weld, wholly in the casting, and to represent a slag pocket in the casting. The break, in fact, passed across the weld face. A sketch of the conditions, furnished by the M. W. Kellogg Co., makers of the welded pipe, is given in the drawing herewith.

Samples taken from this point as also from other parts of the fracture were examined by the New York Testing Laboratories. Their report on microscopic study of the samples states that both plate and casting are of excellent character, but that just at the slag pocket the casting has a large-mesh structure of decidedly weak type, and many slag inclusions.

The pipe had passed both shop and field pressure tests before the plant was put in operation. In the shop tests, each length was subjected to 50 per cent excess of pressure over the final static head. In the field, the penstock as a whole after completion was tested under full static head. No difficulties or weaknesses developed in these tests.

## Effect of Drought on British Roads

*(London Correspondence)*

British road engineers are complaining of the effect of the prolonged drought on road surfaces. This has not been so apparent in the cities, where the surfaces are asphalt or wood block, nor on the country highways surfaced with tarmac. On all roads, however, which have been surfaced with macadam or gravel, the effect of the prolonged absence of rain has been very marked. In the majority of such cases, especially where the top covering has been comparatively thin, this covering has been broken up and ground to powder by heavy vehicles, especially by motor coaches, the effect of the absence of moisture being to present a brittle shell to heavy traffic. The wind has carried away this powder leaving exposed jagged flints and stones.

In some cases cracks have ensued, so that the entire bed has thoroughly disintegrated. In fact, in traversing some of these roads in an automobile, one has the impression of utilizing a country track which has never yet had the attention of a road engineer. Much repair work on these and other roads must be done in the short space of time between the arrival of necessary rain supplies and the heavy and continuous winter falls when such work is impossible. In the majority of rural districts where local authorities are dependent on wells for water, none has been available for steam roller use so that urgent repairs are necessarily delayed.

## Foreign Commerce for August

The falling off in exports and imports during August as compared with the corresponding month of 1920 is shown in the following figures recently compiled by the Bureau of Foreign and Domestic Commerce. The total imports for August, 1921, were valued at $194,767,564 as compared with $513,111,488 for August, 1920. The value of exports during August, 1920, amounted to approximately $372,000,000 as compared with $578,000,000 for the corresponding month of 1920. For the eight months of 1921 imports were valued at about $1,693,000,000 as compared with $3,994,000,000 for August, 1920, and exports at about $3,227,000,000 as compared with $5,475,000,000 for August, 1920.

# Results of Impact Tests on Bridges in England

**Photo-Recording Strain Gage Applied to 20 Bridges Yields 362 Records — High-Frequency Vibrations Found Especially in Floor Systems—General Agreement With Prior Tests—A New Formula Proposed**

AN ELABORATE set of experiments to measure impact effects in railway bridges was carried out during the past year in England by a subcommittee on bridge specifications, acting for an advisory committee for the revision of the Board of Trade requirements in regard to the opening of railways. A report on these tests has just been issued by the Ministry of Transport, the report being prepared by Major A. Mount, Inspecting Officer of Railways in that department. The work done is notable because of the number of measurements made, the use of a photo-recording strain gage of high sensitiveness and low inertia, the presence of high-frequency vibrations in the record curves, and the conclusion of the subcommittee that a new impact formula is desirable, of the same form as the Pencoyd but with different constants. The main features of the report are summarized in the following paragraph.

When discussing permissible working stresses for railway bridges, in May 1920, the subcommittee recognized "that there was divergence of practice among railway companies in dealing with impact effect. Some vary the permissible working stress of 6½ tons per square in. in accordance with the span, or with a range-of-stress formula, while a minority make no allowance." Because of these facts and the active interest in the subject already manifested by railway bridge engineers in India, the adoption of a uniform specification was considered desirable. "The adoption of the Pencoyd formula was contemplated, but it was recognized that the view was held by engineers that this formula

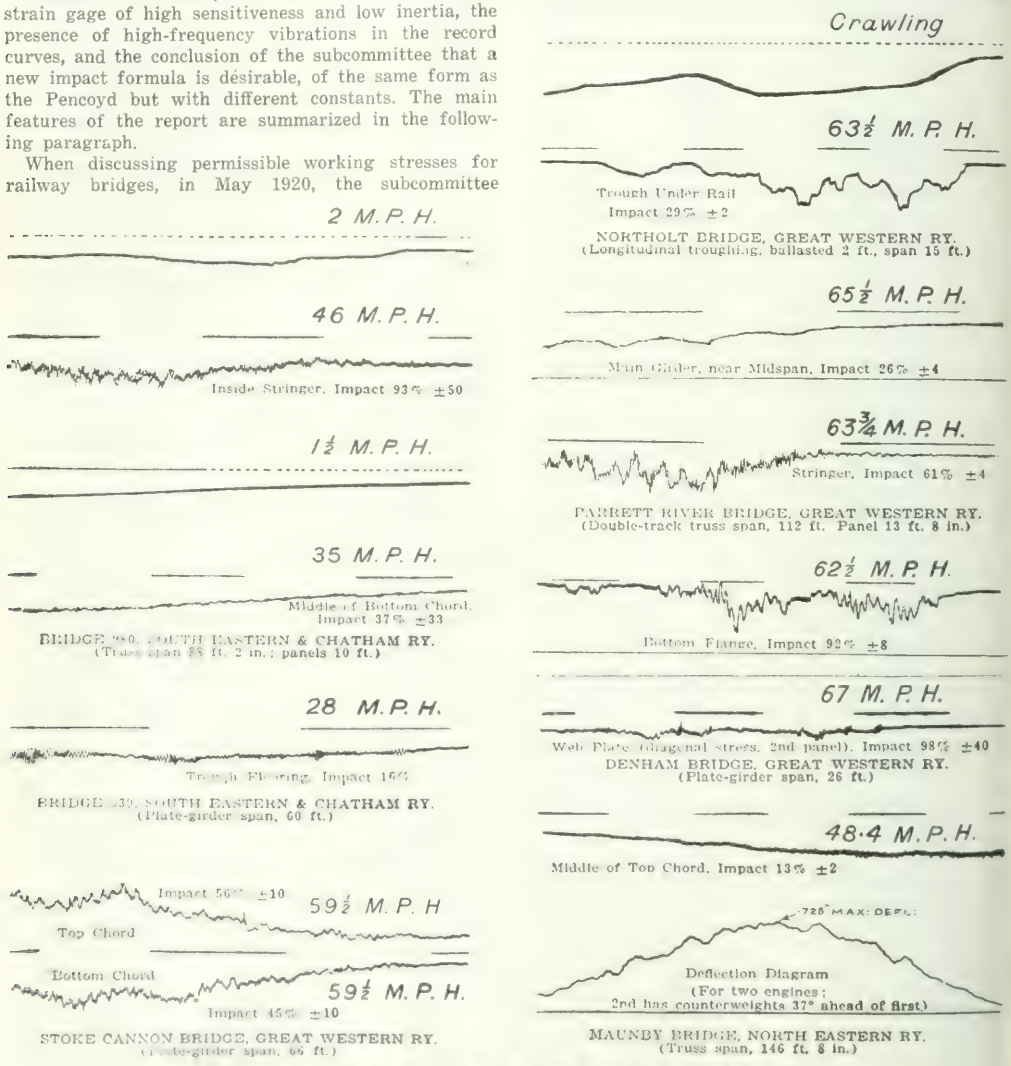

2 M.P.H.
46 M.P.H.
Inside Stringer. Impact 93% ±50
1½ M.P.H.
35 M.P.H.
Middle of Bottom Chord. Impact 37% ±33
BRIDGE 280, SOUTH EASTERN & CHATHAM RY.
(Truss span 88 ft. 2 in.; panels 10 ft.)
28 M.P.H.
Trough Flooring. Impact 16%
BRIDGE 332, SOUTH EASTERN & CHATHAM RY.
(Plate-girder span, 60 ft.)
Impact 56% ±10
59½ M.P.H
Top Chord
Bottom Chord
59½ M.P.H.
Impact 45% ±10
STOKE CANNON BRIDGE, GREAT WESTERN RY.
(Plate-girder span, 66 ft.)
Crawling
63½ M.P.H.
Trough Under Rail
Impact 29% ±2
NORTHOLT BRIDGE, GREAT WESTERN RY.
(Longitudinal troughing, ballasted 2 ft., span 15 ft.)
65½ M.P.H.
Main Girder, near Midspan. Impact 26% ±4
63¾ M.P.H.
Stringer. Impact 61% ±4
PARRETT RIVER BRIDGE, GREAT WESTERN RY.
(Double-track truss span, 112 ft. Panel 13 ft. 8 in.)
62½ M.P.H.
Bottom Flange. Impact 92% ±8
67 M.P.H.
Web Plate (diagonal stress, 2nd panel). Impact 98% ±40
DENHAM BRIDGE, GREAT WESTERN RY.
(Plate-girder span, 26 ft.)
48·4 M.P.H.
Middle of Top Chord. Impact 13% ±2
.726" MAX. DEFL.
Deflection Diagram
(For two engines;
2nd has counterweights 37° ahead of first)
MAUNBY BRIDGE, NORTH EASTERN RY.
(Truss span, 146 ft. 8 in.)

FIG. 1. SPECIMEN RECORDS OF ENGLISH TESTS OF BRIDGE IMPACT
(The curves are reproduced full original size, but show only short sections of the records)

TABULATED RESULTS OF IMPACT TESTS ON ENGLISH BRIDGES FOR COMMITTEE OF MINISTRY OF TRANSPORT

| Railway | Bridge. | Calculated Ratio D/L Main Girder. | Type | | | Effective Span of Loaded Length | Instrument Series. | Max. speed of Train m.p.h. Test Series. | Max. speed of Train m.p.h. Test Impact. | Ratio dead load to live load (static). Test Impact. | Calculated dead load plus live load (static). Tons per sq. in. | Recorded stress due to live load (static). Tons per sq. in. | Maximum recorded live load stress. Tons per sq. in. | Maximum increment per cent., col. 14 compared with col. 13. | Maximum recorded impact factor. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 2. | 3. | 4 | 5 | 6 | 7 | 8. | 9. | 10. | 11. | 12. | 13. | 14 | 15. | |
| S.E. & C.R. | 1577 | ·48 | B. | one | C.T. | 10′ 4″=4 | V. 1–7 | 58 | 58 | 0·834 | 2·98 | 1·18 | 1·90±5 | 61±4 | — |
| S.E. & C.R. | 473 | ·52 | B. | | C.T. | 1′ 0″=3 | V. 58–62 | 42 | 28 | 0·17 | 1·28 | 0·93 | 1·08 | 16 | — |
| G.W.R. | Denham | ·46 | B. | | C.T. | 11′ 6″=6′ | VI. 116–120 | 62·5 | 51·5 | 0·69 | 3·91 | 2·20 | 2·60 | 18 | — |
| G.W.R. | 124/21 | ·28 | B. | ,, | C.T. | 11′ 8″=6′ | V. 83–87 | 67·5 | 67·5 | 0·575 | 3·73 | 1·71 | 2·45±9 | 40±5 | — |
| S.E. & C.R. | 134 | ·56 | O. | one | R.B. | 7′ 6″ | VI. 42–47 | 58 | 58 | 0·129 | 1·65 | 1·67 | 3·18 | 90 | — |
| S.E. & C.R. | 134 | ·56 | O. | ,, | R.B. | 7′ 6″ | V. 42–47 | 58 | 58 | 0·134 | 1·65 | 0·87 | 2·25±11 | 159±13 | — |
| G.W.R. | Staffords | ·35 | O. | two | R.B. | 8′ 0″ | VI. 63–67 | 56 | 55 | 0·59 | 3·07 | 1·12 | 1·90±14 | 70±12 | |
| G.W.R. | Parrett | ·35 | B. | ,, | R.B. | 8′ 0″ | V. 98–101 | 63 | 63 | 0·396 | 3·78 | 0·90 | 1·50 | 67 | — |
| S.E. & C.R. | 980 | ·94 | O. | ,, | R.B. | 9′ 8″ | V. 19–25 | 54 | 46 | 0·277 | 2·57 | 0·89±11 | 1·57 | 76±22 | — |
| S.E. & C.R. | 980 | ·94 | O. | ,, | R.B. | 9′ 8″ | VI. 19–25 | 54 | 46 | 0·277 | 2·57 | 0·78±17 | 1·42±6 | 93±50 | — |
| L. & N.W.R. | 45 | ·65 | O. | ,, | C.G. | 10′ 0″ | VI. 178–181 | 65·5 | 65·5 | 0·44 | 1·49 | 1·22 | 1·95 | 60 | 43 |
| G.W.R. | Blackthorn | ·94 | B. | ,, | R.B. | 10′ 8″ | V. 106–110 | 64·5 | 64·5 | 0·43 | 3·09 | 1·65 | 2·55±14 | 54·5±9 | — |
| L. & N.W.R. | 27 | 1·98 | J.A.C. | ,, | C.G. | 12′ 0″ | VI. 170–172 | 65·5 | 65·5 | 0·96 | 1·33 | 0·5 | 0·81 | 62 | — |
| G.W.R. | Parrett | ·62 | O. | ,, | R.B. | 13′ 8″ | VI. 88–92 | 64·75 | 63·75 | 0·23 | 4·00 | 1·85 | 2·98±6 | 61±4 | — |
| G.W.R. | Stoke Cannon | ·81 | O. | ,, | R.B. | 14′ 8″ | VI. 71–75 | 63·5 | 54 | 0·24 | 3·66 | 2·12 | 2·65 | 25 | — |
| G.W.R. | Northolt | ·5 | B. | ,, | L.T. | 15′ 0″ | V. 126–130 | 63·5 | 63·5 | 2·47 | 5·56 | 2·50 | 3·22 | 29 | — |
| S.E. & C.R. | 134 | ·56 | O. | one | C.G. | 15′ 1″ | VI. 48–51 | 63 | 63 | 0·437 | 2·39 | 1·85 | 3·54±23 | 91±12 | — |
| G.W.R. | Parrett | ·35 | B. | two | C.G. | 15′ 6″ | VI. 95–101 | 63 | 63 | 0·66 | 3·30 | 2·12 | 3·00 | 46 | — |
| G.W.R. | Staffords | ·35 | O. | ,, | C.G. | 16′ 0″ | V. 63–67 | 56 | 56 | 0·22 | 2·93 | 2·28 | 3·15 | 38 | — |
| S.E. & C.R. | 980 | ·94 | O. | ,, | C.G. | 20′ 0″ | V. 26–29 | 57·5 | 57·5 | 0·662 | 1·84 | 1·20 | 1·93±8 | 61±7 | — |
| S.E. & C.R. | 339 | ·185 | O. | one | P.F. | 21′ 4″ | V. 35–40 | 57·5 | 47 | 0·33 | 1·78 | 1·42 | 2·1±7 | 48±5 | — |
| G.W.R. | Blackthorn | ·94 | B. | two | C.G. | 22′ 0″ | VI. 106–110 | 64·5 | 64·5 | 0·88 | 2·27 | 1·25±5 | 1·70±10 | 36±13 | — |
| S.E. & C.R. | 1597 | ·54 | B. | one | P.F. | 23′ 4″ | VI. 8–18 | 55 | 55 | 0·633 | 1·17 | 1·08 | 1·31 | 26 | 14 |
| G.W.R. | 124/21 | ·28 | B. | two | P.F. | 25′ 0″ | VI. 83–87 | 67·5 | 38 | 0·716 | 2·60 | 1·53 | 2·07 | 35 | — |
| G.W.R. | Denham | ·46 | B. | ,, | P.F. | 26′ 0 | V. 116–120 | 62·5 | 62·5 | 1·66 | 3·60 | 1·55 | 2·98±13 | 92±8 | 20 |
| G.W.R. | Denham | ·46 | B. | ,, | P.W. | 26′ 0″ | VI. 121–125 | 67 | 67 | 0·27 | 0·89 | 0·43±5 | 0·85±7 | 98±10 | — |
| G.W.R. | Denham | ·46 | B. | ,, | P.F. | 26′ 0″ | V. 121–125 | 67 | 67 | 1·03 | 2·29 | 1·25 | 1·95 | 56 | 20 |
| G.W.R. | Parrett | ·62 | O. | ,, | C.G. | 26′ 6″ | V. 88–92 | 64·75 | 64·75 | 0·39 | 2·08 | 1·20 | 1·73 | 44 | 21 |
| G.W.R. | Stoke Cannon | ·81 | O. | ,, | C.G. | 29′ 0″ | V. 71–75 | 63·5 | 63·5 | 0·45 | 2·08 | 1·35 | 2·00 | 48 | — |
| S.E. & C.R. | 1577 | ·48 | B. | one | P.F. | 30′ 0″ | VI. 1–7 | 58 | 45 | 0·652 | 1·38 | 1·05 | 1·44 | 37 | 22 |
| G.W.R. | Parrett | ·35 | B. | two | P.F. | 42′ 0″ | V. 102–105 | 59 | 52 | 1·18 | 3·34 | 1·60 | 2·21 | 38 | — |
| G.W.R. | Parrett | ·35 | B. | ,, | P.F. | 42′ 0″ | VI. 102–105 | 59 | 59 | 1·18 | 3·34 | 0·80 | 1·00 | 25 | — |
| L. & N.W.R. | 31 | 1·00 | J.A.L. | ,, | R.B. | 44′ 7″ | VI. 161–163 | 64·5 | 64·5 | 1·82 | 1·70 | 0·17 | 0·30 | 76 | — |
| L. & N.W.R. | 31 | 1·00 | J.A.L. | ,, | R.B. | 44′ 7″ | VI. 155–160 | 84 | 84 | 2·23 | 2·20 | 0·32 | 0·75 | 44 | — |
| S.E. & C.R. | 825a | ·65 | B. | one | P.F. | 48′ 0″ | V. 52–55 | 60 | 45 | 1·031 | 1·59 | 0·80 | 1·42 | 77·5 | 40 |
| S.E. & C.R. | 825a | ·65 | B. | ,, | P.W. | 48′ 0″ | V. 56–57 | 52 | 52 | 0·259 | 0·46 | 1·17 | 1·55 | 32·5 | — |
| S.E. & C.R. | 134 | ·56 | O. | ,, | P.F. | 56′ 8″ | V. 48–51 | 63 | 43 | 0·863 | 1·53 | 1·07 | 1·50 | 40 | 16 |
| S.E. & C.R. | 473 | ·52 | B. | ,, | P.F. | 60′ 0″ | VI. 58–62 | 42 | 42 | 1·71 | 3·27 | 2·05 | 2·23 | 9 | — |
| G.W.R. | Staffords | ·35 | O. | two | P.F. | 64′ 0″ | V. 68–70 | 59·5 | 59·5 | 1·17 | 3·3 | 2·20±13 | 3·43 | 56±10 | 10±8 |
| G.W.R. | Staffords | ·35 | O. | ,, | P.F. | 64′ 0″ | VI. 68–70 | 59·5 | 59·5 | 1·38 | 3·9 | 2·12±15 | 3·05 | 45±10 | 26±9 |
| L. & N.W.R. | 27 | 1·98 | J.A.C. | ,, | P.F. | 66′ 4″ | VI. 164–169 | 67 | 67 | 3·18 | 1·60 | 0·65 | 0·94 | 45 | — |
| L. & N.W.R. | 27 | 1·98 | J.A.C. | ,, | P.F. | 66′ 4″ | V. 164–169 | 67 | 67 | 2·57 | 1·31 | 0·95 | 1·34 | 41 | — |
| L. & N.W.R. | 45 | ·65 | O. | ,, | P.F. | 75′ 6″ | V. 173–177 | 67 | 67 | 1·51 | 2·31 | 1·09 | 1·45 | 33 | — |
| L. & N.W.R. | 45 | ·65 | O. | ,, | P.F. | 75′ 6″ | V. 178–181 | 65·5 | 65·5 | 0·95 | 1·51 | 0·41 | 0·73 | 80 | 17 |
| S.E. & C.R. | 980 | ·94 | O. | ,, | L.C. | 88′ 2″ | VI. 30–32 | 57 | 35 | 1·147 | 1·44 | 1·10±5 | 1·51±31 | 37±33 | — |
| S.E. & C.R. | 980 | ·94 | O. | ,, | L.C. | 88′ 2″ | V. 33–34 | 58 | 58 | 0·616 | 0·77 | 0·37 | 0·58±15 | 57±40 | — |
| S.E. & C.R. | 980 | ·94 | O. | ,, | L.D.B. | 88′ 2″ | VI. 33–34 | 58 | 58 | 1.138 | 1·34 | 1·30 | 2·02±50 | 55±40 | |
| G.W.R. | Blackthorn | ·94 | B. | ,, | P.F. | 94′ 0″ | VI. 111–115 | 65·5 | 65·5 | 2·43 | 2·59 | 1·40 | 1·90 | 36 | 20 |
| G.W.R. | Blackthorn | ·94 | B. | ,, | P.F. | 94′ 0″ | V. 111–115 | 65·5 | 65·5 | 1·94 | 2·07 | 1·92 | 2·45 | 30 | 23 |
| N.E.R. | Tees Viad. | ·48 | O. | ,, | L.D.B. | 100′ 0 | V. 149–152 | 60 | 60 | 1·865 | 3·38 | 3·15 | 3·78 | 20 | 10 |
| N.E.R. | Tees Viad. | ·48 | O. | ,, | L.V.B. | 100′ 0″ | VI. 149–152 | 60 | 60 | 1·236 | 2·57 | 1·40 | 1·70 | 21 | — |
| G.W.R. | Parrett | ·62 | O. | ,, | L.C. | 112′ 0″ | VI. 93–97 | 65·5 | 65·5 | 1·33 | 2·14 | 1·41 | 1·77±5 | 26±4 | — |
| G.W.R. | Parrett | ·62 | O. | ,, | L.C. | 112′ 0″ | V. 93–97 | 65·5 | 65·5 | 1·33 | 2·14 | 0·75 | 1·07 | 43 | — |
| N.E.R. | Tees Viad. | ·48 | O. | ,, | L.C. | 116′ 3″ | V. 143–148 | 58 | 44·8 | 1·83 | 3·81 | 1·30 | 1·90±19 | 46±15 | 21±14 |
| N.E.R. | Tees Viad. | ·48 | O. | ,, | L.C. | 116′ 3″ | VI. 143–148 | 58 | 58 | 1·593 | 3·32 | 1·14 | 1·32 | 16 | — |
| G.W.R. | Stoke Cannon | ·81 | O. | ,, | L.C. | 132′ 0″ | VI. 76–78 | 64·5 | 64·5 | 1·69 | 2·126 | 1·3 | 1·6 | 23 | 13 |
| N.E.R. | Maunby | ·634 | O. | ,, | L.C. | 146′ 8″ | V. 133–142 | 56·8 | 52·4 | 1·82 | 2·76 | 0·97 | 1·57±7 | 62±7 | 26±7 |
| N.E.R. | Maunby | ·634 | O. | ,, | L.C. | 146′ 8 | VI. 133–138 | 56·8 | 48·4 | 1·44 | 2·18 | 1·85±5 | 2·10 | 13 | 5 |
| N.E.R. | Maunby | ·634 | O. | ,, | L.C. | 146′ 8 | VI. 139–142 | 56·8 | 44·4 | 1·78 | 2·70 | 0·87±10 | 1·31±10 | 51±30 | 18±40 |

Types of floor:— O. Open (unballasted). B. Ballasted. J.A.C. Cross Jack Arches. J.A.L. Longitudinal Jack Arches.

Members:—

C.T. Cross Trough. R.B. Rail Bearer. P.F. Plate Girder Flange. P.W. Plate Girder Web. L.V.B. Lattice Girder Web, Vertical.

L.T. Longitudinal Trough. C.G. Cross Girder. L.C. Lattice Girder Chord. L.D.B. Lattice Girder Web, Diagonal. H.F.V. High Frequency Vibrations.

Note.—In the case of [illegible] the ballast beneath has been taken as the assumed width over which distribution [illegible]

$\frac{D}{L}$ is the ratio of the calculated dead load to the calculated effect of the test live load on the main girder tested.

The live load stress shown in Columns 12, 13, 14, refers to the test load

provides inadequately for small and excessively for large spans." It was thereupon decided to make measurements of impact in a number of bridges. The instructions governing these measurements were: "To determine, as a provisional measure, pending further more extended experiments which, it is recognized, will be necessary, some formula or curve giving the minimum desirable increments for impact to form the basis for calculation of stress in the immediate future."

All the tests were made with a Fereday-Palmer photographic stress recorder, an instrument in which the compression of the gage length tilts a small mirror and changes the position of a small spot of light reflected from a lamp upon a photographic film. This film is moved by a hand winder, under control of a speed-changing transmission, intended to make it possible to adapt the various lengths of record to the available film length (about 20 inches; the instrument uses a standard six-exposure film for 2¼ x 3¼-in. camera). A shutter in the path of a second beam of light is moved by clockwork so as to cover and uncover alternately the film on the datum line, breaking it up into lines and spaces each one-quarter second long. This gives not only a datum line for the strain

curve but also a time scale (see the specimen records, Fig. 1).

Major Mount states that the instrument was found subject to a certain amount of datum-line error, probably due to slip of the gage points on the member. The frequency of the instrument was found to be 200 to 300 vibrations per second. Certain types of trough flooring and stringers had equally high frequency; the records in those cases were not reliable. Attempts were made to increase the frequency of the instrument by applying a stiffer spring to the moving mirror, but the desired effect was not obtained. By clamping the instrument more tightly to the member under test, however, the frequency was increased to about 350.

Of the 362 records obtained on 20 bridges (the work was done on eight Sundays in the period from July

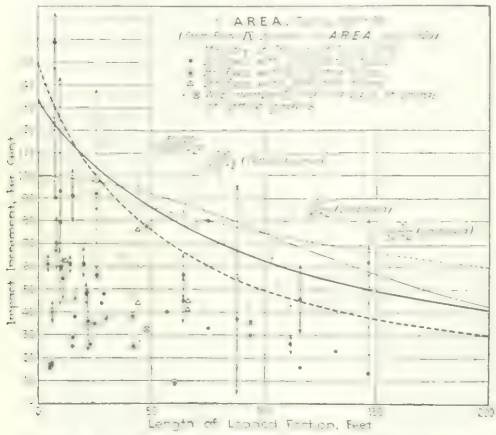



FIG. 2. IMPACT TEST RESULTS AND FORMULAS

to October, 1920) some records are reproduced herewith, selected from a large number given in the report. The structures selected for test were steel bridges, "as far as possible typical of British practice"; they ranged in span from 15 ft. to 146 ft. 8 in., and in type from simple longitudinal troughing to two-girder and three-girder structures (both plate-girder and shallow truss). Floor types included open, ballasted and jack-arch. "Special attention was given to testing floor members and spans under 40 ft., to which less importance was attached in the experiments carried out by the American Railway Engineering Association."

Test trains were made up of one or two locomotives and a dynamometer or other car. "The engines were of typical two-cylinder passenger type, chosen from approximately the heaviest working on each system. Speeds from zero (or crawling) up to a normal maximum of 55 to 65 miles per hour were used, but in one case the speed was run up to 84 miles per hour."

The ordinate scale of all the records was 0.1 in. to 2,240 lb. per square inch.

In determining and reading records, which was done with dividers and an ivory scale, readings checking 0.005 in., allowance had to be made for the datum error, that is the difference between stress-line ordinates at beginning and end of a record. Half of the datum error was taken as a measure of the reliability of the result, and this figure (converted to impact percentage) is given in the tabulated results as a plus-or-minus addendum following each result. Where less than 0.05 ton (2,240-lb. ton) per square inch it was neglected.

*Features of the Results.*—The recorded stress at crawling speed, considered as the static stress due to live load, was found to be in nearly every case *less than the calculated* live-load stress for the weight of the test train. The report suggests that this is due to neglecting the partial continuity of the stringers, to the deduction for rivet holes, to the omission of web and sometimes part of the flange in calculating moments in plate-girders, to the co-operation of floor system and bottom laterals with the chord, to the relief of main stress occasioned by the secondary stresses (distortion stresses), and, in the case of jack-arch floors, to assistance of the steelwork by the masonry.

Aside from the instrumental vibrations, which were ignored in reading the records, "some of the records, particularly those of larger spans, show high-frequency vibrations," ranging in frequency from about 30 to 70 per second. "They are much slower than those due to the instrument, and faster than those due to the girder as a whole," and they are considered to represent definite variations in stress in the member. These vibrations appeared in records of bottom-flange stress, but were generally less evident in corresponding records from the top flanges. In some records it was possible to measure the amount of this vibrational stress, which the report calls "secondary stress"; and the results of these measurements are given in the last two columns of the table of results, p. 643.

The measured live-load stresses given in the table are those corresponding to the maximum ordinates, thus including the effects of any high-frequency vibration. If these "secondary stress effects" were omitted in drawing the limiting curve of experimental results (in a diagram like Fig. 2) the curve would follow generally the direction of the Pencoyd curve but would be 40 to 50 per cent lower.

The report says: "It may then be argued that, if allowance for impact should exclude any increment on account of secondary stress, the results of these tests should be held to justify a percentage addition for impact not exceeding, say, 60% of the live load for any length of span. These experiments, however, have not been carried out with the object of exploring the more theoretical side of this controversial problem." It should be noted that the term "secondary stress" in the report refers throughout to the high-frequency vibration and not to what is more commonly called "secondary stress," namely, that due to distortion of a truss under applied load.

After comparing the test results with those computed from the Pencoyd formula, the report says:

"The opinion may at first be formed that there is no marked evidence to justify any decided departure from the Pencoyd formula. It must, however, be borne in mind that higher speeds than those attained in the experiments (say up to 75 m.p.h.) are not uncommon with express traffic. At the same time, as this speed is below the critical speed for short spans, greater impact effect than that recorded is quite likely to result under ordinary running conditions. Moreover, no steps have been purposely taken in these tests to locate engine driving wheels in their worst positions, so it is improbable, for this reason also, that maximum results have, in any case, been attained. In regard to longer spans, the results certainly indicate that the Pencoyd

allowance is excessive, provided that, as already explained, comparatively high secondary stress effect is not taken into account. Although in the case of trough flooring, high impact percentages were not measured, we have, in view of the above considerations, indications that for floor members and short spans the Pencoyd formula does not provide an adequate allowance. It will be of interest to note that high results were, in certain cases, obtained on ballasted bridges, and it does not appear therefore, at the moment, to be advisable to make special concession in respect of this type."

Two formulas devised by the subcommittee are shown on their plot of results, Fig. 2 on the preceding page. The first, represented by a dash line, is $I = 75/(L + 50)$, giving a maximum of 150 per cent increment. "This," says the subcommittee, "may be deemed a little too high, and moreover the curve does not cover the maximum results of the A.R.E.A. in the important neighborhood of 60-ft. spans." The second formula, represented in full-line curve, is $I = 120/(L + 90)$, which gives a maximum increment of 133 per cent. Major Mount concludes, "It includes, to all intents and purposes, the A.R.E.A. results mentioned above. It practically covers the mean of the readings on 7½-ft. rail bearer on the Southeastern and Chatham Ry. bridge No. 134, and if considered as covering only normal secondary stresses, it very amply embraces our results for longer spans. It is the curve which, I think, more nearly represents the results of our tests."

## Street Explosions in Electric Conduits

EXPLOSIONS along an electric cable conduit in the center of Minneapolis, Minn., on July 30, last, resulted in blowing off manhole covers and sidewalk lights nd breaking many windows. This was a 12-duct conduit arrying the mains of the Minneapolis General Electric Co. The direct-current mains to which the building services were connected were in an adjacent 9-duct onduit and were not affected. Smoke from a manhole t 6th St. and Nicollet Ave. was seen at 10:15 p.m. nd in a short time two manhole covers were blown off, ollowed by an explosion in an areaway which blew a ole in the sidewalk. Later, two other manhole covers ere blown off and there was a second areaway explosion. After the explosion there was an odor of luminating gas at the opening of the first sidewalk xplosion, and leaks were found in a 1½-in. gas pipe. n investigation was made by the chief electrical inpector in the building department, the fire marshal nd the inspector of outside wiring in the city engineer's epartment. The report, as abstracted, follows:

Upon digging up the conduits it was apparent that a round and short circuit had occurred at two places and ie cables were damaged between these points. Heat is enerated in conductors carrying current and if prevented rom escaping it may reach abnormal temperatures. The onduit was an asphaltic compound and had softened either y the heat of the short-circuit or previously due to the eat of the normal current and the long spell of hot weather, ius closing the air space around the cables and shutting ff ventilation. The soil was dry and afforded little escape f heat by conduction or radiation. It was found that this uct softened at about 310 deg. F. and gave off a dense ellow smoke at 470 deg. This smoke burned freely in air nd when mixed with air in a closed receptacle it exploded n ignition, according to tests made by the city engineer's epartment. This would indicate that an explosion could appen without the presence of illuminating gas.

The load on the cables was well below their safe carrying capacity and could not furnish enough heat to generate gas in the conduit, but an electric arc caused by a ground and short circuit could easily heat the duct to such a point. Recording instruments show that the first serious short-circuit occurred at 10:11 p.m. on July 30.

*Recommendations* — (1) All service tubes and conduits entering buildings and sidewalk areas from underground manholes should be sealed at the entrance to the building so as to prevent passage of gas between the manholes and buildings; (2) the type of 12-duct conduit which failed should be replaced by single-duct approved conduits separated by concrete so that a burnout in one will not spread to adjacent cables; (3) the duct space should provide at least 25 per cent of unused conduit for ventilation; (4) manholes should be ventilated and have covers so made as to prevent them from baing blow into the air in case of explosion; (5) fire department underground circuits should be carried in municipal cables in conduits, but not in the same conduits with lighting or power cables.

## Stone Carriers Supplant Cableway

IN THE construction of the Marikanave dam in Mysore State, India, an aerial cableway was erected to bring the stone from the quarry to the dam site. According to E. W. D. Slater, who lives in that state, the

"NOWGUNNIES"—UNIONIZED STONE CARRIERS OF INDIA

engineers soon found that it was cheaper to deliver the stone on the work by human means; that is, by utilizing the local craft known as "nowgunnies." These men are professional stone carriers who work in gangs of fifteen, twelve, eight, four, and two, and carry from 70 to 150 lb. per man, working 10 hr. per day for 8 annas, which is 16c. today. The stone are suspended on chains attached to bamboo sticks which are carried on the shoulders of the men as shown in the accompanying view. Ninety per cent of the stone on this dam was carried by gangs of four, for which two men tracking each other carried long bamboo sticks on their shoulders with cross bamboo sticks suspended in the middle by chains with the stone suspended from the cross stick.

# Railway Tracks Removed from Streets of Dallas

## Texas City Establishes Belt Line and Takes Main Lines from Streets to Form an Industrial District

REMOVAL of railway main tracks from streets and from private right of way in the city of Dallas, Texas, is an unusual and important feature of a "city planning" program which includes the elimination of grade crossings, the more systematic arrangement of railway facilities and the improvement of city traffic conditions. A considerable part of this program has been carried out, particularly as to the railway work.

This city, with a present population of nearly 160,000, was located originally on the east bank of the Trinity River because the Houston & Texas Central R.R and the Texas & Pacific Ry. happened to cross near there. Since that time six other lines have entered the city, and with the usual unregulated growth of both the city and the railways there developed the undesirable feature of the city being cut into many sections by main line railway tracks.

As a result of this situation the business district expanded as a long narrow stretch and grade crossings were numerous. Some of the crossings were particularly dangerous from the fact that heavy grades called for relatively high speed of trains in order to pull over the summits of grades. Another result was the development of "blighted districts" along the railways, where property which would ordinarily be good for business locations was given over to the cheapest sort of housing, thus constituting an economic loss to both the property owners and the city. To remedy such conditions and to promote the proper development of the city, the municipal authorities in 1910 engaged George E. Kessler, city planning expert, St. Louis, Mo., to prepare a city plan for Dallas.

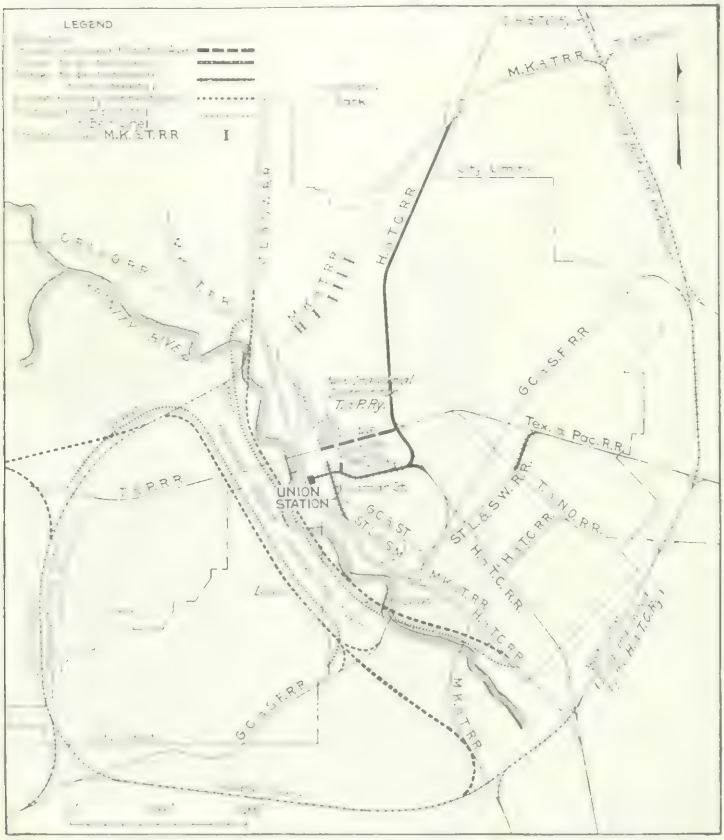



FIG. 1. RAILWAY IMPROVEMENTS AT DALLAS, TEX., INCLUDE RELOCATION OF TRACKS

In regard to the railway situation, Mr. Kessler's report, made in 1911, recommended four important features: (1) A belt railroad in two loops on the east and west sides of the Trinity River, connecting with each other along the bottom lands; (2) a union passenger station on the eastern loop and at the west end of the business district; (3) a freight terminal for local business, located near the passenger station and adjacent to the business district; (4) the elimination of grade crossings in the downtown section of the city.

The union passenger station was the first project carried out, this being done by a company representing all the railways concerned. The station with its approaches cost about $6,500,000 and was opened on Oct. 8, 1916 (see *Engineering News-Record*, June 25, 1914, p. 1415). Next came the separation of grades on the Missouri, Kansas & Texas Ry. along its right of way from the north yard limit to Knox St., 2¼ miles. The railway was elevated slightly and the streets were depressed. This work, which eliminated seven street crossings, was completed in October, 1919, at a cost of $460,000, the city paying for property damages and street paving. The next work was the construction of that part of the new Houston & Texas Central R.R. belt line from the terminal tracks to the Texas & Pacific Ry. main line beyond the city limits, a distance of 2.6 miles. This construction was done at a cost of about $300,000.

*Clearing Tracks from Pacific Ave.*—The completion of this belt line connection, in the spring of 1921, made it possible to remove the Texas & Pacific Ry. tracks on Pacific Ave. for a distance of 0.67 mile through the

FIG. 2. PACIFIC AVE. BEFORE AND AFTER REMOVAL OF T. & P. RY., DALLAS, TEX.

heart of the city, thus eliminating nine dangerous grade crossings.

Removal of the tracks from Pacific Ave. was an important event which closed a controversy of eleven years. In addition to negotiation with the Texas & Pacific Ry. it necessitated persuading the Gulf, Colorado & Santa Fe Ry. to relinquish its running rights on the Pacific Ave. lines. This case is considered a striking illustration of what may be accomplished through complete co-operation of the railways and the city government, with the backing of public opinion. For several years business interests had hesitated to establish themselves beyond Pacific Ave., on account of the railway obstruction and the consequent poor condition of the property, in spite of the fact that the growth of the city was in this direction. With the 80-ft. thoroughfare clear of tracks there is oportunity for developing a high class business street. Fig. 2 shows the condition of this street with and without the railway tracks.

The railway company had a long term franchise on Pacific Ave. which it gave up in exchange for rights of way in a new industrial district. All details of the project were handled by the Wholesale District Trackage Co., composed of a committee of business men. They raised approximately $534,000 to purchase rights of way in the district bounded by Lamar, McKinney and Orange Sts. and Ross Ave., which is to be developed by the Texas & Pacific Ry. as an industrial district. In addition to this, the railway had an old passenger station at Lamar St. and Pacific Ave. which was purchased from the Trackage company by the city for $166,000. This was the only amount paid by the city. The rights of way in the industrial district were then given to the railway in return for the abandonment of its franchise rights on Pacific Ave. and the complete removal of its tracks. A stretch of the Texas & Pacific Ry. track north of the union station is left unchanged (see Fig. 1) because it forms the lead into the new industrial district and also because it is not desired to remove trackage west of Lamar St.

*Other Track Removal Projects.*—Several other problems involving track removal have been given encouragement by the success of the Pacific Ave. project. Chief among the problems now under consideration are the following: (1) Removal of the Houston & Texas Central R.R. main line on its private right of way from Williams St. to its intersection with the Missouri, Kansas & Texas Ry., near Highland Park, about 3.75 miles; (2) removal of the St. Louis Southwestern Ry. tracks from Lamar St. (0.47 mile) and from Parry Ave. (0.50-mile). These three changes would eliminate 37 grade crossings and permit rational expansion of the city.

The Houston & Texas Ry. project differs from the others mentioned in that the railway is on its own right of way, but entire removal of the line is considered preferable for the city's interests, rather than elevation of the tracks simply to eliminate grade crossings. A committee is now working on this project and will offer rights of way in an industrial district in exchange

FIG. 3. PAVED MAIN TRACK ON LAMAR STREET (TRACK TO BE REMOVED)

for abandonment of the present right of way. It is proposed to transform the 50-ft. right of way and an acquired strip 150 ft. wide into a 200-ft. boulevard between the business district and North Dallas. The benefit to the city and the adjacent property owners would be in the increased value of this property, as the section of the city traversed by the railway is now of low value and is either vacant or occupied by cheap housing.

Removal of the St. Louis Southwestern Ry. tracks on Lamar St. would release a thoroughfare on the western boundary of the business section which has been designated as part of a system of belt trafficways. It would also promote the opening up of a section which is considered ideal for industrial development but which has not been developed on account of inaccessibility and railway obstruction. These tracks originally formed the approach to the company's old passenger terminal, but since the opening of the Union Station they are used but little, except as team tracks.

On Parry Ave., a residence street 50 to 100 ft. wide fronting the Texas State Fair Grounds, the St. Louis

Southwestern Ry. has a single track connecting with the Texas & Pacific Ry. But with the completion of the Belt Line this connection has become unnecessary. Its removal will release a street needed for vehicle traffic and will increase property valuations considerably.

*Industries and Freight Stations.*—Industry tracks served by the abandoned lines were not provided for in the change, but most of the industries are moving to other locations and others are using trucks. With the removal of the Houston & Texas Central line north of Williams St. the lines of the Texas & Pacific Ry. and the Texas & New Orleans Ry. which now connect with the former (see Fig. 1) will lose their through connection but will continue to be used as industry lines.

The union freight station proposed by Mr. Kessler has not been built, but new freight terminal facilities are expected to be provided by individual railways when they are able to undertake these improvements. A new freight station has been completed recently by the Missouri, Kansas & Texas Ry. The other lines are badly cramped and probably will expand their present facilities or seek new locations.

As to the condition of the streets occupied by railways, Pacific Ave. was an unpaved thoroughfare with ruts, holes and pools of water (see Fig. 2). This street was not paved because the property values did not justify the city in incurring the expense and the property owners would not do so. The city is now preparing to spend $300,000 on a storm sewer for Pacific Ave. and when this is completed the street will be paved. On the other hand conditions on Lamar St. warranted its paving, as shown in Fig. 3, brick being used along the track and asphalt at the sides.

### Track Removal and Track Elevation

The agitation for grade separation or elimination of grade crossings at Dallas, Tex., reached its climax in 1914, when amendments to the city charter were adopted giving the city authority to require such elimination. The administration which went into office in the spring of 1915 was pledged to take the necessary action. Removal of the tracks and rearrangement of the railways in preference to elevation of the tracks on their existing locations was adopted on the recommendations of both Mr. Kessler and the late John Findley Wallace, consulting engineer, who was called in by the city to investigate the situation. The following is an extract from Mr. Wallace's report, made Nov. 22, 1915:

It is possible to bring about the elimination of grade crossings by the elevation of the tracks of the several railroads by the expenditure on the part of the railroads of not to exceed $5,000,000. To protect all of the existing grade crossings by watchmen, gates and bells would require an annual expenditure that would represent a capitalized value of about $3,200,000. The construction of a belt line with adequate interchange and terminal facilities for the joint use of the railroads of Dallas would eliminate the necessity for general track elevation and would cost approximately $900,000, including the double tracking and grade separation of a portion of the Missouri, Kansas & Texas Ry. The removal of most of the tracks within the more central portions of the city and the taking over of the rights of way by the city as a part of the street system would be a desirable accomplishment.

These railway and municipal improvements have been promoted and assisted largely by the Chamber of Commerce Metropolitan Development Association, of which Charles Saville is general manager; E. A. Wood, engineer, and George E. Kessler, city planning consultant.

## Making Chlorine Gas at the Point of Consumption

By Clarence W. March
Consulting Engineer, New York City

*Extracts from a paper read before the New England Water Works Association, September, 1921.*

WHY not make chlorine on the job? This is the best and most efficient way because the chlorine is made as a gas under atmospheric pressure or less and is immediately available for use and in the exact proportion to the dosage and water pumped without the need of further control apparatus.

Why is it not done to a much greater extent? Up to the present time there has not been enough recognition of the basic economy of producing chlorine as wanted at the point of consumption without the necessity of tying up money in inventories, in shipments and at the factories. There is not enough knowledge of various steps in the manufacture and distribution of chlorine in the possession of the consumer. Manufacturers of bleach and chlorine have shown commendable zeal in the sale of their products and have helped the consumer by placing in his hands excellent devices for the control and dosage of chlorine to water, but until recently there has not appeared in the market an efficient enough machine at reasonable cost to make feasible the manufacture of chlorine in small quantities by the small consumer.

Recently there has been developed an electrolytic cell battery which takes very little space and is a unit, not several units, which means few parts and a very low cost of repairs, renewals and depreciation. In addition, the efficiency with which the power is used makes the cost of producing chlorine 20 per cent less than present methods and cuts the waste of materials used in cells to less than one-half that which formerly seemed necessary. It places a more efficient machine in the hands of the small consumer than the largest manufacturers of chlorine use today.

[The author then gave somewhat detailed comparative estimates of the cost of bleach, liquid chlorine and chlorine gas at the place of use, and pointed out the various advantages of the latter, as he sees them. Stress was laid on the small size of the cells and the fact that they can be placed in the laboratory of a small water-works. Finally, the author described an average installation to produce 50 lb. of chlorine daily, consisting of three working and one spare cells, as follows.—Editor.]

Each of these cells will produce 17 lb. of chlorine daily at a rate of approximately 1⅛ kw.-hr. (a.c.) per lb. of chlorine or 1¾ kw.-hr. (d.c.) after transformation of current per pound of chlorine at the switchboard. The current used will be 260 amperes at 2.8 volts per cell or 8.4 volts at the cells for the battery of three cells. This is for a period of six months. The cells are approximately 2½ ft. long x 10 in. wide x 2½ ft. high.

The cells consist of three parts. The concrete top, which may be suspended from above and to which is attached perforated and horizontally corrugated steel plates, carrying in turn several sheets of asbestos paper conforming in shape to the steel plates. The steel plates are the cathodes and the asbestos paper is the diaphragm. The anodes of Acheson graphite are suspended from the top and are enclosed by the steel plates which form the compartment for receiving the brine solution or electrolyte. With a few fittings, such as the copper conductors, the automatic brine-feed floats, the gage glasses for determining the height of the brine in the cell, and the chlorine outlet from the top of the cell, the cell is complete. The top is solid except for the openings for the anode, float and the chlorine outlet, which are sealed tight against leakage of gas.

There are no expensive parts to the cell. The top is a concrete casting of small dimensions and will last five years or longer. It is subject to no stress because it is not restrained in any direction. It can be readily replaced at very small cost. The cathodes are sheets of corrugated steel which last not less than five years. The anodes are the most expensive but weigh only about 85 lb. for the above type. They last two years without replacement. The mate-

rial is of the cheapest form. Cylinders 1¾ in. to 2 in. in diameter and 2 ft. long and a post rectangular in shape and approximately 2½ ft. long, all pinned together with graphite pins. The fittings are glass, rubber and lead—all standard commercial forms and cheap.

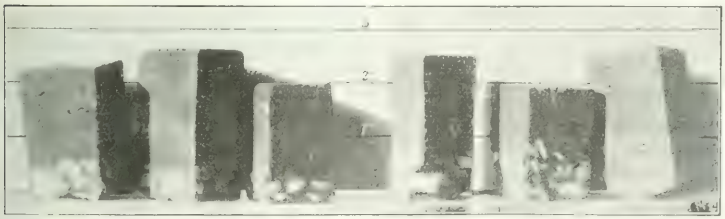
*Discussion*—Frank W. Green, superintendent of filtration Montclair and East Jersey Water Companies, Little Falls, N. J., said that his plant is one of four that has made its own chlorine for some years past [the other three being the private plant at Montreal and the city plants at Trenton, N. J., and Omaha, Neb.] The cost of local manufacture at Little Falls is 1½c. against 8½c. per unit for liquid chlorine, but with no allowance for power at Little Falls. An old Nelson cell is used at Little Falls, which, Mr. Green said, is not so good as the Marsh cell.

# Thin Binder Course a Menace to Asphalt Pavement

## Tendency on the Part of Engineers to Specify Depth of 1 Inch or Less Is Proving a False Economy

By Roy M. Green
Manager, Western Laboratories, Lincoln, Neb.

During the last three years there has been an increasing tendency in asphalt paving practice to use binder courses only 1 in. thick, in order to reduce costs. In the construction of the earlier pavements the use of 1½ and 2 in. of binder was considered good practice, the 2-in. depth being regarded as the best. The present tendency to decrease the depth of the binder course is shown by the fact that 34 per cent of the specifications for sheet asphalt for 1920 from 42 states and municipalities widely distributed over the United States call for a depth of 1 in., 49 per cent for 1½ in., 3 per cent for 1¼ in., 2 per cent for no binder course at all and 12 per cent for a binder depth "shown on the plans." In other words, of the specifications which indicated the depth to which the binder was to be laid, approximately 40 per cent required that it be 1 in.



VARIATIONS IN BINDER DEPTH OF ASPHALT PAVEMENT IN FORT WORTH, TEX

In the construction of a sheet asphalt pavement there are three reasons for which it is desirable to lay a binder course. First, to even up depressions and irregularities in the foundation so that a uniform thickness of the wearing surface may be laid. Second, to bind the wearing surface to a stable combination and thus reduce the possibility of waves being formed by traffic. Third, to assist in preventing cracks formed in the rigid foundation from being transmitted through the wearing surface.

When the concrete foundation is completed and ready to receive the wearing surface it is always slightly irregular in cross-section. If a fine bituminous mixture were laid upon this irregular surface and rolled all the irregularities of the base would be apparent at the surface. Due to the poorer compaction of the wearing surface above the low spots in the base and the resulting porosity the surface would continue to become more wavy with usage. When a binder course is laid upon such a foundation a surface true to the finished cross-section and parallel with it should be produced, so that the wearing surface may be laid to a uniform depth. This is one of the important functions of the binder course.

Bituminous wearing surfaces laid directly upon concrete foundations do not become attached to them, as is shown when such surfaces are torn up. Under such conditions there is generally a movement between the wearing surface and the concrete base. To prevent such motion of the wearing surface along the base a stable mixture of binder is interposed. With a binder course, then, the concrete foundation simply acts as a support to the pavement, the binder furnishing a stable medium to which the plastic wearing surface mixture may attach itself. To be successful the binder course must be a dense combination laid to a sufficient depth so that it may possess maximum stability.

Foundation cracks are transmitted to the surface much more readily in pavements that have no binder course between the rigid foundation and wearing surface. The reduction of the number of these cracks in the surface is one of the chief functions of the binder course.

If the binder course is to meet these requirements it must be properly prepared and laid to a thickness such that it may effectually even up all irregularities of the concrete base without being so thin in places that its stability is sacrificed. If the average thickness of the binder is only 1 in. there will be many places that have a thickness of only ¾ in. The illustration shows several cross-sections selected at random from the streets of Fort Worth, Texas, where 1-in. binder has been used. It shows the variation which may be expected in the depth of the binder course due to irregularities existing in the base.

Since it is considered the best practice to construct binder with stone having a maximum size three-fourths the depth of the course, a 1-in. binder should be made of a stone ¾ in. in maximum size. When constructed of stone of such a size there will be places where the ¾-in. stone will be exposed at both the upper and lower surfaces of the binder course. When the course is being rolled many of these will become shattered. Under such conditions it is impossible to expect any great amount of stability to result from the course nor will it be of any great assistance in reducing the number of foundation cracks from being transmitted through the top surface.

Many more sheet asphalt pavements that fail are failures on account of waviness rather than because the top surface is worn away by traffic, thereby exposing the binder. If it is desirable to produce a cheaper pavement it is much better to reduce the depth of wearing surface than the binder, the minimum thickness of which should be 1½ in. This will result in greater economy, as the wearing surface is always by far the more expensive.

# Interpreting the Chemical Analysis of Portland Cement

## Suggested System of Recasting Has Not Demonstrated Relationship of Such Results With Physical Behavior

By J. C. Witt
Structural Materials Research Laboratory (Co-operation Portland Cement Association and Lewis Institute), Chicago, Ill.

IT IS the purpose of this paper to discuss some of the tests that may be applied to a given sample of portland cement to determine its value as a material of construction. We are to consider the sample as representing a finished product, and the information that may be gained concerning it by applying tests, without presuming any detailed knowledge of the raw materials or the operation of the particular plant in which it was produced. That is, the statements made herein are applied to the testing of finished cement, and not to plant control nor research.

The limitations of chemical analytical methods have been in a measure taken for granted, and comparatively little discussion has found its way into the literature for some time past. The general opinion has been that the results of a complete chemical analysis add little to the information that may be obtained from a series of physical tests and often magnesia, sulphuric anhydride, loss on ignition, and insoluble matter are the only chemical determinations made. It is obvious that the composition of a cement is of the highest importance and is the determining factor of its quality. However, the nature of the material is such that comparatively little is revealed by the chemical analysis, though if the quality is not satisfactory, it will show up in one or more of the physical tests. Irregularities in composition that cannot be detected by chemical means may have a marked effect on the physical properties, and therefore physical tests have come into general use as the principal basis for deciding whether or not a cement is satisfactory for the use for which it is required.

### Processes During Clinkering

The reason for this lack of relationship between the chemical analytical results and the true composition may be understood if we consider the changes that take place in the raw mixture as it passes through the kiln and is formed into cement clinker. The burning may be divided into three periods. These are not sharply divided, but gradually merge one into the other. During the first period, moisture and organic matter are expelled. During the second, the calcium carbonate is decomposed, the carbon dioxide being expelled, while the calcium oxide remains behind. During the third the calcium oxide unites with other substances present, the principal ones of which are silica and alumina, to form the mixture of chemical compounds which constitute cement clinker. The progress of the process during the first and second periods may be readily traced by chemical analyses. Successive samples taken from the upper to the lower end of the kiln show a progressive decrease in the percentage of moisture and carbon dioxide, and a corresponding increase in the percentage of calcium oxide and most of the other compounds present.[1]

After the beginning of the third period, practically no further appreciable change is revealed by chemical analysis. Volatile substances have been volatilized and the chemical changes taking place do not involve any change in the proportion of the elements present. However, if successive samples are taken during this third period and subjected to physical tests, it will be found that they vary all the way from worthless material to cement of satisfactory quality. Assuming, therefore, that a properly proportioned and ground raw mixture enters the kiln, the quality of the resulting clinker is dependent on the last period of the burning process. The first two periods are simply preparatory for the third or most important period.

Recently R. J. Colony[2] has reopened the question of the value of chemical anaylses in judging the quality of cement. He states that " . . . some additional mode of determining the quality of cement must be employed. The problem is to find a simple, usable, easily applied method that will supplement the standard tests. The solution of this problem involves a knowledge of the chemical composition of portland cements, also of their constitution (or componental composition), as the behavior of a cement, when gaged, is dependent on the physical and chemical characters of the compounds of which it is composed, the proportions existing between them, and the fineness of grinding. It is likewise essential to know the character, behavior and composition of the hydration products of portland cement.
As the components of portland cement have a definite composition, the various oxides found by chemical analysis must be uniformly distributed and united with one another according to fixed laws of chemical combination. Hence it should be possible to recast an analysis in much the same manner as rock analyses, and to obtain the percentage composition of the cement in terms of the actual compounds, instead of the oxides of the elements forming the mass."

### Components of Cement

His method of calculation is based principally on the constitution of portland cement as determined by Rankin, Wright, and others at the Geophysical Laboratory. Work in this field has also been carried on at the Bureau of Standards and elsewhere. According to these investigators the principal components of portland cement are a series of calcium oxide and silica compounds, and calcium oxide and alumina compounds. Over 90 per cent consists of the three compounds, tricalcium silicate ($3CaO.SiO_2$), dicalcium silicate ($2CaO.SiO_2$), and tricalcium aluminate ($3CaO.Al_2O_3$). Colony proposes to calculate the amount of each of these three components from the chemical analysis. The carbon dioxide, sulphuric anhydride, ferric oxide, and alumina are calculated to the corresponding calcium compounds. The remaining calcium oxide (which we shall designate as the *net* calcium oxide) is then applied to the total silica, and by means of simultaneous equations the amounts of tricalcium silicate and dicalcium silicate are calculated.

It is possible to determine the approximate proportion of the components of a cement by use of the petrographic microscope, and the chemical analysis of the material may be of some service in this connection. However, in this case, the real information comes from the petrographic examination, and the chemical analysis is only auxiliary, and may be dispensed with entirely.

In order to make clear the comments of the writer on this proposed system of calculating results (as he

understands it), the various steps are indicated in the form of equations. For each compound to be considered, let $P$ = the percentage, and $W$ = its molecular weight. Then, starting with the value determined by analysis in each case, we have

Carbon dioxide to calcium carbonate:

$$P_{CO_2} \frac{W_{CaCO_3}}{W_{CO_2}} = P_{CaCO_3} \quad (1)$$

In the same manner, $P_{CaSO_4.2H_2O}$, $P_{CaO.Fe_2O_3}$, and $P_{3CaO.Al_2O_3}$ may be obtained.

The *net* calcium oxide, which we may designate as $P'_{CaO}$, may be calculated by the equation

$$P_{CaO} + P_{CO_2} + P_{SO_3.2H_2O} + P_{Fe_2O_3} + P_{Al_2O_3} - P_{CaCO_3} + P_{CaSO_4.2H_2O} + P_{CaO.Fe_2O_3} + P_{3CaO.Al_2O_3} = P'_{CaO} \quad 2$$

Now, having the net calcium oxide, $P'_{CaO}$, calculated as indicated, and the total silica, $P_{SiO_2}$, as determined by analysis, we may calculate the percentages of tricalcium silicate and dicalcium silicate present in the cement by means of simultaneous equations, *assuming that these two compounds (and only these) are present.*

Let $x$ = % tricalcium silicate = $P_{2CaO.SiO_2}$
$y$ = % dicalcium silicate = $P_{3CaO.SiO_2}$
$a$ = % net calcium oxide = $P'_{CaO}$
$b$ = % silica = $P_{SiO_2}$

$m$ = the ratio, $\frac{W_{CaO}}{W_{3CaO.SiO_2}}$

$n$ = the ratio, $\frac{W_{CaO}}{W_{2CaO.SiO_2}}$

Then
$$x + y = a + b \quad (3)$$
$$mx + ny = a \quad (4)$$

Solving for $x$ and $y$,

$$y = \frac{m(a+b) - a}{m - n} \quad (5)$$
$$x = a + b - y \quad (6)$$

### Conditions in Ideal Cement

In discussing these equations and the analytical work on which they are based, let us assume two cases:

1.—An "ideal" portland cement made from chemically pure materials. The calcareous and siliceous materials are exactly proportioned, the burning has been continued at sufficiently high temperatures until the maximum amount of tricalcium silicate has been formed. After the clinker has been ground and cooled, the proper amount of chemically pure hydrated calcium sulphate ground to the same fineness has been added, and thoroughly mixed. The sample is then preserved in such a manner that it cannot absorb either water or carbon dioxide.

2.—A commercial portland cement of average quality, which passes all standard specifications.

In an ideal cement there should not be more than a trace of moisture or carbon dioxide present. There should be no difficulty in calculating the percentage of gypsum, tricalcium aluminate, and calcium ferrite—assuming that the formula given for the last is correct. Without going into the details of chemical analytical methods, it may be pointed out that every determination is subject to experimental errors[4] and results obtained by different laboratories do not always agree.[5] When the net calcium oxide is calculated by equation (2), the result is subject to the sum of practically all the analytical errors made in the complete analysis of the sample. It may happen that some of these errors compensate each other, but there is no way of knowing when this occurs and consequently it is not possible to make allowance for this in the calculation. While the error in the result of any one determination might be negligible, or even the algebraic sum of the errors for the complete analysis might be negligible (in some cases), it may be seen that there is always a possibility of a considerable error and the value for the net calcium oxide obtained by this round-about method cannot be considered exact.

In calculating the percentage of tricalcium silicate and dicalcium silicate from the net calcium oxide and the total silica, use is made of what is termed "indirect analysis." In some cases, it is not possible to get complete information by making direct determinations, and in other cases the work is so difficult or so much time is required that direct determinations are not made. It is well understood, however, that such indirect analyses are only approximate[6] and that they should be used as sparingly as possible. The method is sometimes applied to the determination of sodium and potassium. If the weight of sodium chloride plus potassium chloride and the weight of the chlorine combined as chloride, or the weight of the chlorides and the sulphates are known, the sodium and potassium present may be calculated without determining them directly. The difficulty is that small experimental errors cause considerable differences in final results.

The errors that may arise in applying the principle of indirect analysis to calculate the percentage of tricalcium silicate and dicalcium silicate in a cement may be easily demonstrated. By placing first $y$ and then $x$ equal to zero in equations (5) and (6) and then, in each case, solving for $b$ in terms of $a$, the values for silica which correspond to all tricalcium silicate, and to no tricalcium silicate, respectively, may be calculated. If we assume 45 per cent as the net calcium oxide value, the silica values are 16.2 per cent and 24.2 per cent respectively. Substituting these values in Equation (5) and (6), the first sample shows 61.1 per cent tricalcium silicate and no dicalcium silicate, while the second shows zero tricalcium silicate. That is, in round numbers, a difference of 8 per cent in silica corresponds to a difference of 61 per cent in calculated tricalcium silicate. In other words, in this one part of the system of calculation, an analytical error is multiplied by 7.5, or an error of 0.2 per cent in making the silica determination becomes an error of 1.5 per cent—which could hardly be considered negligible. In the same way, it can be shown that errors in the calculated value for net CaO have a corresponding—though smaller—effect on the final result.

### Commercial Portland Cement

A recast analysis of a commercial cement is subject to all the errors just explained and to a number of others. These arise from the impurities in raw materials, differences in the manufacturing process at the various plants, contamination from the grinding machinery and fuel ash, and so on. It must be remembered also that the work on the constitution of cement was carried out with the ternary system, calcium oxide, silica, and alumina. While these constitute more than 90 per cent of an average cement nevertheless the minor constituents are by no means negligible and influence the reactions taking place in the kiln, by acting as fluxes, for example. So many variables are involved that it is impossible to say just how the

reactions known to take place with pure materials are modified under plant conditions.

Indirect analysis will not reveal whether a mixture consists of the two silicates alone, or the two silicates plus free calcium oxide. The fact that the analysis of a cement shows it to occupy a given position on the triangular $CaO - SiO_2 - Al_2O_3$ diagram, does not necessarily indicate its composition in terms of tricalcium silicate, dicalcium silicate and tricalcium aluminate.

Without discussing the merits of petrographic methods, it is evident that the results obtained for tricalcium silicate and dicalcium silicate by the proposed system of recasting chemical analyses are not dependable, because of the many sources of error that exist. Further, the practical value of such results even if accurate, is questionable, since the relation between the silicates and the physical properties of cement has not been fully established.

According to Rankin's paper[7] "Of these constituents, the compound tricalcic silicate is the one which hardens and devlops the greatest strength within a reasonable time. This most important constituent, which is the one formed with the greatest difficulty, makes up only about 30 to 35 per cent of an average normal portland cement. It may be said, therefore, that the essential process for the manufacture of portland cement is the formation of this compound and that any improvement in this process yielding an increased percentage of tricalcic silicate will increase the cementing value of portland cement." However, Bates[8] is of the opinion that ". . . the composition of portland cement should be along lines which would not produce a great preponderance of either silicate. The ideal cement should possibly have an excess of the dicalcium silicate, which would give a not too dense hydrated material, gaining strength at later periods."

### Equivalent Weight Ratios

Another recommendation made by Colony is that the ratio of the equivalent weight of the total calcium oxide to the equivalent weight of the total calcium alumina, and ferric oxide, respectively, is to be used as an indication of the quality of the cement. He is of the opinion that the minimum value for this ratio should be set at 2.4. It may be seen by consulting any book on cement manufacture that some such formula is always used for calculating the composition of the raw mixture. It is generally considered that, everything else being equal, the more calcium oxide present in a cement, the higher the strength (assuming proper burning), until the calcium oxide exceeds the equivalent of the other compounds present. In this case the excess of calcium oxide, will tend to make the cement unsound. Therefore, a maximum value for such a ratio is more important than a minimum, but neither should be specified until unmistakable evidence of the relationship has been obtained by comparing a large number of results of physical tests and chemical analyses, by a number of operators. Even then its usefulness is questionable, if physical tests of the cement have shown it to have a satisfactory strength and soundness. There are formulas for calculating the tensile strength of steel from the chemical analysis, and for calculating the calorific value of coal from its analysis. While these are of great value theoretically, we rely on the testing machine and calorimeter for making routine tests on these materials.

In the case of the analyses and physical tests of a number of samples of cement taken at random from the records of this Laboratory, there was no apparent relation of the tensile and compressive strength either to the calculated tricalcium silicate content, or to the calcium oxide ratio.

### Summary

The information that may be obtained from the chemical analysis of a cement is limited. The percentage of the various components cannot be determined directly since they contain the same elements in common, and a system of indirect analysis is subject to so many errors that the results obtained are unreliable.

The system for recasting results of chemical analyses has not demonstrated any definite relationship between such results and the behavior of the cement when subjected to physical tests. The system does not give any indication of the degree of burning to which the clinker has been subjected, and it is of no value in showing the proportion of the components of the mix, since this is shown by the ordinary analysis.

The ratio of the calcium oxide to the other principal components may offer some indication of the strength of a cement, but is of little importance since the strength may be determined directly.

References in the article are as follows:

[1]Witt, Concrete (Mill Section), 16, 73 (1920).
[2]Transactions of the American Institute of Mining and Metallurgical Engineers; *Eng. News-Record*, 86, 637 (April 14, 1921).
[3]Cf. Rankin, J. Franklin Inst., 181, 747 (1916).
[4]Cf. Witt, Concrete (Mill Section) 16, 75 (1921).
[5]Cf. Meade, Portland Cement (Second Edition), 18; Grimm, Tonind. Zeit., 33, 128 (1909).
[6]Olsen, Quantitative Chemical Analysis (Fifth Edition), 492.
[7]Rankin, loc. cit.
[8]Technologic Paper of the Bureau of Standards, No. 78, page 27.

## Electrification of Railways at Large Steel Plants

IN the railway systems of large steel manufacturing plants there is a large field for economy by the introduction of electric traction for the entire system, as distinct from the present occasional use of electric traction for individual sections of the plant. This view was expressed in considerable detail in a paper presented at the recent annual meeting of the Association of Iron and Steel Electrical Engineers, at Chicago, by R. B. Gerhardt, electrical superintendent of the Bethlehem Steel Co. plant at Sparrows Point, Md. A brief abstract of this paper is given below:

Electric locomotives or cars are used to some extent at most steel plants and although this use has been limited to particular pieces of work, such as the handling of hot coke and hot ingots, there is a great benefit over steam operation. The plan now in view is the complete displacement of the steam locomotive and the introduction of the electric locomotive for all transportation and shifting. A contact system is necessary, for although the storage battery engine offers some attractions for yard work, it is not able to withstand so much rough usage as the straight electric machine, its batteries are subject to a high rate of depreciation and the machine must be idle at certain periods of charging or exchanging batteries. A combination machine using both line contact and battery may have considerable advantage over the straight battery engine. Practically all steel plants have a 250-volt direct-current system, and this should be utilized for traction, as the men are familiar with it and the railway load would tend to equalize the load on the power plant.

For the contact system, the third rail would be the most satisfactory, the objection to the overhead wire being the

extended use of locomotive cranes at steel plants. However, the trolley system might prove of advantage for the classification yards. As to safety of the third rail system, it has been in use on blast furnace trestles for many years without a single accident due to contact with the live rail having the usual current of 250 volts.

The under-contact method is preferable to the top contact for safety and convenience, as it is easy to step over the contact rail and there is no danger in stepping on the guard which covers the rail. Gaps up to 40 ft. in length can be left in the rail at road crossings, and when two tracks are parallel the third rails would be placed between

COST OF STEAM AND ELECTRIC OPERATION OF STEEL PLANT RAILWAYS

| | Steam | Storage Battery | Third Rail |
|---|---|---|---|
| No. of locomotives | 27 | 27 | 23 |
| First cost, complete | $850,000 | $1,220,000 | $1,376,000 |
| Annual operating cost | 567,000 | 438,200 | 335,100 |
| Annual saving over steam | | 128,800 | 231,900 |
| Return on investment | | 10.5 per cent. | 16.9 per cent. |

them. As to adapting the third rails to complicated track layouts with numerous switches and cross-overs, such difficulties have been overcome successfully at many furnace tracks.

For work in buildings and at special places, such as slag dumps, where the third rail is objectionable or prohibited, the engines would be equipped with a 500-ft. cable to be attached to a suitable electrical connection. At furnaces, the third rail would stop at a convenient distance, an idler car being placed between the engine and the ladle car. At scrap yards, where metal is liable to block the track at the foot of the scrap pile, the cars could be poled from an engine on an adjacent track equipped with the third rail. When the plant railway is electrified, the next step would be to convert the locomotive cranes to motor operation, thus reducing their annual operating cost by about 50 per cent.

Comparative cost of steam and electric railways for steel plants is shown in the accompanying table, actual figures being given for steam and estimated figures for electric traction. The operating cost includes fixed charges, locomotive depreciation, fuel or power, repairs, operating labor, cleaning and the supply of coal, water, sand and supplies.

## Pump Stop, Water Hammer and Pipe Break Follow Lightning Bolt

LIGHTNING, striking the power line Sept. 20, feeding one of the electrically-driven pumping stations in Minneapolis, threw out the circuit breakers. Two 50-m.g.d. centrifugal pumps, delivering water through a 54-in. steel lock-bar pipe 3 mi. long to the reservoir under 100-lb. pressure stopped suddenly when the current was shut off. The water hammer resulting from the closing of the check valves caused the bursting of the bonnet of a 42-in. valve on a header at the station and the failure of 16 ft. of lock bar on the steel pipe ½ mi. away from the station and at about the same elevation. This double break left the Northeast station temporarily out of service.

Newspaper accounts attributed the damage to the pipe directly to the bolt of lightning, but J. Arthur Jensen, supervisor water-works, reports the foregoing information. Further, he states that temporary repairs made by removing the broken bonnet and closing the opening on the gate body by a temporary plate, permitted starting the pumps the following morning. The break in the steel pipe was by-passed by using a second force main to the reservoir. During the repair the Camden station was in operation at a 20-m.g.d. rate, the additional amount required being made up by reservoir storage.

Repairs to the steel pipe were made by cutting out the opened section and replacing it with a heavier piece of riveted pipe.

## Cleveland Reverts to Asphalt Filler for Brick Pavements

BY FRED R. WILLIAMS
Paving Engineer Cleveland, Ohio

ASPHALT filler for brick pavement in Cleveland, Ohio, was used this year for the first time since 1905 on sections of Lake Shore Boulevard and Arlington Ave., where a 7-in. concrete base was employed. The city has approximately 7,000,000 sq.yd. of brick pavement in service, built cumulatively since 1887. A large part of this yardage is cement-grout filled and is laid without other foundation than the natural sand of the old lake bed which underlies the city.

In 1913 Cleveland laid its first semi-monolithic brick pavement and a year later began the construction of monolithic brick. The latter type has, in recent years, where cement filler is desired, given place almost entirely to a pavement on a slag cushion with concrete base, approximating the semi-monolithic type.

That the city now turns to the construction of important sections of asphalt-filled brick pavement is due to confidence in the type and belief that a higher quality of asphalt filler is available than that which could have been obtained in earlier years. By virtue of this filler, promise is afforded for the repetition of the service-life which has characterized the older brick pavements of the city, some of which are more than 25 years old.

In addition to carrying heavy through traffic the newly paved section of the boulevard, lying alongside the city's principal lake-front pleasure resort, is called upon to bear the extra traffic of thousands who visit the park in automobiles during the summer months. This accounts for the heavy construction. The filler used was specially made for the city according to the specifications of the National Paving Brick Manufacturers' Association. It was applied at a temperature from 350 to 375 deg. F., and immediately squeegeed into the joints, leaving a minimum of excess filler on the surface of the brick.

The filler specification follows:

*Description* — Asphalt filler shall be homogeneous, free from water and shall not foam when heated to 200 deg. C. It shall meet the following requirements:

*Flash Point*—Not less than 200 deg. C. (392 deg. F.).

*Melting Point*—(Ring and ball) not less than 65 deg. C. (149 deg. F.).

*Penetration*—At 0 deg. C. (32 deg. F.) 200 gm., 1 min., not less than 10. At 25 deg. C. (77 deg. F.) 100 gm., 5 sec., 30 to 50. At 46 deg. C. (115 deg. F.) 50 gm., 5 sec., not more than 110.

*Loss on Evaporation* — 163 deg. C. (325 deg. F.) 5 hr., less than 1.0 per cent.

*Ductility*—Not less than 3.

*Total Bitumen* — Soluble in carbon disulphide, not less than 99 per cent.

*Percent of Total Bitumen* — Soluble in carbon tetrachloride, not less than 99 per cent.

*Reduction in Penetration* — At 25 deg. C. (77 deg. F.) due to heating specified under "Loss of Evaporation," not more than 50 per cent.

### Snow Melted in Turntable Pits

In clearing snow at engine terminals the Canadian National Railways have had very satisfactory results from the use of steam coils in turntable pits. This not only facilitates the operation of the turntable but enables the pit to be used as a snow melter, into which is thrown the snow cleared from the yard and tracks, the water being carried off by the drains.

# Enlargement of the Sewage-Works of Baltimore

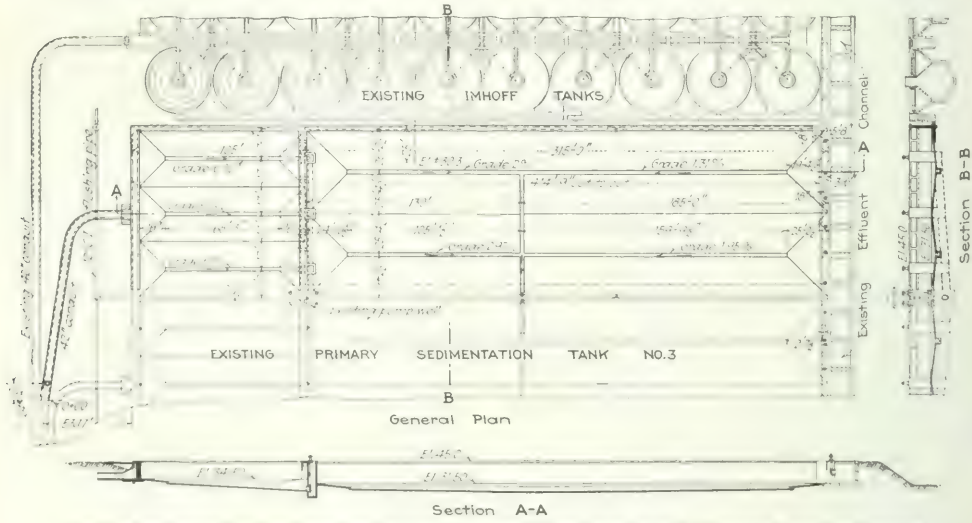
## After Experience with Primary Sedimentation Followed by Separate Sludge Digestion and with Imhoff Tanks City Adopts the Former for Extensions—New Unit Described

By C. Edward Keefer
Assistant Designing Engineer, Sewer Division, Baltimore, Md.

SINCE the last extensions to the Baltimore sewage-works were completed in 1916 about 10,000 buildings have been connected to the sewers. To meet the added volume of sewage, a primary sedimentation tank, a sludge digestion tank and a small pumping station are being built. In November, 1920, a loan of $26,000,000 was voted for public improvements, $8,000,000 of which will be used to extend the sewerage system into the unsewered areas of the original city and into a portion of the 59.7 sq.mi. of territory annexed in 1918. The sewage from all of this annexed territory will flow through the existing outfall sewer to the treatment plant except that from a section which is separated from the city proper by the Patapsco River for which another sewage-works will be built. As additional sewers are built in the city the flow will increase, and provision will have to be made to treat it by the expenditure of large sums of money for extensions to the plant. These extensions will consist of primary sedimentation tanks (until recently called hydrolytic tanks), sludge digestion tanks, a meter house, trickling filter beds, sludge drying beds, a workshop and storage building, together with the necessary conduits, pumps, pipe lines, comfort stations, roads, etc.

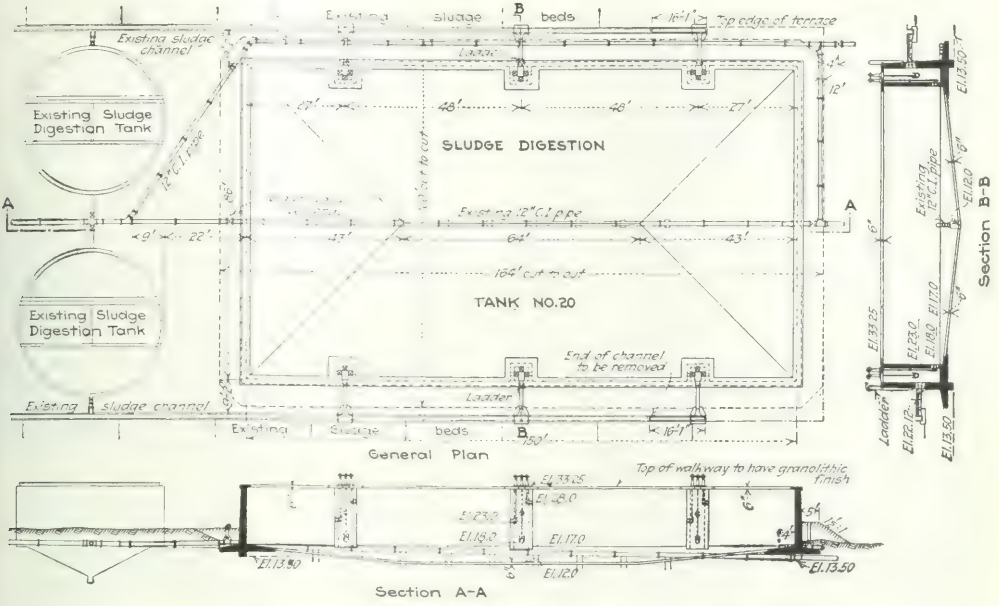
Before designing the new sedimentation tank, much thought was given to the advisability of building in place of it one or more Imhoff tanks. As both kinds of tanks have been in service at this plant, it has been possible to get comparatively low figures. [See "Nine Years' Operation of the Baltimore Sewage-Works," by Theodore C. Schaetzle, principal sanitary chemist in *Engineering News-Record*, July 14, 1921, p. 50—Editor.] Everything points to the adoption of sedimentation tanks in conjunction with sludge digestion tanks as the most logical solution of the problem for Baltimore conditions.

None of the many troubles that have to be confronted in the operation of Imhoff tanks are found in treating sewage with sedimentation and sludge digestion tanks. No foaming is met with; no time is spent squeegeeing; no scum has too be removed; no skimming of the tanks is required; and no uncertainties of operation have to be considered. The settled sewage from the sedimentation tanks compares favorably with that from the Inhoff tanks (see Table I). The digested sludge from the sludge digestion tanks and the Imhoff tanks are practically identical and one dries as quickly as the other on sludge beds. The interest and depreciation on the sedimentation and sludge tanks is less per million gallons of sewage treated (see Table II) than on the Imhoff tanks, and the operating costs at Baltimore per million gallons for treating the same kind of sewage through the sedimentation tanks, sludge digestion tanks and trickling filters is 53 per cent of what it is when the Imhoff tanks and trickling filters are used.




PLAN AND SECTIONS OF PRIMARY SEDIMENTATION TANK FOR THE BALTIMORE SEWAGE-WORKS

The primary sedimentation tank is 420 ft. long and 103 ft. 2 in. wide, with a capacity of 3,800,000 gal. to the flow line. It is divided into two compartments by a baffle wall 5 ft. high at the outer wall of the tank. The compartment into which the sewage enters is 105 ft. long and has a depth varying from 10½ to 12½ ft. The other compartment is 315 ft. long and from 13½ to 15½ ft. deep. In the smaller compart-




PLAN AND SECTIONS OF SLUDGE DIGESTION TANK

ment there are three U-shaped channels that lead to an egg-shaped drain, which in turn empties into a pump well. In the larger compartment there is also a system of "U" channels.

Normally, to get the best results, the tank should be kept in continuous operation from ten days to three weeks in summer, and about six weeks in winter.

TABLE I. COMPARATIVE AVERAGE RESULTS IN 1916 FROM BALTIMORE PRIMARY SEDIMENTATION AND IMHOFF TANKS

| | Parts per Million—Effluent From | | |
|---|---|---|---|
| | Raw Sewage | Primary Sedimentation Tanks | Imhoff Tanks |
| Settling solids | 102 | 35 | 26 |
| Biochemical oxygen demand | 91 | 158 | 132 |
| Total bacteria | 1,100,000 | 800,000 | 550,000 |
| Acid-forming bacteria | 89,000 | 98,300 | 100,000 |

After this period it should be cleaned by opening the two 12-in. sluice gates which connect with the pump well. The sewage runs into this well, and is lifted by a 12-in. open impeller pump into one of the other sedimentation tanks in operation. Next, the sludge, which is often 4 or 5 ft. deep, is broken up by a stream from a ¾-in. nozzle, delivered under a pressure of 45 lb. per sq.in. Enough water is added to make the sludge flow through the "U" channels and the egg-shaped drain to the pump, which removes it to one of the sludge digestion tanks. The grades of the "U" channels vary from 1.31 to 6 per cent, and the grade of the floor from 8 to 8.2 per cent. As it wil be necessary for the man who flushes out the sludge to get into the tank, it was decided not to give the bottom a steeper grade. Previous experience has demonstrated that it does not take a great deal of time to remove the sludge if the tank has not been in operation longer than the period named.

The need for additional sludge digestion space has been urgent for the past few years. In 1916, when the last digestion tanks were built, the sewage flow averaged 39.16 m.g.d. By 1920 this flow had increased to 52.12 m.g.d., with an increase in the quantity of sludge. Fortunately there were several low-lying areas of land in the 468-acre tract reserved for disposal purposes which have been filled with sludge to an advantage. Because of the lack of sludge room part digested sludge has frequently been run on the drying beds, and a longer period of time has been required to dry it.

There are now 19 sludge digestion tanks, of which three are rectangular and 16 are circular. Although all of them adequately serve the purpose for which they were designed, local experience of the past ten years has demonstrated various possible improvements and these have been incorporated into the new tank. The rectangular tanks are a considerable distance from the sludge drying beds. To get the sludge to these beds, a 12-in. open impeller centrifugal pump is used to force the sludge through several hundred feet of 12-in. cast-iron pipe. In performing this operation much water has to be added to get the sludge in a sufficiently fluid condition. Hereafter all of the digestion tanks that are built will be adjacent to the sludge beds so that no pumping will be needed to transfer the sludge to the drying beds.

The old rectangular tanks were built with a covered channel around the top. It was thought that the clarified sewage could be easily removed through this channel but it was found that it distributes itself haphazardly in pockets throughout the sludge accordingly, a similar channel was not incorporated in the tank under construction.

The sludge draw-off points in the old tanks were placed at the bottom since it was supposed that the undigested sludge would form at the top, and in gradually

digesting would settle to the bottom. The reverse condition, however, has usually resulted. To get the well digested sludge at the top, which forms a thick scum, to the sludge beds, a good deal of water has to be added. The circular tanks were also built with draw-off points at the bottom of the tanks, but in these tanks also the digested sludge forms on the top.

TABLE II. COMPARATIVE CAPITAL AND OPERATING COSTS OF PRIMARY SEDIMENTATION AND IMHOFF TANK TREATMENT AT BALTIMORE

| | Three Primary Sedimentation Tanks and Ninety-six Sludge Digestion Tanks | Twenty-eight Imhoff Tanks |
|---|---|---|
| Construction cost | $202,213 | $78,400 |
| Fixed charges (interest and depreciation) | $14,155 | $5,488 |
| Average yearly capacity, m.g | 16,060 | 3,650 |
| Fixed charges per m.g | $0.88 | $1.50 |
| Total operating cost (1920) | $67,184 | $6,877 |
| Total sewage flow (1920), m.g. | 18078.42 | 986.81 |
| Operating cost per m.g | $3.71 | $6.97 |

### Features of the New Sludge Tank

The new tank has a capacity of 232,500 cu.ft.; is 150 ft. long, 86 ft. wide and from 16 ft. 3 in. to 21 ft. 3 in. deep. The undigested sludge enters the tank near the bottom at both ends. The floor slopes towards the center with a grade of 11.6 per cent so that the tank can be emptied with ease if necessary. There are six manholes along the walls, each with one outlet pipe and three 10-in. circular sluice gates, placed at different elevations. The outlet pipes connect with an existing rectangular concrete channel, 1½ ft. deep and 1 ft. wide, through which the sludge flows by gravity to the drying beds. These channels are built level throughout, and, as they are almost 900 ft. long, it is practically impossible to get sludge to run from one end to the other without overflowing. To prevent this condition, these channels will be made higher.

Sludge is removed from the tank by opening one of the sluice gates, and if undigested sludge runs out another gate at a different elevation will then be opened in order to draw off digested sludge. With 18 sludge outlets situated at different elevations and at different points the chances of being able to remove digested sludge is greatly enhanced. Experiments will be conducted to see what effect, if any, the depth of the tank has on the rate of digestion. The tank was made of such a depth partly to conform to the contour of the ground and partly to give an economical design. The contractor on both tanks was Robertson Bros., whose bid price on the sedimentation tank was $107,055 and on the sludge digestion tank $57,329.

### Auxiliary Pumping Station

Another improvement has been the building of a small pumping station. Before this station was built, all of the water from the sludge passed through the underdrains of the sludge beds to a pipe line and emptied into a large pond or stream. As the water from the sludge contained much organic matter in solution, this pumping station was built to intercept it so that there would be no complaint because of odors and the contamination of the pond.

The station is provided with two 5-hp. vertical a.c. motors, direct-connected to two 2-in. centrifugal closed impeller sump pumps, each having a capacity of 160 gal. a minute against a static head of 43.5 ft. The pumps are in separate wells so that if one breaks down it can be repaired while the other is in operation. There is an overflow from the station, which will be used only if both pumps are out of service. The water is pumped through a 4-in. cast-iron main to the effluent channel of the primary sedimentation tanks, from which it flows through the trickling filters and the final settling basins. Each pumping unit will work automatically.

Ordinarily the sluice gate connecting the two wells at the bottom will be left open so that a greater storage space will be available. The floats on the pumps will be set at different elevations so that if one fails to start the other pump will be in reserve when the level of the water reaches the elevation of the higher float. This station was built by the Whiting-Turner Construction Co.

The improvements as a whole are under the supervision of A. E. Christhilf, highways engineer, with Milton J. Ruark at the head of the sewer division. The author is in charge of the design and construction of this work, and J. S. Gorsuch has direction of the field operations.

## Conference Accepts Reports Outlining Unemployment Relief

### Permanent Measures Included—State Employment Offices Urged—Financing, Material and Labor Costs Deter Construction

DURING the three sessions which came to a close Oct. 13 with its adjournment *sine die*, the President's Unemployment Conference received reports from various committees and adopted recommendations which outline in general and in detail recommendations for both emergency and permanent relief of unemployment. Outstanding were the report of the committee on construction industries, the report of the committee on employment agencies, and the general recommendations arrived at by the conference itself and presented during its last session.

### Temporary Relief Measures

*Construction Financing*—The committee on construction industries felt that a return of confidence in values in construction would assure more employment than in any other business, inasmuch as more than 2,000,000 people could be employed if construction should be appreciably resumed. Its report indicated that the three great factors affecting a resumption of construction activity were financing, material costs and labor costs, and that throughout the country owners had declined to start new projects because of financing charges, commissions and premiums at times reaching from 10 to 20 per cent being charged in addition to from 7 to 8 per cent interest on money loaned. Excessive financing charges for building had been exceptional, and the committee found many savings banks, trust companies, and insurance companies had maintained a conservative loaning policy with regard to real estate and home building, and that the building and loan associations with their $2,500,000,000 in assets had been conducted with exceptional efficiency. The committee reported that, underlying the whole matter of the financing of construction, there is, however, "the sound banking principle that long-term deposits and the savings accounts of the people should primarily be

used for long-term purposes and should not be intermingled with business carried on for speculative and business purposes."

### Materials and Labor

*Construction Materials*—Though there have been substantial reductions in some construction materials, the committee found that other construction materials had not yet been reduced in keeping with the trend of wholesale prices of other commodities, and that in some instances retailers of construction materials had failed to follow reductions of manufacturers and wholesalers.

*Labor*—As to labor costs, the committee reported that wages should be such as to allow not only proper education of the family of the laborer, but systematic, though small, saving. In reporting upon unfair practices the committee asserted that "all practices which unnecessarily retard the work or add to its cost should be immediately discountenanced and abandoned if the confidence of the public is to be fully restored."

*Other Considerations*—In order further to revive activity in the construction industry the committee recommended readjustment of freight rates on a more equitable basis, the ironing out of inequalities in the freight schedules, the elimination of priorities, and the standardization of building codes.

In its recommendation to the general conference the committee on construction industries recommended the appointment of a committee selected from various elements interested in construction which would be charged with the responsibility of co-operating with the governors and mayors in the several states in carrying on community conferences on construction and to look to the removal of unnecessary or inequitable limitations and restrictions which have retarded real construction activity.

*Employment Agencies*—The committee on employment agencies recommended the extension of state employment agencies, asserting that the state and not the federal government should operate the local offices and do placement work. However, it was recommended that the federal government could assist the state employment agencies in the collection, compilation, and distribution of statistical information and general information which would facilitate interstate placement, and do educational and other work which would improve employment standards. With this view of federal co-operation with the states in mind, the committee on employment agencies and registration urged that Congress be asked to appropriate $400,000 to enable the United States Employment Service to operate more actively in the interstate field.

### Permanent Unemployment Relief

The general recommendations which the conference adopted for permanent recovery from unemployment included: (1) Readjustment of railway rates to a fair basis of relative value of commodities; (2) speedy completion of the tax bill; (3) a definite settlement of tariff legislation; (4) a settlement of the financial relationship between the government and the railways; (5) limitation of world armaments; (6) steps looking to the minimizing of fluctuations in exchange; (7) definite programs of action that will lead to elimination of waste and more regular employment in seasonal and intermittent industries; and (8) the elimination of the disproportion between the primary price of commodities and the ultimate retail price, the disproportion being due to increased cost of transportation, large profits, interest, taxes, labor, etc. The conference concluded that since the buying power of the different elements of the community was to be restored, these levels must reach nearer a relative plane.

"For example," cites the conference report, "the farmer cannot resume his full consuming power and thus give increased employment to the other industries until either his price is increased or until more of the other products and services come into fair balance with his commodities and therefore the reach of his income." As an indication of this disproportion, the approximate index numbers of various commodities were included in the conference report. The index numbers are based upon 100 for 1913 and are cited as of August, 1921. They are as follows: Cost of living, Department of Labor (May survey), 180, National Industrial Conference Board, 165; average price to producer, farm crops, 109; average price to producer, live stock, 113; average wholesale price, foods, 152; average retail price, foods, 155; wages in meat packing, 186; freight rates, dressed beef, Chicago to New York, 214.

The disproportion existing in index numbers in the building industry were indicated as follows: Lumber, average Southern pine and douglas fir at the mill, 128; brick, average common, New York and Chicago, 199; cement, portland, net without bags to trade f.o.b. Buffington, Ind., 175; freight rate on common brick from Brazil, Ind., to Cleveland, 204; freight rate on cement from Universal, Pa., to New York, 179.

The conference found that the index number for the union scale of the average of fifteen occupations in building labor was 190. The union scale with a weighted average of eight occupations on frame house construction was 177, and the union scale with a weighted average of eight occupations in brick house construction 193. The index number of common labor was found to be 130.

## Clean Concrete Paving Joints With Automobile Exhaust

An inexpensive method for cleaning joints and cracks in concrete pavement before filling with tar has been devised by Burgess & Dorrier, contractors, of Scottsville, Va.

The method involves the use of a 30-ft. length of ¾-in. rubber hose, provided with a ½-in. gas pipe nozzle. The hose is attached to the exhaust pipe of the small motor truck used for hauling the tar kettle and other tools. The end of the gas pipe nozzle is drawn down to ¼-in. diameter. The crack or joint to be cleaned is first freed from any tightly packed dirt by means of a metal cleanout hook. The material thus loosened is then dislodged by directing the exhaust pressure of the motor, by means of the hose and nozzle into the joint. The motor is speeded up to produce the necessary pressure at the nozzle. This method leaves a clean crevice. The exhaust gases, being warm, evaporate any moisture that may be present in the edges of the concrete, thus insuring a good bond between the concrete and the hot bituminous filler. The method is stated to be much quicker and more effective than the commonly used street broom, especially in getting rid of the fine dust which, if left in the crevices, may prevent the bitumen from adhering to the concrete.—*The Concrete Highway Magazine.*

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## How the Patent Office Could Help Thousands

Thousands of users of the printed copies of patent specifications issued by the United States Patent Office must curse the government daily for persisting in leaving the first page of these valuable documents entirely blank. If instead of this the patent number, date, title, and the name of the patentee were printed on the first page a vast amount of time and profanity would be saved to thousands. Or, if the government balked at the extra cost thus involved, it might omit the blank cover page and place the drawings at the end instead of the beginning of the document, thus revealing the basic information which every user of each patent wants every time he has occasion to refer to a patent. As the matter now stands, every one who has occasion to file a patent for reference is compelled to write more or less of the information suggested above upon the blank page for purposes of identification. Why a vast number of people should be compelled to do each for himself what could readily be done by the government's printing presses is a mystery.

## The Design of Centrifugal Pumps

—REVIEWED BY ROBERT E. HORTON, Consulting Hydraulic Engineer, Voorheesville, N. Y.

CENTRIFUGAL PUMPS—By J. W. Cameron, A.M.I. Mech. E. London: Scott, Greenwood & Son. New York: D. Van Nostrand Company. Cloth; 6x9 in.; pp. 142, illustrated. $3.75.

The author of this book evidently presents a digest of notes and formulas used by him in practical centrifugal pump design. The introductory chapter discusses in non-mathematical language the modus operandi and advantages of the categorical type of turbine pump. Unfortunately, the book begins with a definition of the centrifugal pump that applies equally well to reciprocating and other pumps. A second definition of the centrifugal pump is given as "a reversed radial inward flow reaction turbine." While interesting and descriptive, this definition is wanting in other respects.

The hydraulic theory of centrifugal pumps as related to practical design is treated concisely, yet clearly, in a space of ten pages. Some very good diagrams used in this section to illustrate the vector relations of flow through centrifugal pumps could be greatly improved in clarity. Next follows a chapter on hydraulic losses during the passage of fluid through the pump. Formulas and, where available, experimental data for calculation of these losses, are given. The mode of occurrence of losses is rendered clear by illustrations. M. Hanocq's formulas for friction losses in guide and runner passages are given and will be new to many English readers.

The following chapter covers calculations of the hydraulic efficiency obtainable with turbine pumps of various designs. The theory and design of shaft bearings and the determination of bearing and disc friction are next taken up, thus laying a complete foundation for the succeeding chapter which covers calculation of over-all efficiency, including both mechanical and hydraulic losses. A chapter on the effect of the angle of discharge on efficiency completes the portion of the book devoted to general theory. It is followed by details of mechanical design of the various parts of turbine pumps, including casings, impellers, shafts and axial thrust bearings. Then actual designs of single- and multi-stage pumps are worked out in detail.

The 97 pages of the book thus far covered are remarkable for clearness and compactness. Apparently there is little omitted that is essential. The next chapter (30 pp.) gives brief descriptions, with many half-tone illustrations (some are poor), of typical designs and installations of one English, one Swiss and one American pump builder. Descriptions are meager and superficial. Hydraulic characteristics and efficiencies are not given, and this chapter adds little value to the book.

Probably all that is given in this book is available elsewhere, but there appears to be no book that gives the essentials of ordinary turbine pump design in an equally complete and compact form with so little abstruse theory.

## For the Practical Concrete Man

CONCRETE WORK: Vol. II. A book to Aid the Self-Development of Workers in Concrete and for Students in Engineering—By William Kendrick Hatt, C.E., Ph.D., M. Am. Soc. C. E., M. Am. Soc. T. M., M. Soc. Prom. Eng. Ed.; Professor of Civil Engineering, Director of Laboratory for Testing Materials, Purdue University, Lafayette, Ind.; President, American Concrete Institute; and Walter C. Voss, B.S., Assoc. M. Am. Soc. C. E.; M. Am. Soc. T. M.; M. Am. Conc. Inst., Head, Department of Architectural Construction, Wentworth Institute, Boston, Mass.; Licensed Architect, State of Illinois; Master Builder Boston. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd Cloth; 5 x 8 in.; pp. 206. Illustrated. $2 postpaid.

Vol. I of this novel treatment of concreting was reviewed in *Engineering-News-Record*, March 17, 1921, p. 475. The second volume is, according to the preface, prepared to develop the practical ability of the concrete worker, the inspector and the student in technical schools, which is effected by successive job sheets, beginning with the use of the triangle and continuing through methods of building a pile wall, determining where tension and compression occur in beams, of ascertaining proper location of reinforcing rods, and similar elements of the concrete art. No better book for the practical concrete man has been written, but it requires considerable study and experience on the part of the instructor to make it most effective for the student.

## Valuable Work on Forestry in France

STUDIES IN FRENCH FORESTRY—By Theodore S. Woolsey, Jr., Consulting Forester, Author of French Forests and Forestry (Tunisia, Algeria Corsica), and Executive Member Interallied War Timber Committee, Paris, 1917-19; with Two Chapters by William B. Greeley, Forester, U. S. Forest Service, and formerly Chief, Forestry Section C. and F., S. O. S., American Expeditionary Forces. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd Cloth, 6 x 9 in.; pp. 550, illustrated $6

France has done so much in forestry and done it so well that a careful study of her forestry policy, methods, and results, such as is presented in this volume, cannot fail to be of interest and value to all interested in forestry, whatever their country. The book contains much that has a direct appeal to Americans. The chapter of widest general interest here is Colonel Greeley's

spirited account of "The American Forest Engineers in France." Chapters of direct appeal to engineers are those dealing with engineering works and with planting to prevent erosion in the mountains and to control and utilize vast sand dunes. A number of appendixes add largely to the mass of data and opinion which the volume affords.

## Insects and Communicable Diseases

SANITARY ENTOMOLOGY: The Entomology of Disease, Hygiene and Sanitation—Edited by William Dwight Pierce, Ph.D., Consulting Entomologist, formerly Entomologist South Field Crop Insect Investigations, United States Department of Agriculture, Bureau of Entomology. Boston: Richard G. Badger. Cloth; 6 x 10 in., pp. 518; illustrated. $10 net.

Not the least valuable feature of this comprehensive survey of insect life in its relation to disease among man and some of the domestic animals is its promise of stimulating still further research into the mysteries of some of our most dreaded communicable diseases. The volume originated as a series of lectures by ten entomologists delivered during the war—and also circulated in mimeographed form at that time. Most of the lectures were subsequently revised for publication.

After a number of general lectures or chapters on how insects carry disease, the "needs of entomological sanitation" in America, and the "seriousness of insect-borne diseases to armies," the several authors take up the relation of insects to the parasitic worms of vertebrates, the bearing of climate and life on medical entomology, non-biting and biting flies, mosquitoes, lice, fleas, cockroaches, bedbugs, mites and ticks, flies and lice in Egypt, insects in relation to packing houses, and poisoning by insects. Some 26 pages are filled with a tabulation of data on the transmission of specific diseases by insects.

The general plan followed is to present for each main class of insect the diseases which it bears, with much related data; the biology of the insect, and means for its control. Such topics as the disposal of garbage, human and animal excreta are considered, and also drainage in its relation to mosquito breeding. The larger part of the space is given to the insects and dangerous organisms that they harbor and spread. A vast amount of material was gone over, in the preparation of the volume, digested, classified and interpreted. Chapter-end bibliographies give abundant references to more detailed sources. The volume promises to be of great usefulness.

## A British Who's Who in Engineering

WHO'S WHO IN ENGINEERING—Edited by John Ed. Sears, C. B. E., M. A., Assoc. M. Inst. C. E. 1920-21. London: The Compendium Publishing Co. Cloth; 7 x 10 in.; pp. 426.

Besides following the well-known lines of the general personal reference manuals in giving biographical information regarding the leading engineers, in this case with particular attention, of course, to their engineering education and experience, this volume contains a section devoted to "The Engineering and Allied Trades," classified indexes for both the engineers and the concerns engaged in the production of materials and appliances of engineering, and several unique additional sections. The latter are devoted to the various engineering societies, the technical schools, the trading and research associations, the associations of employers and also of employees, and the engineering journals of Great Britain. In the section devoted to engineers there is a separate paragraph, where called for, giving the "war service" of each engineer.

## Graphical Representation

GRAPHIC PRODUCTION CONTROL—E. C. E. Knoeppel, Member Society of Industrial Engineers, M. A. S. M. E.; Assisted by Various Members of the Author's Firm and Staff. New York: The Engineering Magazine Co. Cloth; 6 x 9 in.; pp. 477; illustrated. $10.

Graphic representation has been extended in recent years to give a line picture instead of a word picture of trends, developments, and in fact a record of any business operation which has continuity. The physician charts temperature curves, the production manager graphs output with the proper cost distribution, the busy executive watches the general conduct of his business through series of charts. But not everyone can produce a graph that tells the exact manner in which a business is being conducted and a chart that will denote "graphically" what the status of industry is. To give this information is the aim of this book. The author plans in detail the application of graphs to production in its thousand and one uses. The volume explains at length the history of graphical representation, and gives instances of its more popular as well as technical application.

## Weekly Foreign Commerce Reports

Beginning Sept. 5, "Commerce Reports," published by the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, became a weekly ($3 a year for domestic and $5 a year for foreign circulation, from Superintendent of Documents, Washington, D. C.) instead of a daily. In the new form the material is classified by commodities and edited by specialists. Among the eleven divisions thus far established are iron and steel, industrial machinery, electrical equipment and supplies, lumber, automotive equipment, and agricultural implements and vehicles. To save delay in making important information available, Secretary Hoover states in his foreword to the first issue of the new weekly, "special material will be released to the press immediately upon its arrival, in advance of the weekly publication."

## The Industrial Digest

A semi-monthly digest of selected material from 600 Journals covering 30 "industries" started its first number on Oct. 1 (The Periodical Digest Corporation, 25 W. 45th St., New York City; $5 a year in U. S.; $6 in Canada; $7 elsewhere). Among the "industries" covered are Building and Construction; Cement, Stone and Brick; Electrical; Iron and Steel; Economic; Financial.

## Research Narratives

For the purpose of stimulating "interest in increasing the resources of Engineering Foundation" (Engineering Societies' Building, New York City) that body has begun the publication of a bimonthly series of "Research Narratives" that it expects to continue for a short time. The first one is entitled "Isolated Research: Its Handicap—The Story of Mendelism."

## Industrial India

A monthly journal entitled "Industrial India," devoted to the development of India's resources, is now being issued by the Tata Publicity Corporation, Bombay and Calcutta, with a London office at Kern House, 36 Kingsway, W. C. 2.

# PUBLICATIONS RECEIVED

THE AMERICAN RAILROAD PROBLEM—A Study in War and Reconstruction—By I. Leo Scharfman, Professor of Economics, University of Michigan. New York: The Century Co. Cloth; 5x8 in.; pp. 474; $3.

AMERICAN SOCIETY FOR TESTING MATERIALS STANDARDS: Triennial Issue, 1921—Philadelphia, Pa.: American Society for Testing Materials. Cloth; 6x9 in.; pp. 890; Folding Plates and Figures in the Text. $10. Half leather, $11.50

These engineering standards, "consisting of Standard Specifications, Standard Methods, Standard Definitions, Recommended Practice," now total 160, divided as follows: Steel and wrought iron, 61; pig and cast iron and finished castings, 7; non-ferrous metals, 31; cement, lime, gypsum and clay products, 18; preservative coatings and lubricants, 10; road materials, 19; coal and coke, 4; timber, and timber preservatives, 6; rubber, 2; miscellaneous subjects, 2. All the standards adopted up to June, 1921, with subsequent revisions, are given. The volume is worthy of a place in every engineering office in the country.

ANALYTICAL MECHANICS FOR ENGINEERS—By Fred B. Seely, M.S., Associate Professor of Theoretical and Applied Mechanics, and Newton E. Ensign, A.B., B.S., Associate in Theoretical and Applied Mechanics, University of Illinois. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth, 6x9 in.; pp. 436; illustrated. $4 postpaid; 24 s. net.

ANNUAL CONFERENCE ON CITY PLANNING: Proceedings at Pittsburgh, May 9 to 11, 1921—Flavell Shurtleff, Secretary, 60 State St., Boston, Mass. Cloth; 6x9 in.; pp. 206.
Contains papers on the city plan, zoning, aerial photography, etc.

BRÜCKEN IN EISENBETON—Ein leitfaden fur Schule und Praxis von C. Kersten, vorm. Oberingenieur, Oberlehrer an Der Baugewerkschule, Berlin. Teil I: Platten- und Balkenbrücken mit 606 Textabbildungen, Fünfte, Neubearbeitete Auflage. Berlin; Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 256. Paper, 36m. Cloth, 42m.
The first edition of this work was reviewed in *Engineering News*, May 16, 1907.

CANADIAN RAILWAY STATISTICS, 1919—Ottawa Dominion Bureau of Statistics, Transportation Branch. Paper; 6x9 in.; pp. 272, 20 cents.

COLUMNS: A Treatise on the Strength and Design of Compression Members—By E. H. Salmon, D.Sc. (Engineering) London, Assoc. M. Inst. C. E. From a Thesis Approved for the Degree of Doctor of Science (Engineering), in the University of London. London: Henry Frowde and Hodder & Stoughton. Cloth: 6x9 in.; pp. 279; illustrated. 31/6 net; postage 1s. extra.

COURT DECISIONS ON WORKMEN'S COMPENSATION LAW, JANUARY, 1920, TO JUNE, 1921—Albany, N. Y.: Department of Labor. Paper; 6x9 in.; pp. 302.

DIE NATURWISSENSCHAFTEN IN IHRER ENTWICKLUNG UND IN IHREM ZUSAMMENHANGE: Dargestellt von Friedrich Dannemann, Zweite Auflage II Band: Von Galilei Bis Zur Mitte Des XVIII. Jahrhunderts, Mit 132 Abbildungen Im Text und Mit Einem Bildnis Von Galilei. Leipzig: Wilhelm Engelmann. Paper, 6x9 in.; pp. 508. 70 marks, bound, 85 marks.

ELEMENTS OF SPECIFICATION WRITING—By R. S. Kirby, C. E., Assistant Professor in the Sheffield Scientific School of Yale University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 153. $1.50 net (9/-net).
This edition has been revised to accommodate the text to certain developments in contracting since the war, principally the cost-plus contract in its various stages. It is frankly a student's book and an excellent one of that class. It is well arranged, clearly sub-headed, and definite in its statements.

FOOD INVESTIGATION BOARD: Report for 1920—(British Department of Scientific and Industrial Research). London: His Majesty's Stationery Office. Paper; 6x9 in.; pp. 39. 1s. net.
Contains summaries of technical investigations by various committees, including one on engineerings, concerned chiefly with cold-storage problems. Bacterial studies are also reviewed.

FOURTEENTH CENSUS OF THE UNITED STATES, Vol. I, Population, 1920: Number and Distribution of Inhabitants—By William C. Hunt, Chief Statistician for Population. Washington, D. C.: Bureau of Census. Paper; 9x12 in.; pp. 695; 2 fold. maps.
A brief introductory summary is followed by population for 1920, 1910 and 1900 by states, counties, incorporated places, and other minor civil divisions.

HANDBOOK OF THE BUILDING TRADES EMPLOYERS' ASSOCIATION OF THE CITY OF NEW YORK, 1921—A list of Members, the Rates of Wages, the Joint Arbitration Plan, Provisions of Trade Agreements, and the Hours of Work Claimed by Each Union Governing in Questions of Jurisdiction of Trade. New York: The Association, 30 W. 33rd St. Paper; 6x9 in.; pp. 176.

INDIAN RAILWAY BRIDGE COMMITTEE: Vol. I Fourth Report. Technical Paper No. 224; Containing a Report by H. S. Sales, Investigating Officer, on Impact Tests of December, 1919-March, 1920. Calcutta: Superintendent of Government Printing. Paper; 8x13 in.; plates and diagrams. 5Rs.

KANSAS HIGHWAY COMMISSION: Report for 1919 and 1920—Topeka, Kan.: The Commission. Paper; 6x9 in.; pp. 270.

LAWS AND RULES RELATING TO PUBLIC WATER SUPPLIES AND THE ERECTION OF DAMS—Trenton, N. J.: The Department of Conservation and Development. Paper; 4x6 in.; pp. 52.
Contains basic laws giving control of certain phases of water supply to State Water Supply Commission and later on transferring same to district commissions and some to the department named. Includes rules for applications for water-supply rights and for filing plans of dams. Control of the purity of water is exercised by the State Department of Health and over rates and service by the Public Utilities Commission.

A MAJOR STREET PLAN FOR PITTSBURG; Report No. 2, Sept. 1921. Pittsburgh, Pa.: Citizens' Committee on City Plan of Pittsburgh. Paper; 8 x 11 in.; pp. 65. 50c.

MECHANICS—A Text-Book for Engineers, First Edition—By James E. Boyd, M.S., Professor of Mechanics, The Ohio State University; Author of "Strength of Materials," "Differential Equations for Engineering Students," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 417. $3.50.

MANUAL ON ROAD CONSTRUCTION FOR RESIDENT ENGINEERS AND INSPECTORS—By B. H. Piepmeier, Engineer of Construction, Division of Highways. Springfield, Ill.: Department of Public Works and Buildings. Paper; 6x9 in.; pp. 73; illustrated.
Contains much information on organization, inspection and details of various current types of road construction.

MODERN BUILDING SUPERINTENDENCE AND THE WRITING OF SPECIFICATIONS—By David B. Emerson. New York: Charles Scribner's Sons. Cloth; 5x7 in.; pp. 247. $1.75.
A readable but unillustrated description of the materials and some of the construction features of a 20-story modern office building, with general remarks on specifications and a section on specifications for a small house. Originally written for juniors and students and published serially in an unnamed "magazine." A creditable production within its actual limits, but while more up-to-date, so far as it goes, than T. M. Clark's "Building Superintendence" (see *Engineering News*, June 18, 1903, for notice of revised edition) it falls far short of covering the same ground as does that much larger, more comprehensive and liberally illustrated book. A concluding chapter contains some valuable hints on a reading course for draftsmen—but wholly in the field of building as a fine rather than an industrial art.

NATIONAL DRAINAGE CONGRESS: Proceedings, 1920—Chicago, Ill.: L. K. Sherman, Director. Paper; 6x9 in.; pp. 57.
Papers on land drainage, river regulation and malaria control, presented at the convention at Atlanta, Ga.

NEW YORK PUBLIC SERVICE COMMISSION, SECOND DISTRICT: Report for 1920, Vol. I—Albany: The Commission. Cloth; 6x9 in.; pp. 202.

OBRAS PUBLICAS VENEZUELA: Memoria que presenta el Ministro de Obras Publicas a las Camaras Legislativas en su reunion constitucional de 1921. Caracas: Minister of Public Works. Paper: 9x12 in.; pp. 516; halftones, line drawings in text and on folding plates.
A handsomely illustrated annual report on the various public works activties of the department.

OIL-CAMP SANITATION—By C. P. Bowie. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 32; illustrated. 10c. from Superintendent of Documents.

OKLAHOMA SOCIETY OF ENGINEERS TRANSACTIONS, 1921—Tulsa: Donald Witten, Secretary-Treasurer. Paper; 9x12 in.; pp. 51.

ONTARIO HYDRO-ELECTRIC POWER COMMISSION: Report for 1919-20, Vol. I—Toronto: The Commission. Paper; 7x10 in.; pp. 326; illustrated.

PETROLEUM LAWS OF ALL AMERICA—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 645. 40c. from Superintendent of Documents.
Covers both continents, nationally and by states and provinces

PLATTING REGULATIONS—The Approval of Plats and Other Requirements. Detroit, Mich.; City Plan Commission. Paper; 7 x 10 in., pp. 8.

RADIO-COMPASS BEARINGS—By Oscar S. Adams, Mathematician, U. S. Coast and Geodetic Survey—Washington, D. C.: Free on application to Director. Paper; 6x9 in.; pp. 39. 5c. from Superintendent of Documents.
Gives simple instructions for two different methods of plotting a ship's position at sea by means of radio-compass bearings and a mathematical development and discussion of the two methods.

THE RAILROADS OF MEXICO—By Fred Wilbur Powell, Ph.D. Boston: The Stratford Co. Cloth; 5x7 in.; pp. 220. $2, plus postage.
Deals mainly with the history and development of the railway system and some of its more important lines. A useful feature is a 24-page bibliography. The one map is of little use, the lettering being almost illegible.

RAILWAY SYSTEM LIGHTING FOR BUILDING AND YARDS—Compiled by J. H. Kurlander, Lighting Service Department, Edison Lamp Works of General Electric Co. Harrison, N. J.: The Company. Paper; 6x9 in.; pp. 32; illustrated.

REGULATIONS FOR THE INSTALLATION OF ROTARY AND CENTRIFUGAL PUMPS and for Electrical Driving and Gasoline Engine Driving of Fire Pumps, 1921—Boston, Mass.: National Fire Protection Association. Paper; 3x5 in.; pp. 100.

THE ROCKEFELLER FOUNDATION: A Review for 1920, The Program for 1921 By George E. Vincent, President, New York: The Foundation. Paper 6x9 in.; pp. 47; illustrated.

STATISTICS OF RAILWAYS IN THE UNITED STATES: Report for 1919—Washington, D. C.: Bureau of Statistics. Paper; 9x11 in.; pp. 83. 15c. from Superintendent of Documents.

STEAM VERSUS ELECTRIC LOCOMOTIVES FOR HEAVY GRADES—By T. A. F. Stone, B.E., A.M.I.M.E.; Locomotive Department, Indian State Railways. Technical Paper No. 220. Railway Board, Simla, India. Calcutta, India: Superintendent Government Printing. Paper; 8x13 in.; pp. 39; with diagrams. 1 Real 12 Annas.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Road Loads Must Be Limited

Sir—In your issue of Sept. 29, p. 511, you quote from the testimony I gave the Senate Committee on Interstate Commerce. I am afraid that part of my testimony has been overlooked and an entirely incorrect view presented to the engineering profession. You also refer to my remarks as the railroad viewpoint. This may be so of some railroad officials but if it is I have not come in contact with them. I am a consulting engineer in private practice wfth highways as a specialty and I believe that my viewpoint is rather that of those interested in economical transportation than of the railroad industry. As a matter of fact I know of no body of men that taken as a whole are so interested in providing good roads to the country as the railroad managers whom I have met.

The part of my testimony given to the Senate Committee on Interstate Commerce, which you have overlooked, reads as follows:

"I of course do not mean to suggest that highways between large centers be not maintained to a high degree of excellence but I do affirm that it is unnecessary to construct these highways so that gasoline locomotives can be operated over them and that the major portion of the road funds available be consumed in their construction and maintenance to the detriment of tributary territory."

The highway system of this country is being rapidly wrecked by loads moving over it that are far in excess of even the ultimate strength of the roads when considered as a structure. Every state has many miles of road that are today almost impassable as a result of a few heavy trucks operating over them. So-called outlaw truck companies have developed. They operate in a district that has good roads until their heavy equipment ruins the roads and then they move on to another district and repeat the performance.

California had one of the most complete system of good roads that had ever been built. The automobile associations of the state, realizing that this road system was deteriorating after a very short life, employed the leading engineers on the Pacific coast to find the cause. Below I give extracts from their report that show the condition of these roads and the cause of their failure.

"We find ourselves at the end of four short years with but fifty per cent of our state roads, especially in southern California, pronounced good with the remainder classified as fair and poor. In southern California field inspections indicate that as high as 30.5 per cent of the concrete pavements are in poor condition, requiring reconstruction either now or at an early date. An additional 19.3 per cent is in only fair condition, serious failure having already begun."

In pointing out one of the main causes the California engineers say: "It seems incredible that in the face of such a record of destruction of the state pavements that these persistent, unreasonable and illegal loads should be continuously permitted to traverse our highways."

The record of failure of highways is the same the country over. In Texas we find the Brownsville "Sentinel" complaining of the failure of Cameron county's most expensive highway, a concrete pavement 7 in. thick and heavily reinforced with steel.

The editorial reads as follows: "The road has cost almost $49,000 per mile to build. It is less than two months old and with a surface that is wearing so badly and cracking so rapidly that you cannot blame those interested from being anxious to disclaim responsibility."

In Maryland we find Chief Engineer Mackall of the Maryland State Roads Commission describing the failure of the Washington road as follows: "Failure of the concrete sections on the Washington road was due to the most part not to poor subgrade nor to insufficient depth of concrete, but to disintegration of the surface."

If what remains of the country's highway system is to be saved from destruction some measures must be immediately taken to establish what is the safe load of different sections, material, and design to carry with the proper factor of safety, and then vehicles weighing in excess of these limits must be prevented from entering districts, the roads of which are incapable of carrying them.

*Engineering News-Record* is the paper that could best voice a demand that the highway program of this country, both as to design, construction, and operation be placed on a scientific basis.

I should be greatly interested in knowing if after you have read the complete text of my testimony given to the Senate Committee you do not more or less agree with me and if not would it be presumption to ask you to point out in your paper definite rasons why you do so.

Chicago, Ill., Oct. 10. STUART B. MOORE

[We regret having miscontrued Mr. Moore's point of view—due to the fact that only part of his testimony was at hand. That misconstruction, however, does not invalidate the main contention of the editorial in question, that the railroad point of view is of value in helping to secure an adequate consideration of motor vehicle fees.

It is hardly necessary to remark that we are in full agreement with him as to limitation of loads. That view has been expressed editorially at frequent intervals. Opinions differ, of course, as to what should be the proper limits, but the researches under way at Washington, the studies on the Illinois and California test roads, and similar inquiries elsewhere should yield much data on which limiting loads can, with some degree of scientific sanction, be based. —EDITOR.]

## Oiled Cinder Streets for Light Traffic

Sir—I have read with interest the article on roads treated with cinders in the Sept. 22 issue, p. 477, and your comment on p. 510 of the issue of Sept. 29.

Cinders have been used on streets for light travel in Appleton, Wis., for a number of years. We have a population of 20,000; there are paper mills and other industries producing a large volume of cinders which the city gets for the hauling, as the mills are glad to get rid of them. Our sub-soil is a heavy, red clay which, in wet weather, is almost impassable. The streets generally 24 ft. wide, are improved in the following manner:

We excavate the surplus earth 12 in. below the grade and then fill in the cinders. After a block has been filled a 10-ton roller is used to compact them; then a light grader smoothes up the surface prior to a second and final rolling. Best results are obtained when a little water is used and on streets having curbs. In no case, however, has the clay sub-soil ever worked through the cinder layer.

After the first year some of these cindered streets were oiled with a 65 per cent asphaltic oil and the results are excellent. After several applications of oil a mat forms which prevents dust and holds the shape of the road.

This construction, of course, is only for light-traveled residential streets and the cost is very low. On a 24-ft. roadway, we charge the property owners 25c. per foot for the complete work of excavating and placing the cinders. If the street is later oiled, the charge is about 6c. per front foot each season; this figure includes the material and labor. The oil is covered with a light coat of screenings or coarse sand—just enough to keep it from being picked up by vehicles.

Cindered streets will last for years, depending on the travel, and are very easily maintained. No doubt there are many cities that have cinders available, but have not used them. Perhaps these suggestions will help them with some of their problems. OSCAR F. WEISGERBER,

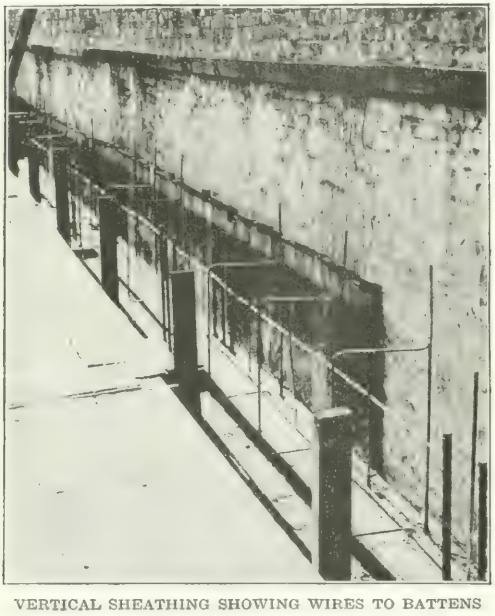
City Engineer and Street Commissioner.

Appleton, Wis., Oct. 3.

# HINTS FOR THE CONTRACTOR

## Concrete Forms Removed from 2-In. Space

IN BUILDING a substation recently completed in San Francisco, it was necessary to construct a concrete wall as close as practicable to the adjoining brick building without leaving any contact with the latter through which vibration might pass from one structure to the other. The concrete wall was located so that its finished surface is only 2 in. from the adjoining building and the forms were arranged so they could all be taken out of this space after the concrete set.



VERTICAL SHEATHING SHOWING WIRES TO BATTENS

In setting the wall forms the first operation was to fasten a horizontal run of 1 x 4-in. battens to the brick wall at a level above the top of the section to be poured. From nails driven into these battens No. 10 wires were strung vertically, and on their lower ends other horizontal 1 x 4-in. battens were suspended. Each suspended batten was held by two wires, one to each end, the arrangement being such that a series of continuous runs of battens were hung 2 ft. apart horizontally for the full length and height of the concrete wall to be constructed. The nails were all numbered, corresponding numbers being used on nails carrying wires to opposite ends of the same run of battens. The batten runs were numbered consecutively from the top down.

The next step was the placing of vertical sheathing of 1 x 6-in. lumber. This sheathing, 20 ft. long, was placed and the wall was poured in two vertical stages of 20 and 10 ft., respectively. As fast as the sheathing was set up it was held in place by the inner half of the concrete form which was built up at the same time. This inner half was of the usual design except that instead of wires to hold the two sides of the form together, ⅝-in. lag bolts, 17½ in. long, were used. These lag bolts were screwed entirely through the sheathing and battens and were turned until they pressed slightly against the brickwork so that the concrete form was held firmly to its prescribed width of 6 in. Thus, braces running down from the form to the interior of the building under construction could hold the form firmly against the brick building while the concrete set.

Vertical sheathing, battens, and the lag screws were thoroughly smeared with crude oil before the forms were erected. After the concrete had set the inside forms were taken down and the bolts removed. The battens were then drawn up by means of the wires, the workmen taking care to pull wires in the proper numerical order. Finally, the vertical sheathing was withdrawn by hand. This entire operation of clearing the 2-in. space went forward rapidly and without hitch, all of the material used in this space being removed from both the 20- and 10-ft. sections. The holes left in the concrete wall by the lag bolts were filled with maple dowels, turned with a taper to insure a tight fit.

The contract for the construction of the substation was carried out by Chadwick & Sykes, engineers and contractors, San Francisco, Cal.

## Surfacing Concrete Blocks

WHITE cement for both white and colored finish of concrete building blocks was recommended at the recent annual meeting of the Concrete Products Association, at Chicago, by Gale M. Brooks, engineer of the technical department of the Atlas Portland Cement Co. An abstract of his paper is given below:

A white mortar facing made with white sand or marble dust in which ⅛-in. particles predominate will make a good surface which is an integral part of the block. This facing need be only ½-in. thick and can be used with little additional labor in manufacture. With a 1:3 mix of white cement and white sand, the body of the block can be made with a leaner mix and larger aggregate than would be used otherwise. Colored sands may be used, or mica spar mixed with the white cement and white sand to give a surface lightly flecked with black. Brownish yellow sands with the white cement give various shades of buff. A little selection of sand will permit the matching exactly of any desired natural stone color.

Further variety of surface can be secured by the use of color aggregates with the white cement motar, such as one part white cement, 1½ parts white sand and 1½ parts of ⅛- to ¼-in. granite or marble chips. The thin film of cement on the surface when the block comes from the form can be removed with a very fine spray of clear water if the forms are removed early. If the blocks are allowed to harden more thoroughly before being released from the forms, this film can be removed by washing the surface with 1 to 3 diluted muriatic acid or by rubbing with a carborundum block. A power polishing machine may be used where a smooth surface is desired.

In place of the white sand, marble dust can be used in conjunction with the coarse color aggregate, but the dust should have a large percentage of coarse particles, ⅛- to ⅛-in. The dust of pink granite mixed with the ¼-in. chips and white cement gives a good surface. Delicate color tints can be secured by the use of mineral pigments with white cement, but too much pigment weakens the stone and increases the chance of fading and of uneven distribution in the mixture.

# NEWS OF THE WEEK

New York, October 26, 1921

## President's Conference on Unemployment Ends

**Standing Committee Named to Complete Unfinished Business and to Plan for Permanent Relief**

After having made provision for the appointment of a standing committee to continue emergency unemployment organization and to appoint sub-committees for studying more or less permanent remedies for unemployment, President Harding's Unemployment Conference adjourned *sine die* October 13. The conference held three sessions during last week and was brought to a close after a resolution proposed by Secretary of Commerce Hoover was unanimously adopted providing for the appointment of a standing committee.

The duties of the standing committee shall be to continue the work and progress of emergency organization throughout the country and to convene sub-committees for future reports. The sub-committees provided for are (1) committees of service on the present emergency as may be required; (2) a committee on construction development; (3) a committee on remedial measures for reducing intermittent and seasonal unemployment; (4) and a committee on permanent measures of preventing unemployment. All matters undisposed of by the general conference are left to the standing committee.

REPORT ON MANUFACTURING

Though the general conference accepted various reports offering both emergency and permanent relief from the unemployment situation, the majority report of the committee on emergency measures by manufacturers was not accepted, though it was included in the record of the conference. Inasmuch as there was so much adverse criticism of the majority report by minority members of the committee, it was deemed inadvisable to accept the report because of its controversial nature.

In the public hearing before the public works committee on government reclamation the conference heard various pleas from local public bodies and officials urging the completion of this and that reclamation and irrigation project. The conference also learned that were sufficient appropriations for the reclamation work available, the U. S. Reclamation Service could employ directly 44,000 men during the winter and indirectly an additional 44,000. Mr. Ottomar Hamerle, Acting Director of the Reclamation Service, stated that $16,000,000 could be economically spent during the winter on irrigation projects already underway in seven states, which would give employment to 16,000 men directly and as many more indirectly in furnishing construction materials, etc., if a loan for reclamation funds were authorized by congress. He asserted that $28,000,000 additional could be immediately expended on irrigation and reclamation projects in the western states were a loan made to the fund.

## Faulty Design Responsible for Destruction of Dirigible

After the coroner's jury, sitting on the destruction of the giant dirigible ZR2 at Hull, England, in August, returned a verdict finding that nobody was to blame for the accident, a court of inquiry for the British Admiralty has now reported that faulty design was to blame. It states that the design should have been but was not reviewed by an official committee before construction began, that "utmost economy in design" had been a governing consideration, that necessary aerodynamical information with respect to structural strength was lacking, that a quick reversal was being made at the time of the accident, bringing a heavy strain on the rear part of the hull due to the swing of the stern, and that the structure failed to the rear of the after-engine car, causing the vessel to break in two while 1,200 ft. high. The results of fuller investigation now in progress are to be made public in due course.

## Colorado Highway Work Held Up

Failure of Colorado state officials to sell highway bonds authorized by vote has resulted in a reduction in the engineering staff by one-third and elimination of some of the large road gangs. Early construction on some projects next year will be hampered because of the lack of plans and surveys. Major L. D. Blauvelt, state highway engineer, has appealed to the citizens to buy bonds over the counter. They are in denominations of from $50 to $1,000 and bear 5 per cent interest.

## Railroad Division of A. S. M. E. to Discuss Waste Elimination

The Railroad Division of the American Society of Mechanical Engineers will discuss the elimination of waste on railroads in connection with the general consideration of that topic at the annual meeting of the society. Papers to be presented include discussions of avoidable waste in locomotives as affected by design, in operation of locomotives and of cars. The meeting is to be held at the Engineering Societies' Building, New York City, the morning of Dec. 9.

## Am. Soc. C. E. Board Holds Quarterly Meeting

**Character Annual Meetings of Society Changed—Recommend Secretary Visit Local Sections**

Passage of resolutions changing the character of the annual meeting of the society so as to make it more technical, instructing the finance committee to include in the 1922 budget an item for covering the expenses of the secretary in visits to local sections, instituting a card index system of keeping a professional record of all members, the passage of other resolutions, and the election of honorary members and the approval of new sections were the chief accomplishments of the Board of Direction of the American Society of Civil Engineers at the meeting held October 10 and 11 at the Engineering Societies Building, New York City.

Though the annual meeting of the society, held in January, is still to retain its social features, there are also incorporated in the tentative program technical discussions. The plan now proposed is to hold a conference lasting for the better part of two days on national transportation problems.

OTHER RESOLUTIONS

By another resolution the secretary of the society is to visit each of the local sections of the society each year, and be reimbursed for his traveling expenses. The Board of Direction instructed, through a resolution, the finance committee to include in next year's budget an item covering such expenditure.

Acting upon the recommendation made at the June 6 meeting the Board of Direction resolved to compile a card index system incorporating a complete professional record of all members of the society. The cards are now being printed and blanks will be circulated shortly so that by the first of the year the record will be full and up-to-date. It will be open to public inspection at the offices of the society in the Engineering Societies Building.

Three new honorary members were elected: Howard Adams Carson, of Boston; Luigi Luiggi, of Rome; and Charles Prosper Eugene Schneider. A resolution was also adopted which directs that, probably at the annual meeting, certificates be presented these men and the two elected at the last quarterly meeting of the board, accompanied by suitable ceremony. Ambrose Swasey and Samuel Rea are the honorary members elected in June.

The formation of two new sections of the society were approved by the

board. They are the Northeastern Section, Boston, and the Sacramento (Cal.), Section. Formation of student chapters at Bucknell University, University of North Carolina and West Virginia were also approved.

Among the other resolution passed by the board were those: (1) Approving the report of the joint committee composed of representatives of the American Institute of Architects, the American Engineering Council, the Federated American Engineering Societies and the Associated General Contractors of America upon a definite plan for quantity survey and payment for estimating; (2) approving the report of a special committee that recommended the society urge Congress to pass legislation which would give commissions to sanitary officers in the Public Health Service on the same basis as they are given in the Medical Corps of the army; and (3) urging Congress to appropriate an adequate sum to carry on highway research.

### Market For California Irrigation Bonds Improves

During September and early in October there was notable improvement in the demand for California irrigation bonds; the current prices of this class of securities showing marked advancement. Bonds of the Turlock and Modesto irrigation districts bearing 6 per cent interest are now selling above par.

In commenting on this situation the financial editor of a San Francisco newspaper states; "When it is considered that there are now about $40,000,000 in obligations of California irrigation districts organized under the amended Wright Act now outstanding, and fully nine-tenths of which are held in this state, it is obvious that an upward trend in the prices of such issues, not only strengthens California's financial position but makes it possible for districts to finance new construction at lower rates of interest."

## Fall Lettings of Contracts Favored by Many State Highway Engineers

### Additional Replies Received to "Engineering News-Record's" Inquiry as to Policy Adopted for Early Award of Next Season's Construction

*In answer to its inquiry regarding the policy adopted by the states in regard to the fall letting of road contracts "Engineering News-Record" has received from state highway engineers the following replies which supplement those published in last week's issue:*

**Vermont**—"We are preparing for a fall letting. It is the policy of the State Highway Department to let as much of the 1922 work as early as it is practicable to get ready for such letting. We believe the policy of early letting is sound and highly desirable from the point of view of State's interests."—*By Thurman W. Dix, State Highway Commissioner.*

**New Mexico**—"The New Mexico Highway Department is endeavoring to relieve the unemployment situation as much as possible by letting contracts as fast as we are able to make the field surveys and build plans covering said road projects."—*By L. A. Gillett, State Highway Engineer.*

**Iowa**—"For the past two years, ever since the program of developing our primary road system was undertaken, we have pursued the policy of letting contracts in the fall for the next season's work. It is our judgment that the letting of contracts in the fall very greatly facilitates the progress that can be made during the next season."—*By F. R. White, Chief Engineer, State Highway Commission.*

**Illinois**—"In my judgment the best policy as to the time for awarding contracts on a large scale varies from year to year, depending upon general conditions. I am speaking, of course, from the point of view of the owner or builder. Ordinarily the contractor, who has perhaps 50 per cent or more of the road equipment needed for a given job, is able to secure the balance of the equipment and be ready to start work in approximately 60 days. This would indicate that in this latitude and as far as the contractor's ability to start work at the beginning of the season is concerned, the award of contracts in February or March would be satisfactory.

"Such an arrangement would not, of course, enable equipment manufacturers to forecast very definitely the demand for the next season's construction and they would be obliged to use less definite data in anticipating the demand and manufacturing equipment during the winter months. The advantage of the earlier knowledge of the demand for equipment might easily be offset by labor and material conditions, which cannot definitely be foreseen six months in advance.

"In regard to letting contracts for grading and bridge work, we consider it desirable to complete grading and bridge work as an independent operation at least six months or a year in advance of paving construction. This is particularly desirable where relocations are made and where the road is to be constructed through rough country. The object of such procedure is two-fold: First, a paving contractor is required to provide equipment for one class of work only and there is no danger of his operations being hindered or delayed by failure to complete one or more bridges which may be located over streams where flood hazard is to be con-

*(Continued on next page)*

### Buffalo, Rochester, Syracuse Hold Joint Engineering Conference

Discussions upon the civic responsibility of the engineer, flood abatement work in northern New York, and the usual municipal engineering problems were chief among those heard at the tri-city conference held under the auspices of the Rochester Engineering Society Oct. 14 and attended by engineers from that city, Buffalo, and Syracuse. The chief speakers at the morning and evening sessions were George H. Norton, city engineer of Buffalo; Henry C. Allen, city engineer of Syracuse; Glen D. Holmes, chief engineer, Syracuse Sewer Commission; A. E. Lindau, president, Engineering Society of Buffalo; and S. B. Storer, first vice-president, Technology Club, Syracuse.

Mr. Storer in discussing the relation of the engineer or technical man to civic life decried the fact that engineers often carried out their duties only with a fidelity to their purely technical training. He emphasized the necessity for the technical man to grasp all the factors back of an engineering development.

Mr. Lindau outlined the evolution of engineering, asserting that fifty years ago but two kinds of engineering—military and civil—were known and that now so many existed that it was possible for one engineer to attend a meeting of a different type, and be unable to understand the topics under discussion.

Flood abatement work along the Buffalo River and that along Onondaga Creek were subjects treated by Mr. Norton and Mr. Holmes, respectively. Sewage disposal problems were also included in the discussion of each.

Of principal interest in the discussion given by Mr. Allen was the proposal of the City of Syracuse to move the New York Central R.R. tracks from their present position to the bed of the abandoned Erie Canal, thus eliminating grade crossings.

During part of the evening session the meeting was turned over to C. Arthur Poole, city engineer of Rochester, who called for an open discussion, which followed upon various routine municipal engineering matters.

The afternoon was spent in an inspection of the new garbage reduction plant in Rochester, the sewage disposal plant, the Barge Canal harbor, and other points of engineering interest. The board of governors of the Rochester Engineering Society were hosts to the visitors at a dinner in the evening served at the University Club.

### Commission-Manager Plan in Effect at New London

The newly elected commission under the recently adopted commission-manager form of government took office at New London, Conn., Oct. 3. A city manager will be chosen by the commission.

(*Continued from preceding page*)

sidered. Second, it makes more certain a satisfactory job of paving inasmuch as fills, especially adjacent to bridges, may have sufficient time to become consolidated.

"In grading work the rail transportation of materials is of but little importance. I am therefore of the opinion that it does not make much difference as to the time of year contracts for such work are awarded, providing judgment is used. Naturally, contracts for very heavy work that may require an entire season for a certain type of grading outfit should be awarded sufficiently early to enable the whole season to be utilized. In highway work, however, where many sections of grading work occur that do not require more than perhaps a few weeks or a month to complete, it is an advantage to the contractor to distribute the award of such work throughout the season, in order that outfits that have completed elsewhere may be employed the full season.

"With this in mind, the Illinois Division of Highways endeavors to award during the winter or early spring heavy grading contracts, requiring a whole season's operations. It is the practice further to award contracts for lighter work at any time during the spring or summer when it is known that contractors, who are able to finish the work during the season, are available.

"From the point of view of the state, it is my opinion that the awarding of contracts in the fall, in preference to the spring, must largely be based on an estimate of labor and material conditions which may prevail during the early part of the succeeding construction season. In view of the present large supply of labor it would seem very desirable to let contracts this fall in order that work may be started in the spring as early as weather conditions will permit. Illinois is following this policy. On Oct. 4 we received bids for 185 miles of road work, awards for which will probably be made immediately. It is expected that we will continue to advertise additional work up to the first of the year."—*By Clifford Older, Chief Highway Engineer.*

**Virginia**—"The idea of fall lettings of contracts appeals to me very strongly. We have let quite a number during the month of September and will let more in November, totaling, however, a comparatively small amount, approximately $2,000,000. The situation in this state is unfortunate in that we are dependent on our General Assembly for appropriations for highway construction. The Assembly meets in January and February, making it impossible for us to carry out a policy of all lettings."—*By George P. Coleman, State Highway Commissioner.*

**Michigan**—"I regret to have to advise you that Michigan has used all of its available funds for contract work during the road-building season of 1921. Since our next fiscal year begins July 1, 1922, there will be no more state bond money available until that time and hence it will be impossible to let contracts for 1922 work before next spring.

"I am in sympathy with the movement to give as much employment to labor as possible during the dull months of winter but our hands are tied and we can not do more than we have done. We have had a record-breaking road-building season, and it is safe to say, counting state and county work, that fully three times as much road building has been done during 1921 as in any previous year."—*By Frank F. Rogers, State Highway Commissioner.*

**Florida**—"Florida is just beginning to let contracts for road and bridge work for the remainder of this year and the fore part of next. Within the next three months it is hoped that we may be able to place from $2,000,000 to $3,000,000 worth of work under contract. It will be our endeavor to have all of this work advertised between now and Jan. 1, 1922."—*By Charles A. Browne, State Highway Engineer.*

***State Highway Engineers Announce Policies on Fall Lettings of Next Year's Road-Building Contracts.***

**Montana**—"In regard to the policy of letting contracts for next year's highway program this fall, please be advised that our program is not sufficiently outlined at this time so that we can proceed with a systematic award of contracts for next year's work. We are, however, proceeding on the policy of advertising projects as rapidly as they are ready for construction."—*By H. C. Kuhl, Principal Assistant Engineer.*

**Arkansas**—"In Arkansas no definite policy has been outlined for the letting of contracts this fall. Because of the low value of Arkansas bonds practically no new work is contemplated in the near future, so the early letting of contracts is not under consideration.

"The vast amount of unfavorable and exaggerated publicity that has been given the Arkansas road situation by the eastern newspapers has so depressed the bond market as far as Arkansas Road Improvement District bonds are concerned that it is impossible to sell these bonds for anything like a reasonable price. This condition has forced a number of districts that have authorization for additional bonds to suspend construction and leave the work in an unfinished state. It has also prevented the progress of a number of new projects that are ready to go ahead and has practically forced the abandonment of all new work.

"However, Arkansas has under way the construction of approximately 4,500 miles of improved roads, all let to contract and the work is progressing satisfactorily and rapidly. It is expected that 1,800 miles of this program will be completed by Jan. 1, 1922."—*By G. Hunter Sykes, Acting State Highway Engineer.*

## Recommend Consolidation of All Government Mapping

**Hydrographic, Topographic, Geodetic, Cartographic, Map Reproduction, Cadastral Branches United**

Consolidation of all the general surveying and mapping work of the federal government in a new bureau under a single directing head has been recommended to the President by the Board of Surveys and Maps of the federal government. It is believed that this will reduce duplication to the minimum, will lower the unit cost of the work and will permit the government to meet the mapping and surveying needs of its own agencies and of the general public in a more effective manner. The action was taken on recommendation of the Board's committee on co-ordination.

The recommendations contemplate the consolidation in the new bureau of the U. S. Coast and Geodetic Survey of the Department of Commerce; the U. S. Lake Survey of the War Department; the U. S. Hydrographic office of the Navy Department; the topographic branch of the U. S. Geological Survey and the surveying and mapping activities of the General Land Office. The latter two bureaus form a part of the Department of the Interior. There are thirteen other organizations which are doing certain kinds of surveying and mapping. A part of this work can be taken over by the new bureau, if it is established, but certain amounts of surveying and mapping necessarily will continue as an incidental activity connected with the major work of some of those bureaus. Extracts from the committee report as amended and adopted are as follows:

ADVANTAGES IN UNIFIED BUREAU

"The advantages to be derived from such a consolidation may be summarized as follows: (a) The entire subject of surveying and mapping could be considered as a whole, the demands of the different interests weighed and adjusted, and a project drawn up to meet systematically and expeditiously the needs of the entire country in the most economical manner. Based on this project, estimates could be presented to the Bureau of the Budget by a single agency with greater prospects of success in securing the understanding and support of that Bureau and of Congress; (b) Such overlapping of work and duplication of effort as may now exist would be eliminated; (c) A considerable saving in overhead expense, in field operations, in the procurement of supplies and equipment, in map reproduction, and in map compilation, would probably result.

"The disadvantages to be considered in connection with a consolidation of mapping agencies are: (a) The danger that there will result and unwieldy organization, unable to make the prompt and sympathetic response to special needs that can be expected from a group of smaller agencies, each created to meet a special need; (b) The

existing services are located in several buildings, so that difficulty would result in securing a smooth running organization, unless provision could be made for housing all under one roof; (c) Some of the existing services are closely linked with other activities which will be more or less disturbed during the transition period.

"The committee therefore recommends the creation of a Bureau of Surveys and Maps in some existing or new department. This bureau should comprise six major branches, or divisions, and should perform the primary surveying and mapping functions of existing Federal agencies, under six branches, as follows: Geodetic, Topographic, Hydrographic, Cadastral, Cartographic and Map Reproduction."

## Pontoon Bridge Project Abandoned by Its Promoters

Abandonment of the plan to build a pontoon highway bridge over the Hudson River at Yonkers, N. Y., was announced last week by George A. Post, president of the Hudson River Bridge Corp. The step is said to be chargeable in part to the unexpected amount of opposition to the proposed construction which developed at the hearing before Col. E. A. Burr, U. S. District Engineer, and in part to a demand made by the Shipping Board that the corporation purchase immediately the fifty wooden ships which it planned to use as pontoons for the bridge. The ships were to be bought for $2,400 each, requiring an investment of $120,000 whose usefulness would have remained contingent on authorization by Congress and the War Department for construction of the bridge.

## Dabney Heads Tennessee Engineer License Board

The Tennessee board of architecture and engineering examiners, held a meeting in Nashville Oct. 1 and organized by electing A. L. Dabney, of Memphis, chairman, and Henry C. Hibbs, of Nashville, secretary. The board is now prepared to receive applications for license, for which the fee is $25 and the annual renewal $5.

The other members of the board of examiners, appointed by the Governor, are: Engineers: Dr. Charles S. Brown, Vanderbilt University, Nashville; and Prof. N. W. Dougherty, University of Tennessee, Knoxville. Architects: Bayard S. Cairns, Memphis; and W. H. Sears, Chattanooga.

## Joint Committee Report For Sale

Copies of the recent progress report of the Joint Committee on Concrete and Reinforced-Concrete, giving specifications for concrete and reinforced-concrete, under discussion by the five societies concerned, are available from E. M. Chandler, acting secretary, American Society of Civil Engineers, 33 West 39th St., New York City, at 50c. each.

## Great Falls Power Development Started at Winnipeg

Work has been started on the construction of the Great Falls dam and power house on the Winnipeg River for the Winnipeg River Power Company. On Oct. 1, 1921, the owners entered into a contract for the construction work with Fraser, Brace, Ltd. of Montreal and New York, and the Northern Construction Co. of Winnipeg which company had already started preliminary work at the site.

The work contemplates a dam 3,000 ft. long and a power house ultimately to produce 168,000 hp. The initial installation will comprise the dam and power house substructure complete with a power house superstructure for three units of 28,000 hp. each and an installation of two turbine and generator units of 28,000 hp. each. About 70,000 cu.yd. of rock excavation and 176,000 cu.yd. of concrete are involved in the construction of dam and power house. A rock cut of 240,000 cu.yd. two and half miles below the power house for lowering the water level in tailrace, an earth dike of 105,000 cu.yd. for confining the river at its new level above the power house and a steel tower transmission line to the company's old power house eighteen miles up the river form a part of the scheme.

The power which will be developed by this plant is to be utilized in Winnipeg and vicinity by the Winnipeg Electric Railway Co. and local industries the old plant of the Winnipeg River Power Co. being inadequate for the present demand. It is expected that by the time the initial development of 56,000 hp. has been completed the market for power in the Winnipeg district will justify the installation of other units. The first installation contemplates an expenditure of about $7,000,000 and will require 2 years to complete.

## Opposition to Highway Bill Appears in House

*(Washington Correspondence)*

Decided opposition to the highway bill from New England and eastern members has developed in the House of Representatives. An effort is being made to prevent the granting of a special rule. Such a rule is necessary before the House can vote upon the appropriation that will be required. As this is written the consensus of opinion is that the rule will be forthcoming, but as the appropriation is new legislation and therefore subject to a point of order, the failure to secure the rule would mean an indefinite delay to the bill.

W. C. Markham, secretary of the Kansas Highway Commission, who has spent seven months in Washington representing the American Association of State Highway Officials, believes that the obstacles will be overcome and that the federal government, by the approval of this bill, will establish a regular highway policy.

## 30-Ton Gantry Crane Blown Off Pier

During a terrific rain and wind storm on Sept. 29 the 30-ton gantry crane on Pier 1, Lackawanna R.R., at Hoboken, N. J., was blown along the rails into the Hudson River. The accident is described as follows by M. H. Doughty, division engineer of the railroad.

"The crane is electric driven, using direct current 265 volts, delivered by contact boxes located adjacent to the running rails. It has a capacity of 60,000 lb. At a radius of 29 ft. the distance center to center of tracks for the gantry frame is 47 ft. 6 in.. The crane is supported on four 4-wheel trucks which run over two running rails on each side of crane, the distance between centers of trucks being 25 ft. All movements are provided with automatic solenoid brakes operated by springs which apply the brakes to the motor shafts at the moment power is cut off.

"The crane travels along the length of the pier, about 900 ft. in east and west direction. On Sept. 29 there was a heavy rain, followed about four o'clock in the afternoon by an unusually high wind from the west. On account of the rain, operators had left the crane and had failed to put in place anchorages which had been provided to protect the crane in case of high winds, and they had also been operating the crane with the brakes on the motors on the traveling wheels blocked off so they were out of service. Under these circumstances the crane had nothing to prevent its moving down the track and it was blown off the end of the pier, falling into about 30 ft. of water.

"The crane was raised and placed on the dock by the Merritt & Chapman Wrecking Co., the work requiring about a week with one machine. Inspection of the crane indicated that the gantry legs were practically destroyed, with the exception of the trucks, the "A" frame practically destroyed and the boom was seriously damaged. The motors will have to be rewound and the various switchboards and controlling devices will have to be practically replaced new. The trucks and the various drums, gears, etc., are practically intact. A small number of boxes, a certain amount of shafting and minor operating parts will have to be purchased new. The total expense of putting the crane back in service is estimated at about one-half the cost of new crane of similar type to-date."

## To Hold Road Congress in Spain

The Permanent International Association of Road Congresses, with headquarters in Paris, has accepted the invitation of the Spanish Government to hold its next meeting in Seville during the spring of 1923. The program, as at present contemplated, is divided into two parts, the first dealing with construction and maintenance and the second with traffic and motor transport.

## Lackawanna Plans Electrification Both Ways From Scranton

Definite studies for the electrification of the Delaware, Lackawanna & Western R.R. east and west from Scranton are now being made. The system to be used has as yet not been decided upon. It is presumed construction will begin some time within the immediate future. Officials of the road say there is no foundation in the report that the Morris and Essex Division is included in the immediate program, studies having been made seven years ago and again but recently and in each case it was found electrification would be excessive as compared with steam operation.

## Am. Soc. C. E. Meeting to Accord With Health Service Jubilee

Instead of November 2, the regular scheduled date, the first November session of the American Society of Civil Engineers will be held November 16 and 17 so as to harmonize with the annual meeting of the American Public Health Association. The program will be along sanitation lines, and symposia will be prepared on "Stream Pollution and Sewage Disposal," and "Water Supply and Water Purification." A paper on "Odors and Their Travel Habits," by L. L. Tribus, followed by a discussion, is also on the program.

## New York Engineers' Club Honors Hoover

On Oct. 13 the New York Engineers' Club gave a reception in honor of Herbert Hoover, Secretary of Commerce. After the formal ceremony, Mr. Hoover, in response to a brief address by E. W. Kiddle, president of the club, spoke briefly about the work of the engineer and the significance in our industrial and social development.

## Accident Records Used as Guide to Highway Improvement

In order to assist in properly determining the sections of roads to be improved, the Maryland State Roads Commission, under J. N. Mackall, its chairman and chief engineer, has arranged to have all accidents on the highways reported to it daily. Upon the receipt of each accident report a numbered colored pin is put in the proper location on a large map of the road system. Fatal accidents are marked with red pins, other accidents with yellow pins. The numbering of the pins, corresponding to index cards, enables one to trace back and find the character of each accident.

By keeping this record and marking the map bad stretches of road, on which accidents have been caused by too narrow a width or too much crown have been disclosed. In some cases the bad sections had not been listed as desirable for immediate improvement. The method, therefore, has proved effective in locating some of the danger spots.

## Philadelphia Council Upsets Plan for Garbage Incinerator

The City Council of Philadelphia, on Oct. 6, repealed the ordinance for the construction of a garbage and refuse incinerator on Cambria St., in the 38th ward, under which bids were received Aug. 26. Opposition to the use of the site is responsible for the council's action. Bids for the incinerator—which have not been acted on, owing to the site controversy—were received from four contractors under two plans, each on a 24-hr.-day basis: (1) For a plant with a capacity of 140 tons of mixed refuse or 280 tons of rubbish only; (2) 480 tons of rubbish only. The bids were:

| | Plan 1 | Plan 2 |
|---|---|---|
| Chicago Incinerator Co., Chicago | $41,940 | $79,800 |
| Krenz Boiler Works, Toledo, Ohio | 51,400 | 99,800 |
| Decarie Incinerator Co., Minneapolis | 75,100 | 142,800 |
| Nye Odorless Crematory Co., Macon, Ga. | (no bid) | 126,500 |

These bids were for an incinerator complete, with forced draft, but did not include foundations, chimney, and building.

## Cement Association Engineers Meet in Washington

Engineers of the eastern districts of the Portland Cement Association met in Washington Oct. 12 to witness tests at the Arlington experiment station of the Bureau of Public Roads. Advantage was taking of the gathering to give a banquet in honor of A. N. Johnson, formerly the consulting highway engineer of association and now dean of the engineering college of the University of Maryland.

## Industrial Relations Conference To Be Held at Harrisburg

A state industrial relations conference is to be held at Harrisburg, Pa., October 24-27 under the direction of Commissioner C. B. Connelley of the Department of Labor and Industry. The conference is to take the place of the annual safety congress. Men prominent in the various phases of industrial relations will be speakers at the several sessions.

## Underwriters Plan Airplane Classification Work

R. W. Schroeder, holder of the world's altitude record (33,114 ft.), and until recently major, U. S. Air Service, and chief test pilot, McCook Field, Dayton, Ohio, will join the staff of Underwriters' Laboratories, Sept. 1, and will take a principal part in the airplane classification work which the laboratories are doing for the National Aircraft Underwriters' Association. The object of this work is "to secure the best and fairest opinion regarding the merits or demerits of every device, system, machine or material in respect to life and fire hazards."

## Railroad Strike Looms as Roads Talk of Freight Reductions

With the announcement that the railroads of the country would seek from the Interstate Commerce Commission authority to reduce freight rates from 15 to 20 per cent, which reduction would undoubtedly be predicated upon further wage cuts, the Big Four railway brotherhoods and the Railway Switchmens' Union, controlling some 2,000,000 transportation workers, announced last week a progressive strike order to become effective October 30 and to continue through four days until all roads in the country were tied up.

The strike order, according to union officials, is based upon the 12 per cent rate reduction ordered last July by the Railway Labor Board, though it is believed to be given now as a possible means of circumventing new wage reductions. Union officials declare the strike order will be carried out, though government officials hope to avoid it. The public group of the Railway Labor Board offers a plan whereby wage reductions ordered last July be immediately translated into lower rates which would probably lower living costs, thereby appeasing transportation employees.

## Railway Claims to Extent of $387,000,000 Settled

Practically half of the claims of the railroads against the government growing out of federal control have been settled according to a report made recently to President Harding by Director General Davis of the Railroad Administration. Up to Oct. 1, an aggregate of $856,000,000 in claims had been filed by sundry carriers. Final settlement adjusted up to the same date aggregated $387,000,000. Practically all of the settlements have been made since Jan. 1. Claims filed represent 108,394 miles—78.71 per cent of the total mileage under federal control. If the remaining percentage of mileage should present claims on the same basis as those already filed the total claims against the Railroad Administration would aggregate in excess of $1,000,000,000.

## Actual Property Value the Basis of Local Improvement Orders

According to a ruling in the Superior Court, the City Council of Seattle has the authority to order local improvements where the cost does not exceed 50 per cent of the actual value of property in the district. Heretofore, the city council has assumed the 50-per cent limitation was based on the assessed valuation, which is about half the actual value. The ruling was made in a recent suit brought by a property owner seeking an injunction to halt street improvement work, on the ground that the cost exceeded 50 per cent of the assessed valuation. E. C. Ewing, assistant corporation counsel, states that a Supreme Court review will be sought on the ruling.

## Point Bridge Report Recommends Immediate Repairs

Restriction of traffic and immediate emergency repairs, followed by the earliest possible construction of a new bridge, are the chief recommendations of a board of engineers that has just reported on the Point bridge over the Monongahela River at Pittsburgh. The board, appointed by Norman F. Brown, director of public works, consisted of John D. Stevenson, T. J. Wilkerson, and C. S. Davis.

As the roadway of the bridge is only 20 ft. wide, which the engineers say is now wholly inadequate to accommodate traffic, and the suspension cables of the structure also are not capable of carrying unrestricted traffic safely, the report says that construction of a new bridge will be necessary and should be taken in hand at once. For present safety, traffic is to be restricted to 150-ft. spacing of street cars and the use of only one track, and exclusion of all trucks weighing more than 10,000 lb. total; at the same time, certain floor members are to be repaired and reinforced in order to make the floor safe under this restricted traffic. The cost of the repairs is estimated at $10,000. Should the recommended restrictions be found too severe to take care of traffic requirements during the construction of a new bridge, reinforcement of the entire floor system, at a cost of $50,000, will be necessary, and thereafter traffic can be operated under a restriction of 200-ft. spacing of street cars (on both tracks) and exclusion of trucks weighing over 13 tons total.

## East St. Louis Drainage Board Cancels Canal Contract

A contract for the first portion of a drainage and flood protection canal along the foot of the bluffs at East St. Louis, Ill., has been canceled by the Board of Trustees of the East Side Levee and Drainage District for the reason, as reported, that the present benefit to taxpayers has not been proved. The contract was awarded by a former board in October, 1920, and the present board is said to have been elected in November of that year on the basis of opposition to the project. This canal, noted in *Engineering News-Record*, July 14, p. 56, was considered by the engineers of the flood protection project as a future supplement to a canal across the district, but the former drainage board decided to proceed with this work first.

## Camden Creates City Plan Commission

A City Planning Commission has been created at Camden, N. J. Among the six members are Levi Farnham, city engineer, Martin Schreiber, superintendent Public Service Railway Co., and E. H. Sapp, of the New York Shipyard. The other commissioners are members of the City Council.

# Engineering Societies

## Calendar

### Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

**The Washington Irrigation Institute,** at its annual meeting in Yakima, Oct. 27-29, will be addressed on the following topics: "Program for the Irrigation Experiment Station," Dean E. C. Johnson; "A General Survey of Reclamation in the State of Washington," Joseph Jacobs; "Our Irrigation District Law—Can It Be Improved," Ralph H. Williamson; "Some of the Fundamental Facts Upon Which Rests the Development of the Columbia Basin," Prof. O. L. Waller; "Some Accomplishments and Prospects of the United States Reclamation Service," F. E. Weymouth; "Progress Under State Reclamation and Land Settlement Laws," Dan A. Scott; "Old Versus New Methods of Land Settlement," E. F. Benson.

**The Kansas Section, Am. Soc. C. E.,** has elected the following officers: President, Prof. L. E. Conrad, Kansas State Agricultural College; vice-president, Prof C. C. Williams, Kansas University; secretary and treasurer, F. S. Altman, field engineer of the Portland Cement Association, Topeka, Kan.

**The Pittsburgh Section, Am. Soc. C. E.,** at a meeting Sept. 19, with 15 present, passed the following resolution: "With due acknowledgment of the work of the committee, it is the sense of this meeting that the proposed revision of the constitution of the American Society of Civil Engineers be ejected."

**The American Water Works Association** announces the formation of a North Carolina Section, with J. L. Ludlow, Winston-Salem, as president. Prof. Thorndyke Saville, Chapel Hill, is secretary and H. E. Miller, State Board of Health, Raleigh, is chairman of the membership committee. A meeting in December, probably at Greensboro, is planned.

**American Water Works Association, New York Section**—At the first meeting of the season, held in New York City, Oct. 16, Col. Theodore A. Leisen, civil engineer, Detroit water-works, reviewed the growth and present program of the water-works of Detroit. In the past eight years, construction has about equalled all that had gone before in sixty years. From 1914 to 1921 there were laid 738 miles of water mains, of which 275 were laid in 1920 and 1921. Trenching and other machines have been used extensively. Included in the large amount of work in hand or projected is a filtration plant with a capacity of 320 to 350 m.g.d., which it is expected will be completed in 1922 or 1923.

# Personal Notes

COL. F. F. LONGLEY, assistant director of the department of health, League of Red Cross Societies, Geneva, Switzerland, is leaving the service of the League in November and will go to Australia, where he will assist the newly created Ministry of Health in the organization and establishment of a department devoted to sanitary engineering. Col. Longley, prior to the war, was with the firm of Hazen, Whipple & Fuller, consulting engineers, of New York City. He entered the military service in 1917 as a major, Engineers, was ordered to France and became head of the water supply section of the Division of Military Engineering and Engineer Supplies of the A. E. F., with the rank of colonel.

F. C. WIESE is organizing the sales department of Amplex Incorporated, importers of S&N beam shears, balanced steel frame combination punches and shears and Hercules angle-bending machines. R. BAUER, formerly with Joseph T. Ryerson & Son, has been placed in charge of the New York metropolitan district.

COL. CHARLES KELLER took the oath of office as Engineer Commissioner of the District of Columbia last week and was selected as chairman of the Public Utilities Commission.

DON MACCRAE, senior member of Ford & MacCrae, consulting engineers, Little Rock, Ark., has been appointed consulting engineer for district 10, the Arkansas-Missouri Highway District and the Spring Lake District, Pulaski County, Ark.

DR. KENNETH G. MATHESON, president of Georgia College of Technology, has accepted the presidency of Drexel Institute, Philadelphia, Pa., and will assume his new duties in April, 1922.

FRANK L. BOLTON, formerly manager of the Erie office and district for Gannett, Seelye & Fleming, engineers, Harrisburg, Pa., has been appointed general manager of the Cayuga Rock Salt Co., Inc., near Ithaca, N. Y. This company is being operated under the management of Gannett, Seelye & Fleming.

GEORGE J. RICHARDS, formerly resident engineer, Mill Creek flood control project, Erie, Pa., for Gannett, Seelye & Fleming, Inc., engineers for the city of Erie, has been appointed manager of the firm's Erie office.

P. H. LONG, formerly designing engineer with the U. S. Steel Corp., is now in consulting engineering practice in Charlotte, N. C.

WILLIAM SHINGLETON has resumed his position as assistant engineer on the Chicago, Indianapolis & Louisville R.R., at Lafayette. Ind., after a three months' trip in Europe.

D. S. WATKINS has resigned as engineer of construction with the Buffalo, Rochester & Pittsburgh Ry. He has been connected with this road for 29 years and has been in charge of the developments in Western Pennsylvania.

STANLEY A. KNISELY has been appointed economist of the National Paving Brick Manufacturers Association. He was formerly on the staff of the Cleveland *Plain Dealer* where he specialized on business news.

RUDOLPH J. WIG has withdrawn from the engineering firm of Wig, Hollister & Ferguson, to devote all his attention to the Celite Products Co., of Los Angeles, Cal. Mr. Wig has been connected with this company for about a year and now has found that his duties on the Pacific coast will take all of his time. The company is engaged in the mining and conversion to various uses of celite, a diatomaceous earth occurring in large quantities near Lompoc, Cal. It is used for filtration and insulation mainly. Mr. Wig's place in the engineering firm has been taken by Wayne W. Light and the firm's name now will be Light, Hollister & Ferguson, Inc., Engineers, with office in the Land Title Bldg., Philadelphia.

## OBITUARY

JAMES W. PIERCE, civil and constructing engineer, died recently in Wellesley, Mass. He was born in Cambridge, Mass., in 1870 and attended the Massachusetts Institute of Technology. For about three years he was rodman and transitman with the Board of Survey, Boston, and from 1894 to 1897 he was assistant engineer with the Massachusetts Highway Commission. From 1897 to 1900 he served as park engineer in the office of the city engineer, Cambridge. He also held the positions of superintendent of parks and later, city engineer of Cambridge. He has been conected, until recently, with Lockwood, Greene & Co., Boston, Mass.

DR. JOSEPH W. RICHARDS, professor of metallurgy at Lehigh University, died in Bethlehem, Pa., on Oct. 12. He was born in Oldbury, England in 1864. He was a graduate of Central High University, and taught at the latter institution for more than thirty years. He was a member of the United States Assay Commission in 1897 and of the United States Navy Consulting Board, 1915-1918. He was a charter member of the American Electrochemical Society, its first president in 1902 and 1903, and its secretary since 1907.

## BUSINESS NOTES

THE CORTLANDT MACHINERY & EQUIPMENT CO., INC., has been organized with offices in New York City, and will specialize in the sale of saw mills, logging tools, wood-working plants and power machinery and is prepared to render full technical service to foreign purchasers and export firms. Maximilian Aviles is secretary and treasurer.

THE CANADIAN CHICAGO BRIDGE & IRON CO., LTD., Bridgeburg, Ont., and Montreal, Que., has changed its corporate name to Horton Steel Works, Ltd. The name has been selected in honor of the late Horace E. Horton, who founded the organization in Chicago in 1865. The Bridgeburg plant was constructed in 1913.

THE BLAW-KNOX COMPANY announces the addition to its staff of H. O. Davidson, formerly general manager of the Hydraulic Steelcraft Co., to have charge of the Prudential sectional building department, and also serve as general manager of the C. D. Pruden plant, with headquarters in Baltimore, Md.

HOMER W. SCOTT is now in charge of the Cleveland office of the Jeffrey Manufacturing Co., located at Leader-News Building, and C. R. Heller is in charge of the Buffalo office in the Marine Trust Building.

R. N. VANWINKLE, formerly assistant operating manager, France Stone Co., Toledo, Ohio, and assistant general manager, National Lime & Stone Co., Carey, Ohio, has purchased an interest in the Hawkeye Quarries Co., Cedar Rapids, Iowa, and has been made general manager of the company.

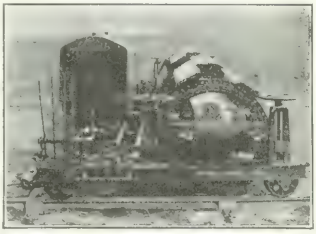
SIDNEY G. DOWN, for the last ten years Pacific district manager of the Westinghouse Air Brake Co. and president of the Westinghouse Pacific Coast Brake Co., has been appointed general sales manager of the Westinghouse Air Brake Co., with headquarters at Wilmerding, Pa. He will also be in general charge of sales for the Westinghouse Traction Brake Co.

N. DEWIND, formerly connected with the Austin Manufacturing Co., is now with Mussens, Ltd., agents for railway, mining and contractors' supplies, Montreal, Can., with headquarters at the Toronto office of this company.

## EQUIPMENT AND MATERIALS

### One Man Subgrader

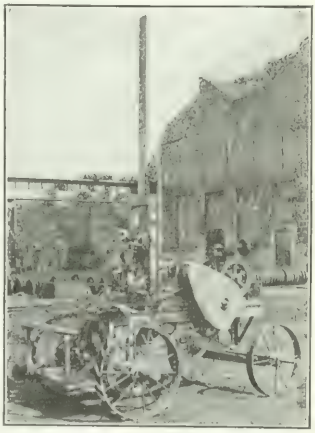
A one-man, gasoline-operated subgrader, drawn along on the road forms by means of cables, is a recent addition to the road equipment manufactured by the Austin Machinery Corporation. The subgrader has 4-ft. digging buckets equipped with removable steel plow lips, which are set to drive in five distinct places to depths varying from 2 to 4 in. In trimming the road, two plows shave



off the sides between the forms and the buckets. The buckets then trim the road depositing the excavated material on the 15-in. conveyor belt, which discharges the surplus material outside the forms. One passage over the road leaves the subgrade in condition for laying the concrete.

### Power Tamper

A number of new features are incorporated in the latest model P&H power traction tamper made by the Pawling & Harnischfeger Co., Milwaukee, Wis. In this new tamper all chains and gears are supplied with enclosing guards. The tamper and steering cables used are $\frac{5}{8}$ in. in diameter instead of $\frac{1}{2}$ in., and the new type



traction wheels are furnished with extension axles to allow for changing the tread from 58 in. to 76 in. The standard tamping head is 150 lb. in weight as before. Only one man is required to operate the tamper, the control of the power ram and the forward and backward movement of the tamper being readily accomplished from the operator's seat.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Southern Pine Orders Still Grow

For the week ended Friday, Oct. 7, the orders received by 127 mills reporting to the Southern Pine Association totaled almost 95,00,000 ft. b.m., 37½ per cent above the production for the week. The shipments during the week amounted to approximately 82,-000,000 ft. b.m.,—19 per cent above the production for the week—leaving the orders on hand at the end of the week 298,000,000 ft. b.m., in round numbers. The total orders for the week were 10 per cent in excess of the normal production. The shipments below normal production were 4½ per cent and production 20 per cent below.

## Idle Freight Cars Fewer

The number of freight cars idle because of business conditions, totaled 375,370 on October 1 compared with 414,698 on Sept. 23 or a reduction of 39,328 according to reports just received by the car service division of the American Railway Association from the railroads of the United States. Of the total 172,420 were freight cars in good condition which could be placed in immediate service if traffic conditions demanded while 202,950 were in need of repairs.

Reports showed that the number of surplus cars in serviceable condition on October 1 was a reduction of 28,733 compared with the total on the previous date. Of the 2,306,036 freight cars on line on October 1, reports showed 364,372 to be in need of repairs or 15.8 per cent compared with 374,431 or 16.3 per cent on September 15.

## Road Work in California Costing $300,000 Weekly

A bulletin recently issued by the California Highway Commission states that expenditures in connection with state highway construction are now exceeding $300,000 per week. "The recent sale of highway bonds" the bulletin states "has permitted the inauguration of a construction program involving a rate of expenditure in excess of that during any previous period of highway construction."

# Construction Volume Index Number Compiled

### Engineering News-Record Establishes Index Which Gives True Picture of Present Volume Compared With 1913

To get a true picture of the condition of the construction industry it is necessary to know how both costs and volume of construction compare with similar figures of other periods. *Engineering News-Record*, since July, has been satisfying the first of these needs by giving its readers a comparison of costs, through the *Engineering News-Record* Construction Cost Index Number. There remains now to give a similar picture of the volume of work, and this will be accomplished by the establishment and regular publication of the *Engineering News-Record* Construction Volume Index Number.

This new index number which will be published regularly in the first issue of every month, will give a true comparison of construction activity at the minute with that of the now commonly accepted reference year, 1913. This will be done by determining the volume of work that could be bought with present contract totals on the basis of 1913 prices. The contract values for 1913 and for the current year are reduced to comparable terms by use of the *Engineering News-Record* Construction Cost Index Number.

The determination of the basis for this comparison entailed a great amount of labor, but it is believed that the resulting benefit to readers of *Engineering News-Record* has justified the time and expense. The money value of all important engineering construction contracts awarded for all classes of work in 1913 has been determined and also for the year 1921 to date. The figures for 1913 and for 1921 to date are given in the accompanying table and in themselves are a valuable compilation.

In actual procedure the volume index number is secured by determining what amount of money in 1913 would have been sufficient to buy the construction corresponding to total amounts appropriated for current work. This figure is then compared with the total amount of money appropriated for construction in 1913. This can be expressed as a simple equation as follows:

$$\text{Vol. Index No.} = \frac{\text{Cost Number for 1913}}{\text{Cost Number for 19xx}} \times \frac{\text{Value Contracts Let 19xx}}{\text{Value Contracts Let 1913}}$$

The year 1913 was selected as the base because it is the last pre-war year, and because practically all cost index numbers (including the *News-Record's*) are referred to that year. As a matter of fact it was not a normal construction year, either in total volume or in distribution, and plotting the monthly totals (last column of Table 1) will not give the characteristic curve of a normal construction year. For that reason it will not to do to compare a fraction of say 1921 with the same fraction of 1913. If the monthly volume index number were calculated on this basis (January, February, etc., 1921, compared with January, February, etc., 1913) the result would be erratic and incorrect. To obviate such error, the average monthly contracts let in 1913 forms the basis for computing the monthly volume index number.

To put it as a formula, let $C_1$ represent the contracts awarded in the month for which the volume index number is desired, $C$ the 1913 average monthly value of contracts, $I$, the cost index number for the $C_1$ period, and $I$ the 1913 cost index number. Then

$$\text{Vol. Index No.} = \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But $I$ and $C$ are constants — 100 and $57,545,000, respectively; therefore,

$$\text{Vol. Index No.} = \frac{100\,C_1}{57,545,000\,I_1} = \frac{C}{575,450\,I_1}$$

TABLE I CONTRACTS LET IN 1913 ON ALL CLASSES OF CONSTRUCTION AS REPORTED BY ENGINEERING NEWS-RECORD

| 1913 | Railways | Bridges | Water Supply Irrigation | Sewers | Streets and Roads | Industrial | Fed. Govt. | Buildings | Miscellaneous | All Class |
|---|---|---|---|---|---|---|---|---|---|---|
| January | $15,896,575 | $2,183,349 | $2,537,857 | $2,601,466 | $1,792,673 | $2,037,758 | $505,182 | $9,833,166 | $6,595,426 | $43,983,452 |
| February | 13,550,000 | 767,239 | 1,167,714 | 2,722,937 | 1,971,145 | 1,673,824 | 1,122,341 | 7,127,486 | 4,361,884 | 36,466,570 |
| March | 25,561,555 | 2,246,544 | 923,470 | 1,824,693 | 4,218,836 | 3,925,636 | 8,473,938 | 11,223,293 | 21,779,491 | 80,217,455 |
| April | 19,900,000 | 617,033 | 744,897 | 2,131,058 | 3,212,460 | 7,976,676 | 2,173,268 | 7,563,153 | 7,182,464 | 51,501,009 |
| May | 23,383,295 | 923,479 | 2,988,265 | 3,281,660 | 6,670,252 | 6,282,405 | 837,063 | 24,937,849 | 3,141,655 | 62,445,923 |
| June | 7,388,080 | 5,393,729 | 1,631,718 | 2,828,831 | 5,950,707 | 14,294,249 | 1,987,220 | 12,698,420 | 2,588,938 | 54,711,892 |
| July | 37,550,000 | 1,257,028 | 6,335,307 | 2,338,361 | 4,810,197 | 2,422,470 | 3,460,169 | 20,075,028 | 16,543,420 | 94,791,960 |
| August | 6,130,000 | 1,556,085 | 1,682,169 | 1,099,440 | 3,769,566 | 1,675,546 | 3,356,282 | 11,453,034 | 2,946,149 | 33,668,271 |
| September | 1,810,000 | 2,391,935 | 1,784,768 | 1,646,049 | 3,150,418 | 1,634,685 | 7,212,138 | 11,187,289 | 24,968,911 | 55,786,193 |
| October | 17,787,500 | 1,257,003 | 1,789,466 | 2,479,178 | 5,531,483 | 3,070,564 | 3,302,491 | 14,242,257 | 16,357,939 | 66,017,881 |
| November | 10,925,000 | 2,299,305 | 690,326 | 1,578,873 | 3,381,838 | 2,274,114 | 3,695,128 | 16,238,030 | 6,667,198 | 47,607,812 |
| December | 13,165,000 | 2,398,201 | 2,097,043 | 2,425,893 | 4,112,041 | 1,784,372 | 3,079,969 | 12,108,646 | 22,169,940 | 63,341,205 |
| Total | 194,997,005 | 23,290,930 | 24,373,000 | 25,906,539 | 48,471,616 | 49,104,299 | 39,405,189 | 148,687,651 | 135,303,415 | 690,539,644 |

For example, contracts let in August, 1921, amounted to $104,644,115, and the cost index number was 193.07. Hence the volume index number is

$$\text{Vol. Index No.} = \frac{104{,}644{,}115}{193.07 \times 575{,}450} = 94$$

This means that in August of this year the volume of work placed under contract was 94 per cent of that placed in the average month of 1913. The figure thus gives a picture of the construction activity of today compared with the activity in the commonly accepted reference year, 1913.

The comparison of the individual lettings in any one month, of course, is not indicative of the volume of work actually under way, since this volume is the sum of all jobs let over, say, nine or twelve months. Consequently, a better comparison is afforded by the index number for the year 1921 to date. Comparing the first nine months of 1921 with nine months of 1913 it is found that the index number is 83, which means that to date this year only 83 per cent as much work, in volume, has been let as in 1913.

Side by side with the Construction Cost Index Number the Construction Volume Index Number will be published in the first issue of each month—the issue containing the monthly prices of construction materials and the rates paid labor and the current labor situation throughout the country. The two index numbers for the months of 1921 were as follows:

ENGINEERING NEWS RECORD'S INDEX NUMBERS

| | Construction Cost | Construction Volume |
|---|---|---|
| 1913 | 100 00 | 100 |
| 1920 | 238 79 | ... |
| 1921 (nine months) | 211 63 | 83 |
| January | 230 87 | 41 |
| February | 230 67 | 43 |
| March | 224 27 | 88 |
| April | 213 07 | 86 |
| May | 210 82 | 90 |
| June | 209 82 | 117 |
| July | 203 82 | 90 |
| August | 193 07 | 94 |
| September | 188 27 | 114 |

## Unemployed in Texas to do Road Work

Texas has made plans to carry on highway work throughout the winter, in order to help the unemployed. Rollin Windrow, state highway engineer, expects to give employment to several thousand men during the fall and winter, by completing several million dollars worth of road work. If congress appropriates sufficient federal aid, it is expected that a far larger program than is now contemplated will be carried forward.

## September Pig Iron Production

According to figures compiled by the *Iron Age* there was a further improvement in the production of pig iron during September. The total for the month was 985,529 tons for 30 days, a figure which compared with 954,193 tons in August. The increase in pig iron production in August compared with the preceding month was the first that had taken place in nine months. The September increase is consequently the second gain since the decline in production began almost a year ago. During September 1920 the pig iron production was slightly in excess of 3,000,000 tons and during September, 1919 approximately 2,500,000 tons. Steel corporation operations are now about 38 per cent of capacity. In the Chicago district the Illinois Steel Company is on about a 39 per cent basis and the Inland Steel Company 40 per cent.

## Standard Oil Plans Work For Unemployed

According to present plans the Standard Oil Company of New Jersey will spend in the neighborhood of $2,000,000 for repairs and reconstruction at his main refineries in New Jersey in an effort to lessen unemployment. The work will provide employment for about 5,000 of the oil company's 10,000 employees now on part time or not employed at all, and will increase the weekly income about 25 per cent. The plan has been made possible by the acceptance on the part of the employees of the bonus elimination, a bonus of 10 per cent having been paid by the company since August, 1919. The three refineries upon which work will be extended are at Jersey City, Elizabeth and Bayonne.

## Freight Rate on Road Materials Ordered Reduced in Ohio

Effective today substantial reductions in intra-state paving brick freight rates were recently ordered by the State Utilities Commission of Ohio. Sand and gravel also shared in the reduction but not to the extent of the consideration given paving brick rates. The ordered reduction restores rates on the foregoing materials to those in effect prior to Aug. 25, 1920. In addition, because, as indicated in the order, paving brick had received prior advances disproportionate to those given under competing materials, an additional reduction of 10 cents a ton is ordered on paving brick.

## A. G. C. Plans Conferences to Stimulate Construction

In accordance with a recent program adopted by the executive board of the Associated General Contractors of America to stimulate construction as a means to lessen unemployment, several members of the executive board are soon to make extended trips through Western and Pacific Coast cities. Meetings of representative citizens and general contractors have been arranged in the principal cities of the country and at these meetings W. O. Winston, president of the A. G. C., W. A. Rogers of Chicago, F. L. Cranford and D. A. Garber of New York, together with G. W. Buchholz, secretary, and E. J. Harding, assistant secretary of the national organization, will address these meetings in behalf of an aggressive program, both national and local, to start construction.

Central committees and general contractors in each of the cities will be appointed as nuclei of a permanent organization. Under the direction of R. C. Marshall, Jr., general manager of the A. G. C., this work has already been organized in from twenty-five to thirty cities covering in some instances entire states. From headquarters in Washington General Marshall is already working through national committees and general contractors on labor, materials, methods, contracts, insurance and bonds, transportation, codes, legislation, information, and statistics to bring about conditions which will make possible the carrying out of the construction program outlined by the President's conference on unemployment.

Local committees will be urged to secure the fall letting of public work and highway contracts. Other committees to secure adequate legislation for highway and water-power development will be recommended. Investigations in better methods of accounting and estimating and improved contract forms will be suggested. Close co-operation with the national headquarters in the entire campaign will be assured through monthly, weekly, and special bulletins and reports.

TABLE II. CONTRACTS LET IN 1921 ON ALL CLASSES OF CONSTRUCTION AS REPORTED BY ENGINEERING NEWS-RECORD

| 1921 | Waterworks | Sewers | Bridges | Streets and Roads | Excavation | Industrial | Buildings | Federal Government | Miscellaneous | All Classes |
|---|---|---|---|---|---|---|---|---|---|---|
| January | $519,028 | $3,146,948 | $3,030,477 | $11,597,810 | $1,266,346 | $12,881,968 | $17,455,673 | $2,071,141 | $2,358,976 | $54,328,367 |
| February | 2,927,307 | 2,445,075 | 885,529 | 12,049,344 | 305,740 | 4,737,850 | 31,902,608 | 1,574,927 | 1,728,441 | 56,556,821 |
| March | 2,028,055 | 2,862,131 | 1,443,060 | 25,880,109 | 1,625,690 | 15,032,130 | 56,520,231 | 3,590,617 | 4,231,823 | 113,213,846 |
| April | 3,342,150 | 3,817,401 | 1,987,808 | 31,026,312 | 580,039 | 9,346,586 | 51,647,900 | 1,186,403 | 2,732,799 | 105,667,398 |
| May | 4,943,562 | 2,162,460 | 1,642,894 | 35,064,031 | 2,631,799 | 7,799,584 | 48,442,471 | 1,809,588 | 4,408,142 | 108,904,531 |
| June | 3,494,584 | 3,802,040 | 2,417,632 | 56,772,257 | 1,240,398 | 6,111,307 | 56,576,768 | 4,158,430 | 6,005,398 | 140,578,814 |
| July | 3,105,969 | 3,985,991 | 5,053,520 | 33,942,893 | 609,233 | 6,781,369 | 45,452,153 | 3,382,964 | 3,696,957 | 106,011,049 |
| August | 2,404,304 | 3,988,318 | 2,353,227 | 28,692,878 | 89,403 | 7,210,378 | 50,475,001 | 1,355,545 | 8,075,061 | 104,644,115 |
| September | 1,487,296 | 5,063,990 | 3,405,876 | 23,256,996 | 9,025,229 | 13,259,789 | 60,979,116 | 3,694,113 | 5,301,392 | 123,473,797 |

## Relief Works for Unemployed Not Economical

(*London Correspondence*)

A large number of public works undertakings will probably shortly be commenced in Britain, chiefly for the purpose of alleviating to some extent the unemployment, which, at September

2, amounted to 1,527,000 with 400,000 on short time. The public utility works suggested all take the form of road construction, dock extension and drainage schemes. Already various local authorities have voted large sums for relief works of this nature, and it is proposed that the Treasury shall guarantee the interest on all sums borrowed by local bodies. Such a proposal would eliminate too heavy a burden on the Exchequer, and would allow local authorities to raise the funds without the heavy imposition which the payment of interest entails upon the rate payers.

Hitherto the provision of artificially created work for the sake of relieving unemployment has proved anything but successful, and, if these new proposals actually materialize, great care must be taken that legitimate employment is not interfered with and the revival of trade impared. Experience has shown that it is far more economical to pay out small sums, sufficient to meet minimum expenses, to unemployed, than it is to provide them with relief works which, in many cases, have resulted in chaotic financial and trade conditions.

### September Shows Decrease in Retail Food Costs

According to figures compiled by the Bureau of Labor Statistics, the retail food index shows a decrease of 1.1 per cent in the retail cost of food to the average family in September as compared with August. Forty-three articles of food are used in the compilation and prices are received from fifty-one cities throughout the United States. During the year ended Sept. 15 the percentage decrease in all articles of food combined was 25 per cent.

Little change in the general level of wholesale prices in September as compared with August is indicated. The Bureau's weighted index number computed from 327 price series is 152 for September, the same as for August.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 6, the next, on November 3.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $2 88 | $4 00 | $4 00 | $2 88 | $3.16 | $3 75 | $3.70 | $3.75 | $4 00 |
| Structural rivets, 100 lb. | 3 50 | 5 25 | 5 50 | 3 68 | 4.15 | 4.25 | 5.50 | 5 00 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2 78 | 3 20 | 3 50 | 2.78 | 3.18 | 3.57½ | 2.35 | 3.75 | 3.75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | -1% | 52 6⅔–5% | 45% | 65⅔% | 58.9–5% | 38% | 51 8% | 55% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 45 60 | 40.50 | 54.30 | —45 60 | 47.80 | 52.00 | —50.00 | 55.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | — 2 40 | 2 60 | 2.55 | 1 97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.10 |
| Gravel, ¾ in., cu.yd. | 2 00 | 2 13 | 2.25 | 1 65 | 2.00 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1 25 | 1 35 | 2 25 | 1.65 | 1.00 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.80 to 1 90 | 2.25 | 3.20 | | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 45.00 | +38.00 | 35 00 | 48.00 | +36.00 | 50.00 | 29.00 | +24.00 | 120.00 |
| Lime, finishing, hydrated, ton | 1 99 | 19.00 | 25 00 | 18 00 | 29 00 | 30.00 | 25.40 | 27.50 | 21.00 |
| Lime common, lump, per bbl. | 3 [illegible] | 1 60 | 2 75 | —1 40 | 1 40 | 2.95 | 1 90 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | .18.90@19.40 | +11.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | + .14 | .124 | .0821 | .092 | .09 | .12½ | .10 | 15 |
| Hollow partition tile 4x12x12, block | .11870 | + 14 | .124 | .0657 | .092 | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | .73 | .86 | .93 | .81 | +.81 | - .93 | .83 | .79 | .90 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | .72½ | .50 | .50@.55 | .75 | .50@.60 | ..... |
| Common labor, non-union, hour. | ..... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 15-5 means a discount of 15 and 5 per cent, 15 & 5 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrate quoted f.o.b. cars New York. Sand quoted delivered [illegible] or quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. ware houses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding brick f.o.b. plant; steel and pipe at ware house. Cement price is in Canadian funds exchange with the United States being 14 per cent at present. Rail charge is 80c per bbl. Discount of 10c per bbl. for payment within 20 days from date of shipment

## Changes Since Last Week

Pittsburgh quotes mill prices on structural steel shapes at $1.60@$1.70; plates at $1.55@$1.65; and reinforcing bars at $1.50@$1.65 per 100 lb. Mill shipments, New York, of steel shapes and plates are quoted at $1.98@$2.13; and bars at $1.98@$2.03 per 100 lb. Denver quotes mill shipments of structural shapes at $3.65; warehouse price, $3.75 per 100 lb. Chicago quotes cast-iron pipe at $45.60 as against $44.10@$46.10 per ton.

New York quotes cement at $2.40 as against $2.50 per bbl., delivered. Decreases in cement prices are reported in three Western cities. Peoria quotes cement to contractors in carload lots, f.o.b., without bags, at $2.14 as against $2.25; Cedar Rapids at $2.28 as against $2.31, and Davenport at $2.22 as compared with $2.27 per bbl. formerly. Chicago shows a reduction of 15c. in crushed stone, making the present price $1.60 as compared with $1.75 per cu.yd. previously.

An advance of $2 per M. ft. b.m. is reported in Douglas fir, base sizes, in Minneapolis and Seattle. Chicago quotes common lump lime at $1.40 as against $1.50 per bbl., 180 lb. net. Common brick has advanced $1 in Atlanta, making the present price $11 as compared with $10 per 1,000 formerly.

Linseed oil has advanced 3c. in Minneapolis and declined 3c. per gal., 5 bbl lots, in Denver.

San Francisco reports that construction work for this time of the year is becoming more satisfactory every day. Large building operations which were being held up by strikes are now progressing rapidly.

A Consolidation of Engineering News [illegible] Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 87 — NEW YORK, OCTOBER 27, 1921 — Number 17

## The Strike Situation

THE THREATENED railroad strike has met with the universal condemnation that was expected. Spurred by the public's attitude, the railroads are vigorously preparing for the maintenance of traffic while public officials are organizing to insure food and fuel supplies. The public condemnation and these firm preparations have probably had much to do in inducing the chiefs of railroad unions with a membership of 1,400,000 to refuse to join in the strike, despite the fact that favorable strike votes are in their possession. The action of the Railroad Labor Board, also, in calling the contending parties before it on Wednesday of this week was probably another factor that encouraged the split that has developed. The situation at the moment fully justifies the view expressed in these columns last week—that if the big brotherhoods are so foolish as to proceed with the strike, they will fail miserably. What is more, their hitherto great influence will probably be destroyed in their mad attempt.

## Lack of Statesmanship

THE BLINDNESS of the labor leaders of this country passes all understanding. After a post-war experience during which they have seen their influence dwindle because of their unreasoning positions, they have failed to profit by the lesson. Their voices are raised constantly in favor of maintenance of peak war wages, but seldom or never are the chief officers heard trying to lead the men to sounder economic grounds by urging increase of production and abrogation of unreasonable and restrictive working agreements. Under statesmanlike leadership the labor movement could win invincible public support. Every man has sympathy with those whose lot in life is, apparently at least, the harder. With that advantage to start with the labor organizations could clinch public sympathy if they "played the game" in the best interests of the whole country. Nothing would make them stronger with the public and better able to carry their side in controversies than a position that would look primarily to public benefit rather than to their immediate personal gain. The leaders, however, lack the statesmanship to take such a stand.

## Good Concrete With Big Stone

NOT OFTEN can the natural rock of the quarry be dug out, broken up and remixed into the artificial rock of concrete in so short a distance and under such favorable conditions as at the Barrett dam, described on another page. It is the very antithesis of central mixing with long-distance material feeding and long-distance concrete delivery, and it differs in the feeding end, at least, from practically all large concrete jobs where material has to be brought from a distance. Interest in the job, therefore, would be mainly in the solution of an unusual plant layout problem were it not for the use of large-size aggregate through the mixer and the exceptional care taken in the manufacture of the concrete. For mass work the opportunity for economy in big stone is great if equipment is made strong enough and big enough to carry the stone and to stand its wear. Mr. Savage has successfully used it before and apparently is doing so now; others who have similar conditions would do well to study the methods and results at the Barrett dam. It should be remembered, though, that with the large-size aggregate there is, on the Barrett job, an attention to the details of concrete-making common enough in the literature of concrete and in some building work, but all too rare on the big mass jobs.

## Revival of Scientific Effort

SCIENTIFIC effort is reawakening in engineering, after a long period in which it was fairly dormant. Investigations like the British Ministry of Transport measurements of impact, the Indian tests in the same field, and the Swiss bridge experiments soon to be reported, are symptoms of such reawakening, the more significant because they represent a wide geographical range and people of different habits of mind. The rebirth of scientific thought has no local limitations, and evidently defines a new phase of engineering development, the forerunner of new progress. In our day-to-day thinking we are apt to look upon engineering as the work of building railroads, digging tunnels, or lifting great weights—the routine of practice, in other words. This is a natural view, even if not an inspiring one. Yet it is essentially false, by being incomplete. The engineer's life is more than a pick-and-shovel existence, and its best part, indeed, lies in the striving for progress; in trying to do a thing in a better way than was known before, or, perhaps, finding a way of doing a thing well enough so that it will be worth doing. That is the scientific element of engineering, and it is the life-giving element, since it stimulates and inspires in a way that the mere practice of the art can never match.

## Great Opportunity Missed

ON MONDAY of last week there gathered in New York one of the most distinguished groups of engineers that has ever been brought together in this country. By reason of the fact that they were the present and past officers of the four leading national engineering societies, of Engineering Foundation, and of the Federated American Engineering Societies, they were the acclaimed chosen leaders of the engineering profession. They had been called together to welcome home the delegation which last summer presented the John Fritz medals to Sir Robert Hadfield and Eugene Schneider. It had been given out in advance that the meeting might be expected to be the occasion for launching some great agency for international understanding between engineers—at least between those of Great Britain, France, and the United States. Unfor-

tunately, the great opportunity was missed. There was fulsome praise of the spirit in which the Americans had been received in England and in France, but there was no adequate response to Sir Robert Hadfield's inspiring cable message urging the formation of a definite agency of understanding and co-operation. M. Schneider's message also implied the desirability of such an agency. With the inspiration of these messages, of the enthusiasm of a returning delegation and of an audience of most distinguished character, it was a time of times for raising engineering thought to a new plane, of showing that the Americans were capable of a response equivalent to the highmindedness of the messages from abroad. An evening that should have gone down as memorable among American engineering gatherings was, for lack of adequate planning, allowed to dwindle into one of the most cold and formal affairs we can recall. It must remain for another time to proceed with the launching of the agency proposed by our foreign friends and so sure to be endorsed by the profession in the United States.

### Promoter Versus Engineer

MR. CABOT'S paper on the engineer's failure as a manager is, in our judgment, too severe with the engineer. There are engineers with vision; technical training has not universally destroyed or constricted a broad outlook. On the other hand, we do believe then he is correct in his contention that it is the promotional mind that is chiefly responsible for conspicuous success in large enterprises. There is, though, still another thought that deserves emphasis; it was overlooked both by Mr. Cabot and by those who attempted to answer him, namely, that the conduct of all great enterprises requires a variety of talent and of point of view for success. There is needed the men of vision. There are needed, also, though they may not get into the public eye, the cautious financier, the careful administrator, the efficient production manager, the capable engineer. It is, in fact, in recognition of the need for a variety of experience and view that the standard form of corporate management is through boards of directors and executive committees. Engineers should not contend that the engineering mind alone will be adequate for success in great projects. Nor should Mr. Cabot place exclusive stress on the promoter. Finally, while it would be dangerous for all engineers to have the promotional instinct it would be helpful to the profession if more of them had that fine combination of vision and courage which has produced our great enterprises.

### Fall Highway Lettings

FROM the replies received to *Engineering News-Record's* inquiry regarding the fall letting of next season's highway contracts, published in this week's and last week's issues, it is evident that a substantial majority of the states not only favor the early award of road construction contracts, but are actually letting them now or are preparing to let them. Of the twenty-five answers received from state highway engineers, as this is written, fifteen announce definitely that either the entire 1922 road construction program or else as much as possible of it will be placed under contract before the first of the year. Some of the states not included in the foregoing category are handicapped by lack of funds and also by the fact that a number of the state legislatures do not meet until January, making it impossible to place work under contract until new supplies of money have been provided. A few of the states are opposed to awards this year in the belief that lower prices will be obtainable next spring, Maryland and Wisconsin being two of the leading states to follow this line of reasoning. Illinois, another big road-building state, while favoring the policy of fall lettings, qualifies its position in an analysis which concludes, in effect, that the proper time to let highway contracts, from the point of view of the state highway engineer, depends upon a combination of labor and material considerations rather than on seasonal conditions. Taken as a whole, the enunciation of policy by the state highway engineers furnishes a basis for a decidedly optimistic outlook for next year's road-building program. The clear evidence regarding the advance planning which state highway departments are doing is also encouraging.

## The Biggest Business Conference

IN LESS than a month the disarmament conference—or, better, the conference on the limitation of armaments—will be in session in Washington. Most people look upon it as a gathering for the discussion of problems in international politics. As a matter of fact, it is the biggest business conference in many a day.

It is a business conference not merely because the limitation of armaments would turn billions of capital into productive, instead of destructive, directions, but because the China question, which will be discussed prior to disarmament, is chiefly a business matter. If a constructive and conserving program for China's future can be mapped out by unanimous consent, reduction of armaments will logically follow. The center of possible future world disturbance has been shifted from Central Europe to the Pacific.

Essentially the Chinese question is that of maintenance of the "open door," the right of all nations to trade in any part of China on an equal basis, to make investments there unaffected by the preferential interests of other nations. In short, it is a matter of determining on what basis American business men, as well as the business men of every other nation, shall be permitted to share in Chinese trade. Also, it is worth noting that the disarmament meeting as a business conference has an important class interest to engineers and contractors. They are the forerunners of intensive material development. They lay out the avenues of communication. Theirs is the task of making possible the living together, in a sanitary and comfortable way, of large aggregations of human beings. Theirs, then, is a primary interest in the outcome of the coming Washington meeting. Before extensive material development in China must come the civil engineer and the contractor.

## A Strike With Novel Features

A STRIKE with two novel features is in progress in the Kern oil fields of California. In the first place, the strikers are perfectly willing to accept the wages and conditions of employment which the producers are willing to grant, but insist that the federal government shall underwrite the agreement for a period of a year. The second novel feature is that the strikers have organized upon military lines, with headquarters at Taft and divisional headquarters at six other points.

A motorcycle corps and emergency patrols are always in readiness to send reinforcements with the aim of preventing the introduction of strike breakers into the district. At the start these patrols were stationed upon all highways entering the oil district and were maintained night and day. Upon protest, however, of the secretary of the Governor of California these patrols were abandoned.

The strikers contend that their maintenance of a military form of organization is due entirely to the desire to prevent violence. Many of the officers of their "army" are constables and deputies under the authority of Kern County. The reports indicate, that while the army is very active and has been successful in preventing the introduction of strike breakers no violence has occurred.

Naturally, the oil producers are protesting at the breakdown of the public authority—or, rather, at its partisan use. In that protest, of course, they will be supported by all fairminded citizens. The situation is novel, to say the least, for in past strikes it has been the frequent charge of the striking employees that the military and police powers were used in favor of the employers. Whether justified or not the shoe in this case in on the other foot.

As to the demand of the strikers that the federal government underwrite the agreement, comment is hardly possible without knowing the full circumstances which have resulted in this extraordinary demand. On its face, and in the baldness with which it has been reported, it seems to go beyond all former measures of composing industrial difficulties. A federal sanction has, of course, been given in the past to industrial settlements, as in the case of the anthracite commission of the Roosevelt administration. That was, however, decidedly different from having the federal government guarantee the carrying out of an industrial compact.

## Will of a Great Engineer

FOR reasons only too well known to most of our readers the last will and testament of an engineer is rarely of interest outside his family circle. An exception rare as to the sum total bequeathed and notable because of the beneficiaries named, the evident thought put upon their selection and the restrictions and explanations relating to the residuary estate, is afforded by the will of the late Hiram F. Mills, which has just been made public. Of the public bequests of specified amounts, two are outstanding because of their objects and conditions. A large cancer research fund bequeathed to Harvard University speaks volumes, coming as it does from a man who, through his thirty years of devoted work on the State Board of Health of Massachusetts, contributed so much to the reduction of the mortality rate in general and to the typhoid rate in particular. Some decades ago, it is conceivable that Mr. Mills might have established a fund to combat typhoid. That is no longer an urgent need. A fund to aid in the reduction of the general death rate would not have that directness of aim to be expected from an engineer like Mr. Mills. What more natural, familiar as he was with the major causes of disease, suffering, and death, still awaiting successful attack, than that Mr. Mills should select that wide-spread, baffling and dreaded disease, cancer?

The minor public bequests, it may be noted in passing, show discrimination. The gifts are small but they will prove helpful—materially and, in some respects more important yet, because of the appreciative recognition given to these institutions in the will of a great and thoughtful engineer.

Most directly human of all the gifts, and perhaps most characteristic of the giver, is the bequest of the residue of Mr. Mills' estate for the benefit of the needy of Lawrence and Lowell, particularly the mill workers. This gift, as stated in the will, springs from Mr. Mills' half century of professional work in making the most of the water-power on the Merrimac and upbuilding the cities of Lawrence and Lowell. The gift shows an appreciation of the human as well as the mechanical factor in the growth of these communities.

Mr. Mills' bequests prove anew that a man's deeds are his best monument. They also show that a last will and testament may be the most self revealing of the documents a man leaves among the written memorials of his life work and his deepest and most heart-felt aspirations.

## Fighting a Unified Port

THERE is evidently trouble ahead for the Port of New York Authority. By law of the States of New Jersey and New York, confirmed by a federal act, an interstate Port Authority has been created. Before next January this body must submit to the two state legislatures a comprehensive plan for the physical development of the district, on the acceptance of which the Authority will really begin to function as a sovereign body subject to law but not to any local or state control.

It is expressly provided, however, that "no city within the port district shall be bound by the comprehensive plan unless and until it has approved the same." The present city administration of New York has consistently fought the idea of joint control of the port, and though step by step it has been beaten in the legislative fight, it is apparently still in the ring. The report of the special committee on the Brooklyn-Richmond freight and passenger tunnel, noted in the news columns this week, is new evidence of that fact. This lengthy report, filled with figures and maps, mentions only twice the Port Authority and those two references are merely an acknowledgement of statistical data. Yet the report which they render is merely another solution of the belt-line problem fully discussed in the elaborate report of the New York, New Jersey Port and Harbor Development Commission and which undoubtedly will form a major part of the proposed "comprehensive" plan to be presented by the Authority in a few months. Starting from the isolated authorization of a passenger and freight tunnel across the Narrows, the Board of Estimate's committee has built up an elaborate study of the entire freight problem of the port of New York.

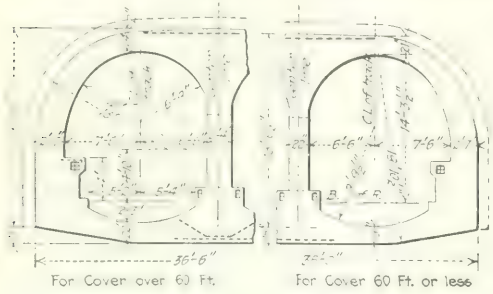
It is not our purpose here to discuss the relative merits of the committee's plan and the plan of the Port Authority, or to advocate one over the other. It is our desire to condemn the obstructionist policy of the city of New York in the development of the port. A proper method of dealing with the problems of the port has been provided in the Port Authority. The city has its rights and privileges fully guarded in the new treaty. Why does it not deal with the problem in the properly constituted manner instead of proceeding along its own lines independently and evidently with full intent of throwing as many monkey wrenches into the machinery of the port's development as it legally can?

# Timbered and Roof-Shield Tunneling in Deep Loose-Ground Subway Section

## Push-Rods Embedded in Tunnel Shell Concrete to Take Reaction of Shield Jacks — Shield-Driven Work Compared With Timbered Excavation—Evidence of Heavy Roof Pressure— Unusual Grouting Experiences

By W. C. Briggs
Engineer in Charge, Degnon Contracting Co., New York

In constructing a section of double-track concrete subway at 100 ft. depth in loose ground along Flatbush Ave., Brooklyn, two radically different tunneling methods were used: (1) Timbered excavation, and (2) roof-shield work, the roof shield traveling on the concrete sidewalls of the finished structure, built in drifts in advance of the shield. The former method was unusual in the arrangement of the several drifts and headings and the construction of the timbering, as well as in the sequence of concreting operations.




from Prospect Park Plaza to a connection at Empire Boulevard with the reconstructed Brighton Beach line of the Brooklyn Rapid Transit Ry. Its construction, during 1916 to 1919, required about twice the time it would have taken but for delays resulting from war conditions.

Of a total length of 4,141 ft. tunneled (300 ft. at the south end of the section was built in cut-and-cover excavation), 2,293 ft. or 55.4 per cent was driven by timbered tunneling, while 1,848 ft. or 44.6 per cent, was driven by shield. The character of the material penetrated was variable. In general, the work passes through terminal moraine deposits, varying from clean, coarse sand, through clay (wet and dry), some of it containing fine sand, to hardpan which at times contained numerous and often very large boulders.

### Timbered Tunnel

Four faces were operated by the timbering method, located as indicated in the plan in Fig. 1. The sequence of operations was the same in all four, with negligible variations in detail, and is represented in the composite sketch Fig. 2.

First a top center heading (1) was driven, by the

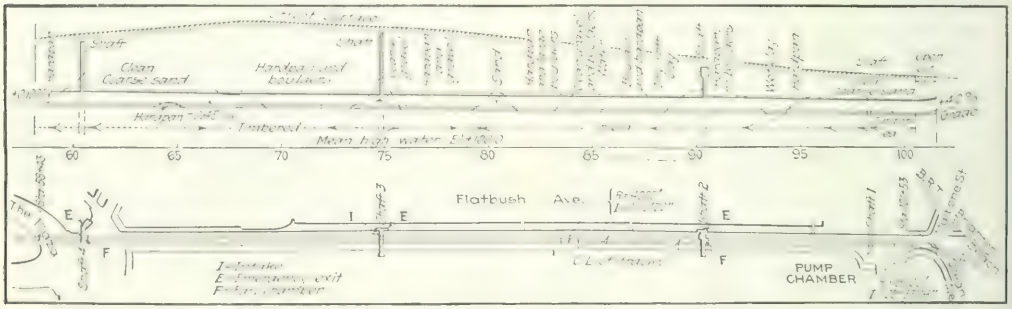



FIG. 1. DOUBLE-TRACK CONCRETE SUBWAY SECTION BUILT BY TUNNELING METHODS

The roof-shield work was unique, because of the fact that the shield was shoved directly after the placing of a ring of concrete, the shield jacks depending for their reaction upon push-rods embedded in continuous lines in the concrete of the tunnel shell. So far as the author is aware, the combination of a shield, concrete forms and wet concrete immediately behind the shield had never before been used. The novel features of the two methods, as well as the fact that both methods proved themselves well suited to the work, warrant a brief description. An incidental point of great value is that a comparison of the working results throws some light on their relative advantages.

The work in question is a section of rapid transit subway 4,300 ft. long, extending under Flatbush Ave.

poling-board method, with square-set timbering. The size and spacing of the caps varied with the ground conditions. At first 8 x 10 caps spaced 3 ft. 8 in. on centers were used; later they were changed to 10 x 12 spaced 3 ft. 10 in. on centers. Where the cover was about 30 ft. and the borings showed coarse sand from surface to subgrade, 12 x 12 caps spaced 4 ft. on centers were used. In all cases the caps were 15 ft. 4 in. long and the legs 9 ft., these dimensions defining the size of the heading. The poling boards were 2-in. hardwood (beech and maple).

Intermediate support of the caps was always necessary. As soon as a set was in place two plumb posts were erected under each cap, dividing it into three parts. After a number of sets had been placed, mud

sills and kneebrace frames as shown in the sketch were put in place, and the load was transferred from the two intermediate plumb posts to this frame. The frames were a very essential part of the timbering of the top heading, not only as support for the caps but also because it was important to have at least some of the roof load carried by continuous longitudinal sills as a protection against accident during the second operation. With the entire roof load supported on isolated posts, failure of the footing of a single post due to caving of the center-wall trench would entail the failure of the set, and this would inevitably be followed by the collapse of adjacent sets. The kneebraces also performed an important function in resisting the side pressure.

After the top heading had advanced two or three hundred feet, the second operation was begun. A

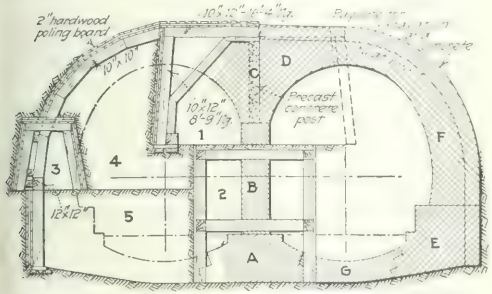



FIG. 2. SUBWAY CONSTRUCTION IN TIMBERED EXCAVATION

sheeted longitudinal trench (2) was excavated in the floor of the heading, down to subgrade, and in it was constructed the center wall of the subway structure, in two successive concreting operations, *A* and *B*. On this wall was erected under each cap timber of the heading a precast concrete post *C* which took the load carried by the timber kneebraces, permitting the removal of the latter. Thereupon the forms for the umbrella section *D* were pulled into place, and the umbrella was poured.

It is evident that when the work reached the stage just described, permanent support had been provided at the place where the greatest load would be developed in making the full excavation. To obtain this condition as soon as possible after the operations began was indeed the object aimed at in adopting this sequence of operations. As the work developed, it appeared to the author that it was the only safe way to prosecute the work by timbering methods for the reason that at isolated points there were failures of both caps and posts, through crushing and fracture, which showed that remarkably heavy loads were brought to bear on the sets. Calculating on the basis of the ultimate strength of the broken timbers, it was found that the load supported by the cap was equivalent to the weight of a column of earth extending all the way up to the surface, with base equal to length of cap times distance between caps (the load was not necessarily the weight of that particular prism, but the equivalent of such a prism.)

The failure of a cap or a post was always promptly detected and easily remedied. It was promptly detected because men were constantly passing through the top heading; and due to the size of the heading, their eyes were never far from the timber, inspection being therefore easy without special effort. After the first failure was noted, everybody connected with the work took an interest in watching the condition of the timber. Failures were easily remedied because all that was required was to introduce an extra set next to the one that had failed, the materials for which were ready to hand, as they were the same as those regularly in use. The loss due to the erection of extra sets was the only loss sustained on account of timber failures.

After pouring the umbrella concrete the wall-plate drifts were driven, on both sides; then, as soon as a wall plate had been placed, a set of segment timbers was placed in line with the cap, poling boards were driven, and area 4 was excavated. The wall plate was posted to subgrade in pits, in the usual manner, and the excavation (area 5) completed. The side-wall footings *E* were then concreted, after which the forms for the arches *F* were slid along into place on the completed side walls and poured. The concrete invert was placed at irregular intervals according to the situation relative to other work, usually on Sundays in order to eliminate interference with mucking.

In a number of cases the ends of caps crushed at *X*, where they cantilevered out of the umbrella concrete, after the segment timbers had been placed and the excavation completed. These failures are mentioned simply to indicate the intensity of loading which developed, as they caused no inconvenience. With this exception there never was an indication of unusual load on the timber after the umbrella was in place.

### Roof-Shield Tunneling

Three miners, three timbermen and three helpers would make a set of top heading in a 9-hr. shift. In the wall-plate drifts one miner, one timberman and one helper would make a set, and in completing the arch (area 4) two miners, two timbermen and two helpers on each side made a set in a shift. This progress was made where the tunnel was in sand requiring careful timbering of the entire face of each drift. In hardpan and dry clay the progress was more rapid.

All of the operations could be conducted simultaneously and at times were; but it worked out better not to advance the top heading with the open trench. Note in the drawing that after the umbrella is in there is room for a small mine car to pass between it and the legs of the timber set.

The muck was loaded by hand into 1-yd. buckets on flat-cars running on a 24-in. track, which were hauled to the shafts by mules.

All concrete was machine-mixed, spouted down shafts into all-round dump cars, which were pushed by hand to the forms. These cars traveled on a track laid on a light trestle erected at about the spring line; the same track was used for the delivery of timber to the headings, thus separating the muck removal from the other operations.

The first step in the sequence of operations in connection with the shield-driven tunnel was the driving of three bottom drifts (Fig. 3), one on the center line and one at each side. The wall footings were concreted in these drifts. Inasmuch as the shield was

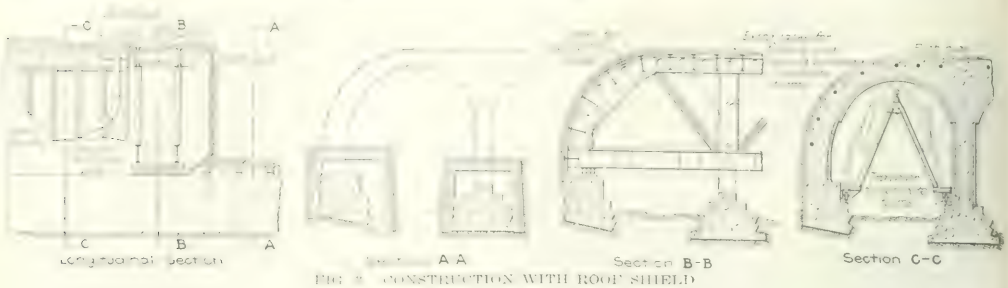



FIG. 3. CONSTRUCTION WITH ROOF SHIELD

supported entirely by the side walls, the center wall was built in advance of the shield only because it was impracticable to do this particular work as a part of the shield operation.

*Shield and Push Rods*—The shield measured 36 ft. 6 in. out to out in width and 11 ft. 11 in. in length. The cutting edge was 3 ft. 6 in. long, the body 4 ft., and the tail 4 ft. 5 in.. The skin was 1½ in. thick. The inside of the tail corresponded to the net outside of the heavier type of structure (for cover exceeding 60 ft).

Movement of the shield was effected by means of 14 hydraulic shield jacks with 7½-in. ram and 36-in. stroke, designed to net 32 in. for each shove. The trouble was due entirely to the bulkheads, the weight of which at the end of an extended ram caused relatively great and certainly unusual reactions on rings and packing of the rams.

*Progress*—The greatest rate of progress attained was 155 ft. of completed tunnel in a month, working 24 hours a day for six days a week. This record was made during two different months, when the material penetrated consisted of hardpan practically free from boulders. No breasting was required, and the face was cut out in front of the cutting edge of the shield, so that there was nothing to prevent its free movement as soon as the pressure was turned on the rams. Under these circumstances ten to twelve minutes only

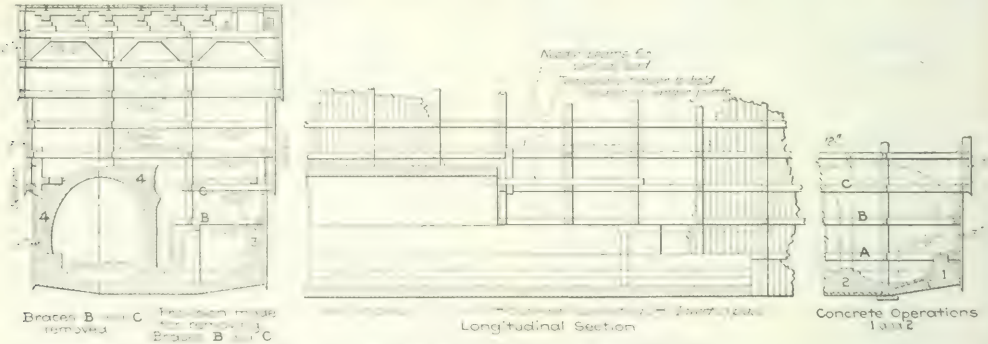



FIG. 4. DEEP OPEN-CUT WORK AT SOUTHERN END

rams reacted against "push rods," which were 4 in. extra heavy wrought-iron pipes 32 in. long filled with concrete, embedded in the concrete ring. The push rods were made up long in advance of their use; the concrete filling of the pipe projected 2 in. beyond one end of the pipe and extended to within 2 in. of the other end of the pipe, thus making what was in effect a bell-and-spigot joint.

A section of the bulkhead making up the concrete form between the arch forms and the inside skin of the shield was fixed to the end of each ram. After a shove of the shield had been completed, the rams were pulled in, carrying the bulkhead with them, and a push rod was fixed between each bulkhead and the end of the push rod on the same line already embedded in the arch ring.

At times considerable trouble was experienced with the rams due to ring and packing failures. While no better method for handling the bulkheads than that described in the foregoing paragraph seemed possible, nevertheless, in the opinion of the author, the packing were required to complete the shove, and progress was limited only by the time required to move, line and fill the forms. When the face was entirely in sand and it was necessary to breast the face from top to bottom, the progress averaged about ten shoves per week. It is the opinion of the author that 155 ft. per month, or roughly two shoves a day, is the limit for equipment of this character, because at a higher rate the concrete behind the shield is not sufficiently set to prevent buckling of the push rods when taking the reaction of the rams.

The shield penetrated two peculiar formations. One consisted of gravel and boulders ranging in size from a few inches in diameter to upwards of 15 cu.yd., the interstices of which were entirely free from any fine material. It was a slow and difficult process to work the shield through this material, and the face had to be timbered over its entire area. To have attacked this formation by the timber method would certainly have involved great difficulties, if, indeed, it would have been possible at all. The other formation was

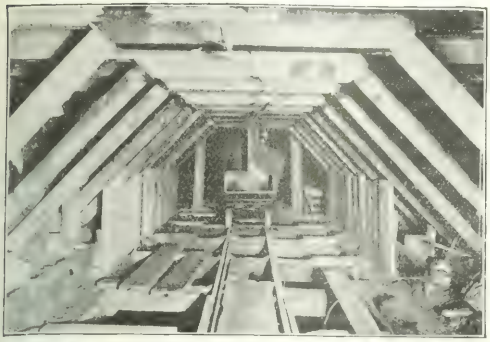


FIG. 5. TIMBERING METHOD: TOP HEADING AND CENTER-WALL TRENCH

the same as the one first mentioned with respect to gravel and boulders, but differed in that the interstices were completely filled with a matrix which bound the stone about as firmly together as if set in mortar. In this formation no timber was used, and frequently a boulder which had been exposed everywhere except on the back would stick in its place.

*Blowing Concrete*—All concrete for the shield-driven tunnel except that in the invert was placed pneumatically. Although some concrete was mixed as well as placed pneumatically, better results were obtained when the concrete was premixed and the pneumatic machine was used solely for placing.

For the purpose of conveying the concrete to the forms, the pneumatic machine was a success; indeed, it would have been well nigh impossible to have conveyed it to the forms under the circumstances by any other means. While it is generally true that the concrete was placed properly, it is also true that some difficulty was encountered on account of the segregation of ingredients, due to the confined space to be filled and to the fact that that space was obstructed by the push rods. In passing it may be stated here that the pneumatic machine was used very successfully for placing the concrete in a part of the tunnel built by the timber method. This particularly applies to the concrete poured into the umbrella, in that it was poured much more expeditiously and was packed up between the caps more completely.

Standard 6-in. wrought-iron pipe was used as a conduit for the concrete. The straight pipe withstood the abrasion for a long time, but bends of 6 and 8 ft. radius made up of extra heavy pipe often would fail after a few batches had passed through them. The straight pipe failed first at the joints, where the metal is thin due to the threads. Further, it wore out at the top rather than at the bottom, which would indicate, apparently, that the batch floated through the pipe. A very effective way of overcoming the short life of the bends was developed; it consisted of clamping a piece of scrap solid rubber tire to the back of the bend by means of a bent plate held by U-bolts drawn up to the limit, the result being that as the pipe wore out, rubber was forced into the hole and it absorbed the impact due to the stone. This scheme, together with reversal of the bends, resulted in a fairly long life for the bends.

In comparing the results obtained by means of the two methods, it must be borne in mind that whereas the shield was uniformly worked on a three-shift basis, the shifts being equal as to number and efficiency of the men, the timbered method on the other hand was never worked in three shifts, and during the comparatively short time that two shifts were used the day shift was always superior to the other in number and efficiency of the men employed.

It was necessary to operate the shield continuously because of the impossibility of determining the time when one element of the cycle of operations would end and another begin; and it was essential that an element should not be left in an uncompleted state. Therefore the shield organization was maintained at full strength at the cost of curtailing the strength of the other organization, where the cycle of operations was not fixed.

Under the conditions described, a progress of 100 ft. of completed tunnel in a month at a single face was

FIG. 6. TIMBERING METHOD: VIEW IN ONE TUBE, LOOKING BACK TOWARD COMPLETED TUNNEL
Umbrella at left; arch form in center background

attained by the timber method. From this it is a fair assumption that three equally well organized shifts would easily maintain the maximum rate attained by the shield, i.e. 155 ft. per month.

As to safety there is little to choose between the two methods so far as the actual results of the work disclosed. Both were safe. However, in the opinion of the author it was a very fortunate coincidence that the shield encountered the very wet clay and the boulder formations; for by the timber method this work would have been extremely difficult.

With regard to street surface settlement, conditions over the shield-driven tunnel were rather worse than those over the timbered tunnel, although, of course, there was more or less settlement over all of the tunnel. The settlement over the shield-driven tunnel resulted from two things: The void left by the skin of the shield, and the loss incident to the timbered tunneling in the drifts. The loss due to the drifts was not evident, generally, until the passage of the shield, probably because the surface over the drifts was supported through arching of the earth, which was destroyed by the opening made by the shield. In

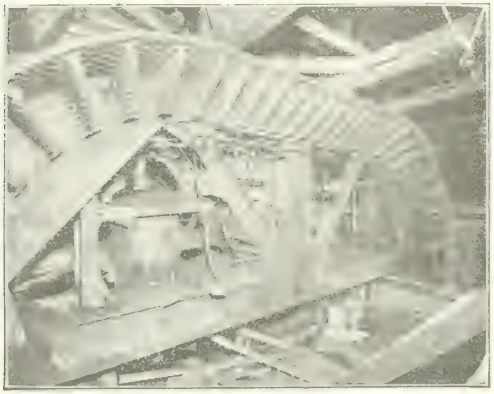


FIG. 7. SHIELD METHOD—CUTTING EDGE ENTERING AN INTERMEDIATE SHAFT

any event, there was a depression in the street all the time directly behind the shield.

An objection to the shield method as applied in this case is the fact that the failure of an element in the cycle of operations resulted in a delay to all. However, under normal conditions, with competent labor, this objection should not be serious.

While it is not important, it is interesting to know that foremen and men who had an opportunity to work both methods preferred the shield. The work seemed to go faster, and it was a satisfaction to see the completed tunnel close to the working face.

To obtain the best results with a timbered tunnel of the character described, in the opinion of the author, the top heading should be driven from shaft to shaft in advance of all of the other operations; for, after the top headings holed through, all the other operations could be conducted simultaneously, beginning at the shafts, without interfering with each other and under favorable conditions with respect to ventilation. The side poling-boards, legs, and sills of the top heading would all be used in timbering the final bore. The top headings were not run through in advance of the other operations on this job because of the uncertainty as to the extent that the timber method would be employed.

*Comparative Costs*—For labor alone (includes mixing and placing concrete) the cost per lineal foot of completed tunnel by the timber method was 22 per cent greater than that by the shield method. The cost of the three bottom drifts is included in the shield-method costs.

Adding to the foregoing the cost of the power, the timber, the shield and the push rods, but not including the cost of concrete forms and ingredients, the cost by the timber method exceeded by 9 per cent that by the shield method. The wide difference between these percentages is accounted for by reason of the fact that the power charges against the shield method are much greater; that the push rods alone cost nearly as much as all of the timber for the timbered tunnel; and that the shield cost $12 per lineal foot of the shield-driven tunnel.

Relative to these comparative costs, it is important to note that the amount of both excavation and concrete was less with the shield-driven than it was with the timbered tunnel, although the pay section was the same in each case (See section in Fig. 1). Crediting the shield method for the amount of excavation not removed and concrete not placed but paid for, the cost by the timber method exceeded by 15 per cent that by the shield method.

The determination to use a shield on this contract was based on the assumption that by means of it a rate of progress could be developed which would make it possible to complete practically the whole tunnel—short sections at each end excepted—within the contract time limit. Due to war conditions, however, the delivery of the shield was considerably delayed; and the extremely unfavorable conditions with respect to the character of the earth encountered at the very start made the progress of the shield a disappointment, so that it became necessary to supplement it by adding the timber method. Had it not been for these contingencies, the author is of the opinion that, while the tunnel would not have been completed on time, using the shield alone, the delay would have been immaterial as compared with delays to subway work generally.

The statement in the foregoing paragraph has a bearing on comparative costs. As the shield was the major and timbering a minor consideration, the plant was all arranged to suit the former; and, by the time it was determined to push the timber method, adequate and suitable plant and labor were not readily available, due again to war conditions.

*Grouting*—The completed tunnel was grouted for its entire length. Grout-pipe nipples were inserted in the concrete ring at several points in a cross-section, in sections about 20 ft. apart. Experience disclosed that the best results were obtained by connecting to a nipple at the crown only, forcing the grout through that connection to refusal at about 60 lb. pressure. As grout appeared at open nipples adjacent to the grout connection, they were plugged and the process repeated until the connection refused. The grout machine was then moved forward to the nipple where grout last appeared and this treated to refusal.

Wherever a connection was grouted to refusal, a bone-dry tunnel resulted even where it had been quite wet before. At the point where the shield passed through the clean gravel formation the tunnel was very wet; and, while the grout cut off the water to some extent, it did not cut it all off. A very large amount of grout was placed in a short length of tunnel, but it was impossible to grout a hole to refusal. After having worked for some time at this point, with very little success, grouting was cut out for about ten days, new holes were drilled through the ring, and another attempt was made to cut off the leaks. However, this attempt also was unsuccessful. Evidently the grout just ran away.

*Surface Cracks*—An interesting development in connection with both tunneling methods was the occurrence of a series of longitudinal cracks which appeared in a gravel walk, closely following the progress of the headings. It apeared at a point horizontally distant from the bottom of the heading equal to one half the depth from the surface to the bottom of the heading. Where a crack appeared during the progress of the top heading, another appeared later farther away from the tunnel, but at the same rela-

tive point, when the excavation for the full section was completed. There was no variation in the location of the crack on account of the difference in the character of the earth penetrated.

In this connection a quotation from the minutes of the Institute of Civil Engineers, Vol. LXV, page 140, is interesting. "The slope of these fissures was so uniformly at the angle of ½ to 1, measuring from the bottom of the excavation, that the resident engineer professed to be able to foretell with certainty where a building or fence wall, standing over the tunnel, would crack." This is from a paper by Sir Benjamin Baker, referring to the London railway tunnels.

The contract was executed under the direction of John H. Delaney, Transit Construction Commissioner, succeeding the Public Service Commission, D. L. Turner, chief engineer, and Robert Ridgway, engineer of subway construction. The Degnon Contracting Co. was the contractor, H. C. Sanford, chief engineer, Francis Donaldson, engineer in charge from the inception to July 1, 1917, and the author from then until completion, John H. C. Gregg, principal assistant engineer, E. A. Herrick and John O'Keefe superintendents.

## Strength Tests on Pre-Mixed Concrete on Detroit Street Railways

By W. R. Dunham, Jr.
Chief Engineer, Engel & Hevenor, Detroit, Mich.

CONCRETE mixed overwet at central mixing plant was used for the base of the new track construction of the Detroit Municipal Railway Lines, as described in *Engineering News-Record*, Sept. 29, 1921, p. 532. Strength tests, not noted in that article, were made during the work and show remarkably consistent and high results.

The type of construction adopted depends for its permanency on the concrete foundation. In order that the work could be carried on with the requisite speed to insure its completion in the time assigned, it was necessary that the concrete be mixed with an excess of water, and this was also thought to be desirable in order that the mixture would flow around the steel ties, thus thoroughly embedding the ties and rail bases in a monolith of concrete. Some tests made on the concrete are given here to show the compressive strength of concrete mixed to the consistency of pea soup. Exact percentages of water content are not available. There are included tests made from samples cut out of the work as actually laid, and from samples taken each day from the mixers. These latter samples were taken in 6-in. cardboard cylinders and tested at the ages as given. At the age of 40 days, blocks were cut from the concrete monolith at the locations where the concrete from which the samples were taken had been deposited. These were dressed to size and tested. Twelve sample blocks were made in the yards using the same aggregate, sand and cement, and kept moist, six of these were tested at the age of 81 days and six at the age of 91 days.

The aggregate used was Detroit River gravel known as forty-sixty, or 40 per cent sand and 60 per cent gravel. To make up the gravel deficiency, 25 per cent of ¾-in. to 2½-in. crushed furnace slag was added.

The aggregate was delivered to the mixers by gravity from two compartment bins, the aggregate in one compartment and the slag in the other. These were delivered by chute into the loading hopper and the cement was added, the concrete being a 1:2:4 mix. Water was added until the desired consistency was obtained, when the mixer was discharged into a train of hopper cars and the concrete was deposited. The average output per mixer per day was 400 cu.yd.

The consistency was such that the concrete flowed under and around the steel ties and up over the rail base, but to insure the avoidance of voids under the plates of the ties and under the rail bases the concrete was tamped. The plates on the ties had 1-in. holes drilled in them to allow the impounded air to escape and prevent the formation of pockets.

TABLE I. SUMMARY OF TESTS OF CONCRETE FOUNDATION

| Test No. | Compression Strength, Lb. per Sq.In. 7-Day | 28-Day |
|---|---|---|
| 1 | 1,869 | 2,949 |
| 2 | 1,373 | 2,331 |
| 3 | 1,252 | 1,846 |
| 4 | 1,595 | 2,125 |
| 5 | 1,192 | 1,905 |
| 6 | 1,760 | 2,390 |
| 7 | 1,959 | 2,086 |
| 11 | 1,440 | 2,397 |
| 12 | 1,516 | 2,500 |
| 13 | 1,831 | 1,945 |
| P-30 | 1,007 | 2,033 |
| P-31 | **675 | **2,750 |
| P-32 | 990 | 2,260 |
| P-34 | 945 | 2,462 |
| P-35 | 950 | 2,032 |
| P-36 | 837 | 1,965 |
| P-37 | 1,200 | 2,480 |
| Average | 1,317 | 2,262 |
| Average first ten samples | 1,579 | 2,247 |

** Least at seven days, next to highest at 28 days.

It will be noticed that the samples showing the least strength at seven days developed about the same strength at twenty-eight days as the other samples; and that the sample developing the least strength at seven days was the next to the highest at twenty-eight days.

TABLE II. POURED SPECIMENS COMPARED WITH THOSE CUT FROM STRUCTURE

| | | (Compression, Lb. per Sq.In.) 7-Day | 28-Day | 40-Day | |
|---|---|---|---|---|---|
| Molded in Cylinders | P-30 | *1,007 | *2,033 | M-3,411 | |
| | P-31 | *675 | *2,750 | M-2,388 | } Cut from track slab. |
| | P-32 | *990 | *2,260 | M-2,785 | } |
| | P-34 | *945 | *2,462 | | |
| | P-35 | *954 | *2,032 | | |
| | P-36 | *837 | *1,965 | | |
| | P-37 | *1,200 | *2,480 | | |
| Average.... | | 944 | 2,283 | 2,861 | |

* Poured M Cut from slab

Samples cut from the base as laid at the locations from which the cylinders were filled give strengths as noted in Table II compared with samples taken from mixer.

TABLE III. TEST OF SAMPLES MADE AT YARD

| 81 Days | 91 Days |
|---|---|
| 2,972 | 2,454 |
| 2,609 | 2,644 |
| 2,328 | 2,450 |
| 2,229 | 1,923 |
| 2,083 | 2,179 |
| 1,322 | 1,968 |
| Average 2,257 | 2,270 |

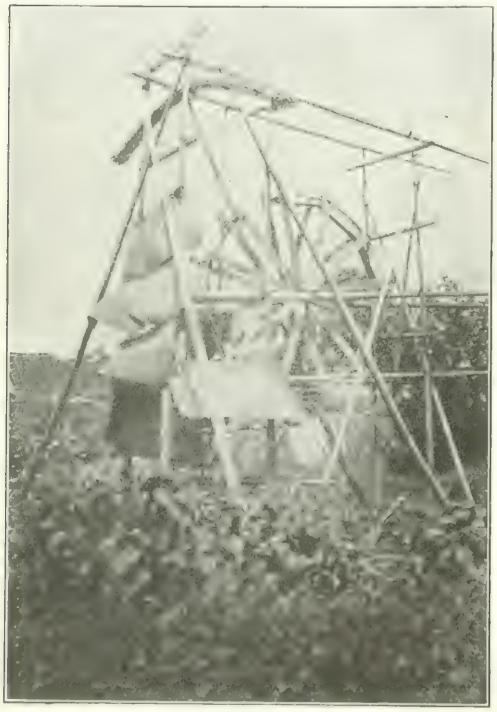
Tests of samples made at the yard using same proportion of aggregate and slag and same cement, and kept moist while curing are given in Table III.

## An Oriental Well-Drilling Rig

By E. W. Lane
Manager, Morgan Engineering Companies in China, Yangchow, Ku, China

THE Orient is rapidly adopting the engineering methods of the West, with modifications to adapt them to the different conditions. Some of these modifications are very interesting and ingenious. One of the best which the writer has seen is the well-drilling rig shown in the picture, which is now used in Central China, but was probably developed by the Japanese.

The unique features of this device are the use of a



CHINESE WELL-DRILLING DEVICE

huge bow for balancing the weight of the drilling rod and cable, and the "squirrel cage" treadmill by which the baler is raised.

The bow is composed of a bundle of bamboo poles and is suspended at the top of a frame work of poles in such a manner that the center of the bow string is directly over the point where a well is desired. From the center of the bow string is suspended the drill rod which is churned up and down by man-power. The tension of the bow balances the weight of the rods and cable and at the same time, by its flexure, allows the churning of the drill rod. The drilling cable consists of strips of bamboo about 1¼ in. wide by ⅜ in. thick and 15 ft. long ingeniously fastened together by small iron rings and wedges. The bamboo cable does not connect directly to the bow string but the extra cable is wound on the reel, a rope from the center of the bow string being fastened to the cable just above the top of the well with an adjustable connection which allows the lengthening of the cable as the well deepens.

Raising the drill rods from the well, or baling out is accomplished by winding up the line on the reel shown, the power being supplied by men walking inside the reel in squirrel-cage or treadmill fashion.

At the time the above photograph was taken a well with a 3-in. pipe casing was being driven at a depth of 80 ft., although depths of 200 ft. are said to be common. The drill rod and baler were similar to those in common use in America.

## Repair of Concrete Pavement With Gunite Unsuccessful

A PAVED street in Aberdeen, Wash., in which grooves were made by heavy traffic before the concrete was allowed to harden properly, according to the contractor's claims, were recently repaired with gunite. A 30-day period was allowed for hardening the gunite and then the street was again opened to traffic. After a short period of service the gunite began to peel off and soon its condition was no better than before the repair was attempted. Some of the conditions involved that might be useful in comparing this experience with similar work contemplated elsewhere are given in the following:

The original pavement was made with a 1:2:3 mix; is 8 in. thick and 10 ft. wide on the south side of a street-car track. The 30 days allowed for hardening was claimed to be insufficient on the ground that during the time of pouring and curing the daily temperatures approximated the freezing point and the nights were below freezing point.

When the pavement was thrown open to traffic, auto trucks, being obliged to travel in practically the same tracks, because of the operation of street-cars, soon wore off the surface in two longitudinal strips, 10 to 12 in. wide under each wheel track. These grooves ranged up to about 1 in. in depth. This wear developed within a week after the pavement was opened and then city officials closed the street and notified the contractor that the pavement was considered defective and his final payment would be withheld. Decision was then made to attempt making repairs with gunite.

The grooves in the old concrete were thoroughly cleaned out with wire brushes and the gunite was shot on in thicknesses ranging from a feather edge to 1 in. where the raveling was deepest. The gunite was cured in the same manner as the original concrete, being kept wet for the first ten days and then air-cured for twenty days more; this curing, however, being under favorable weather conditions. The repair work cost more than $1,500, it is stated, and it is said to be a complete failure. Since the pavement was opened to traffic for the second time six months ago, there has been no further raveling or breaking up of the original paved surface.

The 10-ft. strip on the north side of the street, built in the light of experience with the south half, was kept closed to traffic and allowed to cure for 90 days. After six months of traffic the north side of the street is said to be still in excellent condition, showing no signs of wear whatever.

# Underground Water Storage on The Santa Ana Cone

## Flood Spreading Since 1911 on Southern California Stream Proves Success As Conservation Measure

By Hyde Forbes
San Francisco, Cal.

In SEMI-ARID SECTIONS where stream flow is torrential in character, nature provides better and far more extensive reservoirs, in the form of debris filled valleys, than could possibly be obtained by developing artificial reservoirs in the mountains. The utilization of these natural reservoirs has become a large factor in the development of semi-arid regions and western engineers are more and more frequently being faced with problems as to their extent, duration of the supply and the sources of their replenishment. In the following some notes are given on underground storage in Southern California in general, and in particular on the results of studies made on the debris cone of the Santa Ana River.

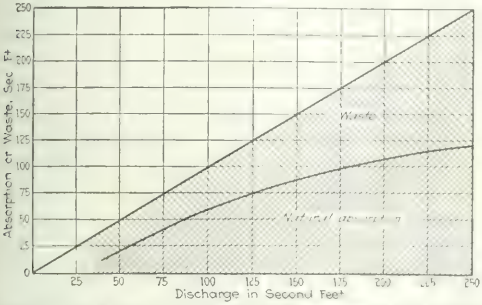



FIG. 1. RELATION OF NATURAL ABSORPTION TO TOTAL FLOW, SANTA ANA RIVER

*Subterranean Storage Conditions*—Southern California depends to a large extent upon underground sources for its water supply and there has been marked development of these in recent years. Not only are underground storage basins becoming a source of water for domestic and municipal water supplies, but large areas are being irrigated with water pumped from underground reservoirs onto arid bench lands and valleys.

Alluvial valleys or debris cones are built up by a ramification of lenzes of stream-deposited material which varies from fine clay to coarse gravel and boulders. The void spaces in these deposits act as a storage reservoir for percolating water. The greater the volume of void spaces that may be filled with water, the more extensive the reservoir will become. Moreover, the frictional resistance of the material is such as to retard the movement of the water, thereby materially affecting the time over which it is available.

*Water Diverted on Santa Ana Cone*—The Tri-counties Conservation Association has accomplished a material increase of capacity of one of these natural reservoirs on the Santa Ana debris cone in San Bernardino County, Cal. In general the method used is that of diverting the winter flow from the river channel into numerous streams and also impounding portions in ponds, thereby increasing the wetted area

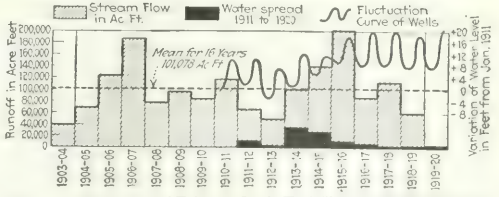



FIG. 2. RELATION OF NATURAL FLOW, DIVERSIONS AND UNDERGROUND WATER LEVELS

Note how effectively methods applied on the Santa Ana cone utilized underground storage during dry years.

and decreasing the velocity. Although this work was undertaken as early as 1911, it is only recently, after a considerable period of time and a series of dry years, that it might be determined just what effect the artificial spreading had on the supply and whether that spreading resulted in actual conservation of water for use during periods of low replenishment.

During the early spring months of 1915 the writer made a detailed study of the effect of this spreading. The work consisted mainly in measurements of stream flow from which was determined the relation between the total flow of the surface stream below a stage of 250 sec.-ft. and the natural seepage loss throughout the entire length of the river channel across the debris cone. This relation is shown in Fig. 1. From these data it was possible to determine the percolation loss which would have taken place naturally had not the diversions been made, and to compute, from the diversion records, the amount of water actually added, (net conservation) to the storage reservoir during the period considered. The actual figures are as follows:

TOTAL FLOW OVER CONSERVATION WEIRS, SEASON OF 1915, IN ACRE-FEET

| | Jan. | Feb. | Mar. | April | May | Total |
|---|---|---|---|---|---|---|
| Upper Weir | 788 91 | 1,370 14 | 2,117 66 | 2,355 80 | 2,469 71 | |
| Middle Weir | 317 17 | 2,115 86 | 2,871 38 | 1,304 81 | 3,034 0 | |
| Lower Weir | 433 60 | 1,459 14 | 2,386 14 | 642 60 | 3,049 5 | |
| Total | 1,539 68 | 4,945 14 | 7,975 18 | 4,303 21 | 8,553 21 | 27,316.4 |

The net conservation for the year 1915 therefore, based on the ratio determined for March, April and May, was approximately 13,000 acre-feet. Upon the same basis, about 20,000 acre-feet of water were conserved in 1914. The year 1916 was one of high runoff with several flood periods. It was impossible during that year to control the stream and diversions were not as extensive as the two preceding years. However, the natural seepage losses were much greater than those that had occurred for several years prior to 1916.

In conjunction with the river measurements, the writer selected a number of wells covering the affected area and made continuous water level measurements. A test pit in the midst of the spreading area registered a rise of over 50 ft. during that part of the spreading season from Feb. 20 to May 31 and fluctuated with the commencement and cessation of spreading operations. Similar rises were measured throughout the Santa Ana Cone but varying in extent according to location. These well measurements have been continued until the present time.

*Results of the Studies*—The interesting feature of this work is its affect during a series of dry years.

This is readily shown in Fig. 2 which indicates through the year 1920, the relation between the stream flow of the Santa Ana River plus Mill Creek at the mouths of their canyons, together with that portion of the winter flow diverted and spread, and the variation in the level of the underground water throughout the Santa Ana Cone. The fluctuation curve of the wells is the average seasonal fluctuation of thirteen representative wells covering the area, with the low point of the seasonal fluctuation at the end of 1910 assumed to be zero in each well. The average accumulative rise over the six-year period, to the end of 1916, was ± 8 ft.

### Increased Storage Capacity

The average normal grade of the water-table prior to 1911 beneath the Santa Ana debris cone was about 20 ft. to the mile. After the spreading operations had been carried on, the grade increased to an average of 50 ft. to the mile in 1915. As the water-table rises and falls during the season with a fixed point of slight seasonal variation in the artesian area (due to escape of ground-water through surface drainage in the Santa Ana River channel and Warm Creek together with escape from artesian wells during the irrigation season) and a seasonal variation of about 75 ft. measured in the center of the spreading area, the additional area of void spaces filled with water probably averages about 75 ft. high. Furthermore, the building up of the water-table from the stream channel under natural conditions would be somewhat limited to that area beneath and adjacent to the stream channel. The conservation ditches carry the water over a greater area, thus building up a water-table of nearly uniform height across the entire debris cone. In this manner considerable additional storage capacity was made available.

After the water-table had been built up to the 1915 level it has been maintained with the lesser amounts of water spread since 1915 through a series of four dry years. This is effected through the frictional resistance offered by the impounding material against the movement of the underground water. Pressures are released when the deeper artesian wells are uncapped and pumping operations are commenced in the shallower wells in March or April. The result is a lowering of the water-table, greater in extent at the apex of the cone. In the fall of the year the artesian wells are capped, pumping operations are discontinued and the water-table is again built up through natural seepage and consedvation processes.

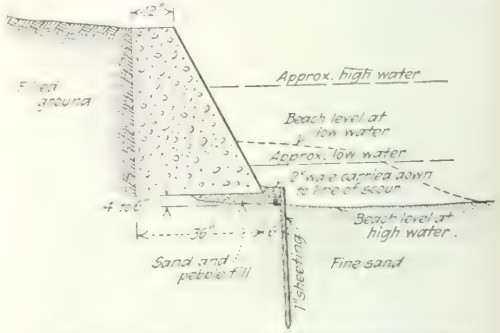
During the past few dry years the extractions from the basin for irrigation purposes exceeded those of years of normal or excessive rainfall yet the water table showed no marked lowering. In other words, the work of the Tri-Counties Conservation Association has shown that water may be stored during periods when it is not needed, for extraction during periods when it is extremely valuable. What has been done on the Santa Ana Cone can be duplicated on many such cones throughout California, in the writer's opinion, and no alarm need be felt by users of underground water because of the lowering of the water-table during the recent series of dry years. The extracted waters can be readily replaced and supplemented with additional supplies by use of proper methods of spreading of the unused winter flow.

## Preventing the Undermining of a Small Sea Wall

By Leo G. Hall
Onekama, Michigan

There are on the rivers and lakes of this country a great many small masonry or concrete walls built to protect the banks from erosion. It frequently happens that shifting sands and currents threaten to undermine these walls. Two common methods of protecting such walls from undermining are piling brush or boulders on the bed in front of the wall. A third cheap and effective method which the writer has used and is using to protect a wall along the waterfront of his home on a lake in the sand country of Northern Michigan, where rock is scarce, is illustrated in the accompanying drawing.

The lake waters vary about 3 ft. in height through a cycle of about seven years. When the water is low, the waves beating against the shore build up the beach




SECTION OF WALL AND SHEETING PROTECTION

in front of the wall. But when it is high, the undertow from the waves scours out this beach, and tends to undermine the wall.

By driving a row of sheet piling in front of the wall, the sand is prevented from washing out from underneath it. Even though of light construction the sheet piling, when driven about to the level of the base of the wall, is not liable to be damaged by the ice. The sand which it holds in place, in turn protects it. It is far enough from the toe of the wall so that the line of pressures from the weight of the wall does not act against it, even when the sand outside the sheeting is scoured to its full depth. Also the 2-in. wale which serves as a guide in driving and which is of sufficient depth to reach the line of scour, prevents the fine sand from filtering through the sheeting. The small space inside the piling and under the wall is then filled with sand and pebbles.

During low water the whole construction is covered under a foot or more of sand, and cannot be damaged. The writer was of course helped in this case by an exact knowledge of the depth of scour as observed over a period of many years. In most cases heavier sheeting would be required. But after all, the greatest skill in engineering lies in doing things as economically as possible, and in this case and others, 1-in. sheeting has been found sufficiently heavy.

The cost of this protection runs about 18 cents per lineal foot.

# Accounting Records for Consulting Engineers

## Arguments for Keeping Books with Segregated Costs—Details of a Loose-Leaf System—Forms for Expense Vouchers and Time Distribution

By Arthur L. Mullergren
Benham & Mullergren, Consulting Engineers, Kansas City, Mo.

FEW consulting and practicing engineers attempt to keep a set of books and accounting records of their operations. The profits and losses derived from their business are usually determined by the bank balance at the end of the year. It makes little difference whether the expenditures were made for furniture, fixtures, tools, instruments, supplies, personal items, development of business or actual operation—all are treated alike. This lack of system may be due largely to the assumption on their part that the practice of engineering is similar to the practice of medicine or law and that cost accounting and records of operation are neither necessary nor desirable. Another argument advanced against such a so-called "refinement" is that the fees are fixed by precedent and the national societies, and therefore, records of the cost of operation are unimportant and useless.

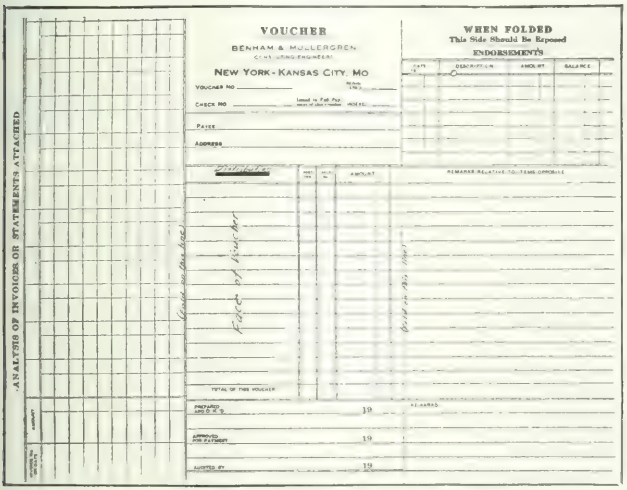



FIG. 1. VOUCHER FORM FOR ACCURATE EXPENSE DISTRIBUTION AND HISTORY OF TRANSACTION

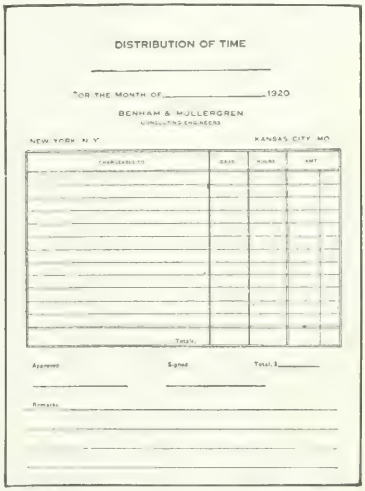



FIG. 2. DISTRIBUTION OF TIME TURNED IN ONCE A MONTH

As a matter of fact, if the engineers knew the exact cost of performing certain services it is very probable that more concerted action might be obtained toward the securing of adequate and proper fees. Generally speaking, present-day fees and charges were established years ago when the services rendered for these fees were limited. It should be borne in mind that with the advancement of the science present-day practice calls for greater skill and specialization, thus making for higher costs of rendering the proper service. The engineer of today cannot conduct his business in the same manner as the engineer of years ago. Today the engineer having a practice of any consequence must maintain an organization of specialists while a few years ago a few draftsmen constituted the organization.

Engineering is a business as well as a profession and engineers should recognize this fact. Today there is keen competition among the engineers and business methods must be employed. This does not mean that the standing of the profession is likely to be or is being lowered, as proper business methods can be successfully employed that are in keeping with the dignity of the profession. Although the average engineer understands very little of accounting practices and methods, it is very important for consulting and practicing engineers to have a general knowledge of accounting. They are called upon frequently to determine the feasibility of a great many proposed projects from an economic standpoint. The economic feasibility is largely determined from the yearly fixed charges and operating costs and this necessarily calls for an understanding of accounting principles and methods. In appraisal and evaluation work accounting and engineering go hand in hand. In rate cases and in preparing reports on utilities and industrial properties a knowledge of accounting is very essential.

This general lack of knowledge of accounting is probably one of the principal reasons why the engineer has not taken the trouble to maintain a system of accounts for his own business. Proper records and accounting methods are very essential to any undertaking or business. These are necessary to an engineering business conducted by a partnership or a corporation for determining the true net profits of the business, for apportioning the assets and liabilities in the case of a dissolution or the withdrawal of a member and in determining the costs of service. The individual engineer needs a system for determining his true profits and the costs of performing the different classes of service.

The proper system to be used and the degree of refinement to which it is to be carried out depends largely on the kind and size of organization, and volume and class of work handled. The larger the organization or volume of business the more elaborate should be the detail of accounts. The object is to provide a workable system neither burdensome nor expensive to maintain, but one that is in keeping with the business in hand and so established that it can be expanded as the organization and business grow. The fundamental system should, therefore, be established with care. A certified or public accountant should be consulted at the very start. He should be fully advised as to the character and extent of the business conducted at the time and the prospects for increase, with the possible extent of same and the ultimate scope of the business. This information will enable the accountant to open a system to fit present needs and one that can be expanded as the business warrants. It should be borne in mind that the scope of the engineer's activities broadens with time and the increase of the organization, so that the present activities are not altogether indicative of the future scope and possibilities.

### Loose Leaf System

The loose-leaf system of records is the most adaptable for an expanding business and offers a further advantage of combining various records under one cover when only a small volume of business is handled. The basic records necessary for an engineering business accounting system would consist of cash book, check record, journal, voucher record, general ledger and project record.

For an average engineering business all of the above records can be combined under one cover if loose-leaf record sheets are used. In addition to the above records, monthly record sheets of bank statements and monthly trial balance can be included in the one cover. If the business expands so that a very large volume of work is handled and more detailed accounting becomes necessary, the various records can easily be separated.

*Vouchers.*—The use of vouchers for all invoices or accounts payable is highly recommended. The voucher system enables the making and keeping of an accurate distribution of all expenses and keeps a permanent record of the transaction as well as the original invoice. For the average engineer or engineering organization the voucher check or voucher receipt is not recommended. The voucher should be an office record and the notation on the voucher of the check number by which the account was paid gives sufficient evidence of payment of the invoice without having the payee's signature on the voucher proper. Furthermore, the invoice marked "paid" can be attached to the voucher. The voucher recommended should be made of thin, tough cardboard so as to be folded easily and not be too bulky when the invoices are attached.

Fig. 1 shows the form of a voucher that will fulfill the requirements of the average engineer as well as a very large organization. This voucher folded measures 4¼ x 9 in. The original invoices are attached to the voucher. The distribution of the charges, the payee, voucher number, number of check by which paid and total amount of voucher are listed on the face, so that full information of the transaction is readily obtainable. In the event any partial payments are made on account from time to time or credits given, a space is provided for indicating them, as shown in the column marked "endorsements." This column provides space for listing the check number of item of credit and a balance column to show the unpaid balance of the voucher. Further space on the voucher is provided for making detailed analyses of the charges to the various accounts. The vouchers are registered by payee's name, voucher number and amount in the voucher record in numerical order and each month's entries are separated. The vouchers are numbered consecutively for an entire year or longer, as desired. The vouchers are also indexed alphabetically by means of a small card index system. A separate card is used for each payee and the same card can be used for a number of vouchers having the same payee. On the card are listed the voucher number and the month issued. This enables the ready location of the voucher for reference purposes. At the end of each month the total of the vouchers issued during the month is credited to accounts payable in the general ledger so that detailed entries are unnecessary in the ledger. All vouchers should be filed in numerical order and separated as to paid and unpaid vouchers. This method will enable the ready reference to all unpaid accounts.

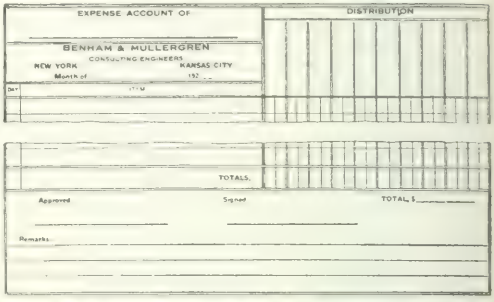



FIG. 3. MONTHLY EXPENSE ACCOUNT WITH DISTRIBUTION ACCORDING TO PROJECTS

The journal is the same size as that used in any system and needs no further explanation. The cash record is merely a cash book showing the cash received, the date, whether the money was paid on accounts receivable or was a cash transaction, and daily charges to the bank. The check record is used to record all checks issued. Columns should be provided for date, check number, payee, account number to which charged, accounts payable and miscellaneous. The total of the charges to accounts payable at the end of each month is taken from the accounts payable column and charged to accounts payable in the general ledger. The general ledger accounts should be opened to suit the business in hand. For the average engineering business the asset accounts would consist of (1) accounts receivable, (2) notes receivable, (3) bank statement, (4) petty cash, (5) furniture and fixtures, (6) tools and instruments, (7) library and (8) investments. The liabilities accounts would consist of (9) accounts payable, (10) accounts payable employees and (11) notes payable. The remaining accounts would be (12) capital stock or present worth, (13) surplus, (14) income and (15) expenses.

The income should be divided into two accounts, fees and miscellaneous. The fees account would represent all income received from clients for professional services. The miscellaneous account is used to handle the

income received from deposits on plans and specifications, sales of supplies and any other income derived from other than professional service.

The proper division of the expenses will depend largely on the class and volume of business handled, but the following classification of expense accounts will probably serve for a general engineering practice: (1) project expenses; (2) general expense; (3) office expense; (4) printing, stationery, supplies and postage; (5) office rent; (6) telephone and telegraph; (7) taxes and insurance; (8) legal expenses; (9) organization dues and periodicals; (10) interest paid; (11) development and advertising; (12) general salaries.

### Project Expenses

Project expenses would include all expenses directly chargeable to the various projects such as resident engineers' salaries, traveling and hotel expenses going to and from the project, blue printing, supplies and the time of office principals and assistants actually engaged on the particular work. The project expense would, therefore, represent the total direct charges to all of the projects handled during the period. The charges to each project are kept separately, as will be shown later. The other detailed accounts are more or less self-explanatory and represent general costs not chargeable to any one particular project and are termed overhead expenses. The development and advertising accounts represent expenses incurred in attempting to secure new work and for professional cards and other advertising. It frequently happens that several months may elapse between the time of the first expenditure made in attempting to secure an engineering contract and the date of its signing. The expenses incurred from time to time should be charged to this development account until the project is secured. Then all such charges to this particular project should be transferred to project expense, thus making each project show its actual total cost. Therefore, when the books are closed, the development and advertising accounts represent expenses incurred only for advertising purposes and unsecured contracts. This account corresponds to the average mercantile concern's advertising and new business expense.

*Project Record*—All accounts should be given a number for the purpose of making proper reference entries. There should also be included in the records a distribution sheet for each project. This enables the posting of charges to each project directly from the voucher at the end of each month. The sum of the monthly entries to the various projects is then entered in the expense sheet headed "project expense." This distribution sheet for each project shows the total direct expenditures made for each particular project, so that the total cost of the job at any time is easily ascertained.

### Cost Distribution

There should also be kept an additional record of the projects in a separate loose-leaf book. This project record will show the total charges to the particular project at the end of each month as taken from the distribution sheets in the large record and carried forward accumulatively. The overhead expenses as designated above are apportioned to the various active projects in accordance with their size and importance and charged to the respective projects in this project record. Credits to each project are also to be shown in this record, consisting of the payments made by the client. The balance column will indicate the profit or loss on the particular project at any time.

In addition to the above set of records, there should be a small loose-leaf accounts receivable ledger listing each client separately, which would represent the total contract fee, the payments made from time to time and the balance due. The total of the balances in this accounts receivable ledger should correspond to the amounts shown in the accounts receivable sheet of the general ledger.

*Time Segregation*—In order accurately to make the proper charges to the various projects and to keep an accurate record of the various expenses, it is necessary that the principals as well as assistants keep a daily record of their time and any expenditures made for the operation of the business. The time of everyone connected with the organization should be made out so as to show the time devoted to each particular project, general office matters, new business, etc. The form similar to Fig. 2 has been found satisfactory for this purpose. This sheet is turned in to the bookkeeper at the end of every month. It gives complete information of the time and amount chargeable to each project or other account. An expense account sheet similar to Fig. 3 should also be turned in monthly by everyone making any expenditures for the business and the expenses should be detailed and separated as to the various projects or other accounts. Both the expense account and distribution of time sheets for each individual are attached to one voucher and the charges to the various projects or accounts summarized and listed on the face of the voucher.

The above is a general outline of a system of records that has been in use by our office for a number of years and has been found entirely satisfactory. As previously mentioned, it is recommended that a competent certified accountant be consulted for the establishment of any set of records or accounts, as no one particular system would apply to all classes of business. It will be found that a proper system of accounts becomes indispensable after using one for several months, and the desire of this paper is to set forth the advantages of a proper system of accounts and records for consulting and practicing engineers.

---

## British Railways Combined in Four Groups Is Government Proposal

Consolidation of the entire railway system of England and Scotland into four large groups instead of six as originally proposed (see *Engineering News-Record*, Feb. 24, p. 341) is provided by the government bill now before Parliament. These groups, all radiating from London, are to be approximately as follows: (1) Eastern group, 6,670 miles, north of London and east of a line drawn a little west of north; (2) Midland and Northwestern group, 6,680 miles, between the above line and another drawn northwest from London to Liverpool; (3) Great Western group, 3,420 miles, between this last line and a line drawn southwest from London to Plymouth; (4) Southern group, 2,130 miles, south of the Thames and of a line drawn eastward from London. All the groups interlock and overlap more or less. The mileages given, totaling 18,900 miles, are those of the several large companies only and do not include the numerous small lines which will be absorbed into the groups.

# Large Roofs Suspended by Cables To Avoid Columns

## French Engineers Have Applied This Novel Design to Airship Sheds, Giving Unobstructed Full Length Side Openings

SUSPENDED roofs for structures in which it is desirable to reduce the number of supporting columns to a minimum is an important innovation in structural engineering which was developed in France during the World War and has been applied to a number of structures. This type of construction is adapted for large shop buildings, for airplane and hydroplane sheds or hangars, and especially for the very large sheds required to house modern dirigible airships. The suspension system consists of a pair of trusses in which the chords

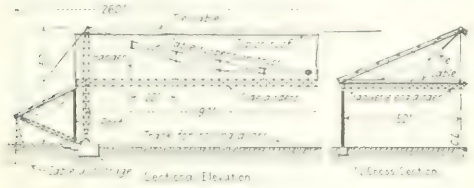


FIG. 1. SUSPENDED ROOF FOR HYDROPLANE SHED AT CHERBOURG, FRANCE

are wire cables, separated by vertical struts and having diagonal members in the panel thus formed. Hangers at panel points are attached to the longitudinal girders of the roof framing, the trusses being placed over the side of the roof. The use of suspension cables to carry the trusses of long-span signal bridges on the French State Railways was noted in *Engineering News* of Aug. 12, 1915, p. 293.

This novel method of roof support is described in *Le Genie Civil*, of Paris, from which the following information has been taken.

In the first place, the suspension system is not entirely new. It was proposed in 1833 for a shop at the arsenal of Lorient, France, by Mr. Laurent, an engineer of the French navy department. This roof, built in 1837 and said to be still in existence, has a length of 143 ft. between supports, with a width of 71 ft. and a headroom of 8 ft. Parabolic suspension trusses were built of eyebars. As the roof is low and heavy and situated in the interior part of the arsenal, it was not subject to serious unsymmetrical loads, for which trusses of this kind are not well adapted. It is now recognized, however, that snow and wind loads are not applied uniformly over large roof areas and that provision must be made for upward wind pressures, especially in structures near the coast. It is recommended that the roofing should weigh not less than 8 lb. per square foot and should be well secured to the purlins.

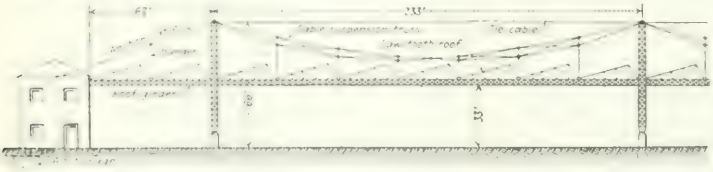


FIG. 2. LONG SUSPENDED ROOF OF SHED AND REPAIR SHOP FOR AIRSHIPS AT BIZERTA, TUNIS

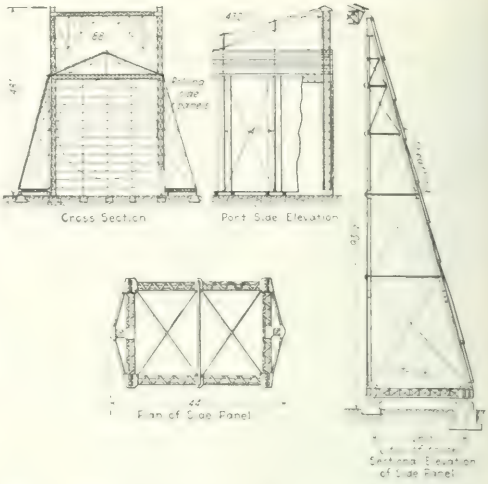



FIG. 3. SHED FOR DIRIGIBLES, WITH SUSPENDED ROOF AND ROLLING SIDE PANELS

Anchorages of a novel type are employed for the suspension trusses of a hydroplane shed at Cherbourg, Fig. 1, owing to the small amount of space available. This shed, which was being erected at Havre at the time of the armistice, has four tall end columns carrying trusses of 197 ft. span. The columns are mounted on pin bearings, and to resist the pull of the cables they are guyed to inclined anchor booms seated against the masonry pedestals of the towers, as shown. In this way the total length of anchorages for a 197-ft. span is only 260 ft. Transversely the towers are spaced 105 ft. c. to c. Two cables are used for each chord of the suspension truss. Rolling doors or panels 16½ x 26¼ ft. can be run one behind the other so as to give an opening 100 ft. long at any part of the side of the building. Two other sheds of this type, but with roofs 394 x 210 ft., have been built at the Cherbourg arsenal.

A combined hangar and repair shed having three suspended roof spans of 233 ft. and a total length of 833 ft. (including end sections suspended from the anchor cables) was under construction at the Bizerta arsenal, in Tunis, at the time of the armistice. In this large shed, Fig. 2, the roof was 132 ft. wide and 33 ft. above the ground. Upon its longitudinal girders was carried a saw-tooth roof covering, and the framing included girders designed to carry traveling trolleys for hoisting and handling heavy loads.

To facilitate the delicate operation of getting large dirigible airships into and out of their sheds during high winds, Captain Cazenave and Inspector-General Minard, of the French aeronautical service, in 1917 undertook to design a shed in which the rolling side doors could give an opening the full length of the shed and could also be used as a protection or wind shield in any direction. This shed, which also was

under construction at the time of the armistice, is shown in Fig. 3. It has a roof 432 x 82 ft. and 92 ft. above the ground, suspended from cable trusses attached to end bents 148 ft. high. The sides consist of panels 93½ ft. high and 36 ft. long, with triangular frames

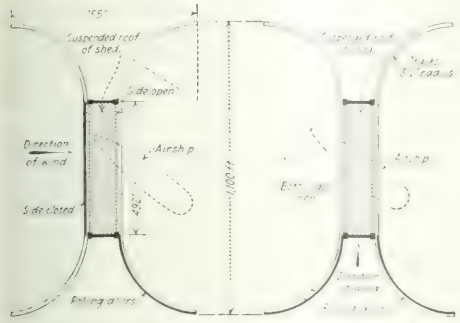



FIG. 4. ROLLING SIDES OF AIRSHIP SHED FORM WIND SHIELDS

mounted on platforms 36 x 22 ft., the sheathing being on the outer or inclined side of the frames.

Each platform is carried by trucks on a pair of tracks parallel with the shed and extending beyond it on curves of 308-ft. radius. In this way any part or the entire length of the side can be opened, free of any obstruction, to allow the airship to enter at any angle. Further, the doors can be so placed on the diverging tracks as to protect the movements of the airships from wind blowing in any direction, as shown by Fig. 4. The door panels or sections are operated by cables and electric hoists.

## Equipment and Materials Being Assembled For Lining Hetch Hetchy Tunnels

Work is to start at once on the installation and operation of equipment for crushing muck from the Hetch Hetchy tunnels, which are being constructed on the San Francisco water supply project, to be used later in the concrete lining. The Construction Company of North America, general contractors on the tunnel work, have awarded a subcontract to the Universal Concrete Gun Co. for lining the 9 miles of tunnel between Priest and South Fork. The actual lining operations will not be begun until the tunnel is holed through, about Christmas of 1922, but meantime equipment and materials are to be assembled, particularly stock piles of crushed rock. Priest, Big Creek and Second Garrote are the three points from which lining operations will be carried on when lining operations start and where material storage piles are to be made meantime. The lining operations on this 9-mile stretch are expected to occupy five months after the tunnel is holed through. Specifications call for a minimum thickness of 6 in. of 1:2:4 concrete without reinforcement. The contract price was $14 per cubic yard, this figure to cover all costs including royalty on the Web and Cox concrete-placing machine which is to be used throughout. This machine, which moves the concrete by means of a piston operated by compressed air, is a California development of recent years which was described in *Engineering News-Record*, July 7, 1921, p. 14.

# Concrete Block Track Supports on Italian Railways

### Fixed and Rocking Blocks Placed Longitudinally Have Rail Seats at Each End—Rockers Insure Vertical Loading

LONGITUDINAL but non-continuous concrete supports for rails, with provision for transmitting a vertical load to the foundation under any position of the wheels, are the features of two types of railway track which has been in experimental service on steam and electric lines in Italy for a few years.

In the design for secondary lines and street railways, Fig. 1, flat blocks 40 x 20 in. on the base and 32 x 12 in. on top, with a thickness of 8.8 in., are spaced about 12 in. apart between their ends. Transverse tie rods have vertical ends grouted into holes in the blocks. A rail seat at each end of the block consists of a wood cushion resting on a base plate and carrying a tie-plate for the rail, the base plate being anchored to the concrete. Lugs or stops prevent lateral movement of the cushion. This arrangement and a simpler design for branch and secondary lines are shown in Fig. 1. In both cases the rail is held by bolts which are screwed down into nuts fitted to sockets in the concrete.

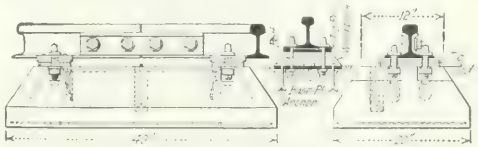


FIG. 1. LONGITUDINAL CONCRETE BLOCKS SUPPORT RAILS

As the blocks weigh about 400 lb. and give a weight of 1,000 lb. per yard of completed track, it is claimed that their vertical motion under traffic is negligible so that they cause no pumping of the ballast. Further, it is stated that some railways have decided to introduce these blocks first under rail joints. The cost of this construction is given as less than half that of ordinary track with wood ties and screened gravel ballast.

In the flexible or rocking design intended for heavy main line track, Fig. 2, the rail supporting blocks are about 29 x 9.6 in. with a depth varying from 7 in. at the ends to 14 in. at the middle. A steel plate bent to form a rocker is anchored to the apex of the block, and is seated on a steel channel embedded in the recessed face of a fixed foundation block 28 x 32 in. on the base and 8 in. thick. In this way, the latter block receives only a vertical load. Hook bolts secure the rocker to the foundation block. Longitudinal connection between the rockers is provided by flat bars hooked to the exposed ends of reinforcing bars and attached also to the rails, as shown. Transverse tie bars are secured to the rails instead of to the concrete blocks. Rail seats and fastenings are similar to those for the rigid track design. The upper and lower blocks weigh 264 and 400 lb. respectively, the weight per yard of completed track being about 2,400 lb., including the earth covering which is filled up to the rail base.

This flexible type of track is said to have been in use for 328 ft. on the Asti-Altavilla line since 1916, although that construction differs somewhat from the improved design shown in Fig. 2. It is stated that the rocking movement is so slight that no friction need be

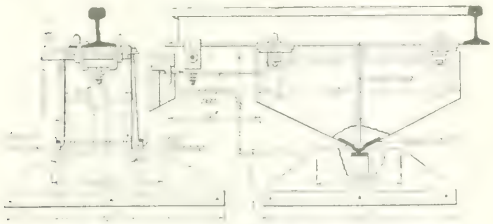


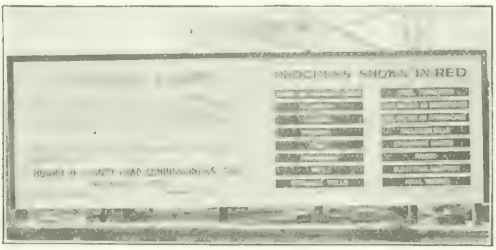
FIG. 2. ROCKING TRACK BLOCKS TRANSMIT VERTICAL LOAD

feared, the support being practically a knife edge. In fact, allowing for rust and dirt, since the blocks are buried, it may be doubted whether the rocking would occur in old track. Adjustment of surface in maintenance work is effected by shims or wedges under the rails.

These two track designs are the invention of O. Valeri, civil and electrical engineer, Rome, Italy, who has obtained United States patents.

## Bulletin Board Posts Public on Progress of Work

A BULLETIN board progress chart is employed by the County Road Commissioners to keep the public informed of the construction progress on all large operations in Wayne County, Michigan. One of the "progress charts" erected at a new county bridge is shown




BULLETIN BOARD KEEPS PUBLIC INFORMED OF CONSTRUCTION PROGRESS

by the accompanying view. It is kept filled in with the necessary red paint ribbons showing progress, and stands where it may be seen by all who travel the detour around the bridge. These charts are considered by the Highway Commissioners to be a service which the public has a right to ask. They have been found to help also with the people in getting favorable consideration of improvements planned by the commissioners.

### Tar Paper Over Subgrade

With the idea of reducing the cracking of concrete pavement on a clay subgrade, ½ mile of 18-ft. subgrade in Wayne County, Michigan, has been covered with ordinary tar-paper roofing laid with lap joints and carefully preserved from being broken through in placing the concrete. It is believed that the watertight diaphragm will keep moisture from the underside of the slab and may thus be a help in preventing cracks.

## Railway Work in Queensland

LINKING up isolated lines of railway into a connected system and revising grades and curves to conform to present traffic conditions are railway developments now in progress in Queensland, Australia. The original policy was to divide the state into four districts and to develop each by a line running inland from its main port. Thus there were lines extending approximately westward from Brisbane, Rockhampton and Townsville and southwest from Cairns. Each had branches to open up the country, but for several years they formed four disconnected systems. Later, a coast line was built from Brisbane north to Rockhampton, and this has been extended at various points so that eventually it will connect all the ports, but this work was delayed by the World War. A diagonal line connecting the western ends of the principal main lines has been authorized, extending from Tobermory northwest to Camooweal, about 650 mi., but work on it has not begun.

The Queensland Government Railway system comprises 5,655 miles, with 6,000 miles of track and 700 miles of sidetrack, besides which there are 133 miles of private railways, the entire system being of 3½-ft. gage. Many of the pioneer lines were of light construction, with 41½-lb. rails and engine loads limited to 8 tons per axle. For renewals, 60-lb. and 75-lb. rails are being used, the latter for the main lines entering the capital city of Brisbane. With the heavier rails, 12-ton axle loads were permitted, which necessitated strengthening the bridges, but all new bridge work is designed for engines of the 4:8:2 class with 15-ton axle loads.

As steep grades and 330-ft. curves were used freely in original construction, extensive revision work is being carried out to adapt the lines to present traffic conditions. On the new coast line the maximum grade is 1.33 per cent with a minimum curve radius of 792 ft and transitions for all curves up to 1,320 ft. radius. By considering momentum as a factor in the rearrangement of grades the cost of this revision work has been reduced materially. Grading is done partly by elevating graders hauled by tractors. In October, 1920, about 1,625 men and 113 teams were employed in grading, mainly on extensions of the coast line.

Electrification of the Brisbane suburban lines has been considered, but the traffic conditions are not likely to warrant the change for some years. New locomotive and car shops are being built two miles from Brisbane the old site in the city being utilized for a large freight terminal. The Central Station, for passenger service is also to be improved and a new building erected for the offices of the Railway Commissioner and his staff. R. E. Sexton is chief engineer for railways.

### Building Activity in New York Cities

According to figures compiled by the New York State Department of Labor, building authorizations in July for the principal cities in the state show a new high record for this year. The estimated value of building work for which permits were issued in July in the first and second-class cities of the state was $52,332,357. This amount is 21 per cent greater than that reported in June and slightly exceeds the previous record for this year established in May. Compared with the same month of last year, the value of authorized building work in July shows a gain of 113 per cent.

## Precautions in Handling Liquid Chlorine

HAZARDS in the handling and storage of liquid chlorine together with methods of overcoming them were described in a paper presented recently to the National Safety Council Congress in Boston by D. K. Bartlett, vice president, Electro-Bleaching Gas Co. Chlorine shipments are regulated by The Interstate Commerce Commission rules and no accidents have occurred since the regulations have been put into effect. In addition to its use for water sterilization chlorine is used in the textile, flour, chemical and pulp-and-paper industries. It is stored at 4,000 to 5,000 different points in quantities up to many thousand pounds. No storage regulations are in force other than those recommended by the producer. Mr. Bartlett comments on the hazards and precautions as follows:

As long as any compressed gas remains in the container it is obvious that it can do no harm, irrespective of its effect when released. It is therefore necessary to consider the probability of escape of gas from the container, as well as the qualities of the gas itself. An escape of gas from a container may be due to (*A*) a true explosion, (*B*) an increase of pressure due to heat, sufficient to rupture the container and (*C*) leaks. If the gas escapes from the container, the resulting hazard may be due to (1) inflammability; (2) poisonous effects; (3) irritating effects, with interference with sight or respiration.

Considering now the specific case of chlorine, we can eliminate (*A*) since it is non-explosive. The chance of a rupture due to (*B*) is very slight on account of the high critical temperature of chlorine, 146 deg. Fahrenheit.

By Interstate Commerce regulation all cylinders and ton drums are provided with fusible plugs melting at 158 deg. *F.*, at which temperature the pressure is about half the test pressure of ton drums at the time of manufacture and a quarter of the test pressure of the smaller cylinders. There has never been an instance of the bursting of a container in transit, or in a user's plant. Four or five cases of rupture of containers have occurred in the manufacturers' plant due to the presence of foreign material in the container which reacted with the chlorine. To guard against a repetition of such accidents, all manufacturers now have in force a rigid system of inspection of empty containers. Even should a container with such foreign material be filled, any trouble resulting will necessarily develop within a few hours, so that any hazard existing from this cause concerns only the manufacturer—not the user or the carrier.

### 'IRES AND LEAKS

A few fires have been caused where a large quantity of chlorine has been stored. In each case the upward draft due to the heat of conflagration has been strong enough to carry the gas upward and cause such a dilution that the fire fighters were caused no inconvenience in their work.

This brings us to leaks. Here the evil smell of chlorine is its own greatest safety factor. Its presence in the atmosphere can be detected in very minute quantities through the sense of smell. After the person in charge of the use of the chlorine in any plant has had his first considerable whiff, he is quite ready—from then on—to exercise reasonable care, take necessary precautions and follow the instructions laid down by the manufacturer.

The next factor is the slow absorption of the heat necessary to evaporate the liquid into a gas. The following table gives the rise of temperature of the liquid chlorine in a tank car during a period of 96 hours:

| Time | Temp. Content, Deg. C | Change During Period, Deg. C | Pressure, Lbs. | Change During Period, Lb. |
|---|---|---|---|---|
| Start | + 9 | | 64 | |
| End 24 hr. | + 2 | 7 | 26 | 12 |
| End 48 hr. | − 3.5 | 5.5 | 8.8 | 12 |
| End 74 hr. | + 0.6 | 2.5 | 4.3 | 5 |
| End 96 hr. | +8.5 | 2.5 | 48 | 5 |

When the odor of chlorine is noticed the source should immediately be located. Never hunt a leak through the sense of smell. Always have a gas mask handy and be sure you have fresh canisters. The mask is not likely to be used, but it gives confidence to the one hunting the leak. Have a bottle of aqua-ammonia and a piece of waste fastened to the end of a short stick. Dip the waste into the ammonia and start your search. The moment you come to chlorine in the air, a white fume of ammonium chloride will appear. If this leak is in the piping, etc., shut off the valves at the containers and repair. If in a valve on the container or the container itself, and it cannot be stopped, connect the gas valve from the container to your absorption system and begin to operate. The liquid cannot evaporate in the containers, without the application of heat, as fast as the gas is absorbed in your system, and thus the leak quickly stops.

As to the properties of chlorine, it is non-inflammable, and not poisonous, in the sense that carbon monoxide or phosgene is poisonous. We can therefore eliminate risks (1) and (2) and confine ourselves to (3).

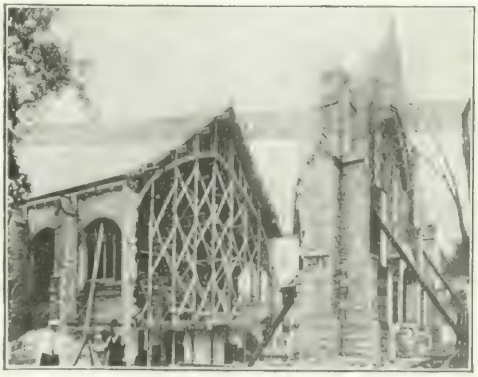
The immediate result of inhaling a large quantity of chlorine gas is the inflammation of the tissues lining the throat, with resulting coughing and nausea. While it is highly irritating and extremely uncomfortable, it is never fatal—unless the subject remains for a considerable period in an atmosphere of highly concentrated gas.

Should a person be affected by chlorine gas we recommend the following treatment: Remove the patient at once to the open air and away from all gas fumes. Place him flat on his back with head slightly elevated, and give a half teaspoonful of essence of peppermint, or a moderate dose of bromo-seltzer or whiskey. This will relieve the tendency to cough and soothe the inflamed membranes, allowing the passage of air and promoting the action of the respiratory organs. The person affected should himself resist as much as possible the impulse to cough. A mustard plaster on the chest will give prompt relief. While there are never any serious after-effects, a physician should always be called.

## Part of Stone Church Moved 30 Ft. To Increase Seating Capacity

BY GUS T. BRITT
Gus Britt Company, House Movers, Buffalo, New York

IN ORDER to increase the seating capacity of the Central Presbyterian Church, Buffalo, New York, which is a stone structure, the front was cut away from the rest of the building, set on rollers and moved a distance of 30 ft. with the aid of screwjacks. That portion of the structure moved was 78 ft. wide, 65 ft. high and 8 ft. thick. The actual time required to move the front of the structure was sixteen hours. The work was done by the Gus Britt Company, housemovers of Buffalo.



FRONT OF STRUCTURE AFTER HAVING BEEN MOVED

# The Engineer a Failure As a Manager

By Philip Cabot
Of White, Weld & Co., Bankers, Boston, Mass.

*Abstract of an address before the joint meeting of the American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and American Institute of Mining and Metallurgical Engineers, New York City, Oct.* 19, 1921.

ESSENTIALLY the great engineer as born and trained in our times is of the scientific studious type, disciplined, severe, ascetic. By nature cool, cautious and fond of formulas, his schooling and the discipline of the professional career which follows teach him to curb his enthusiasms and emotions sternly, never to allow his hopes, fears or aspirations to influence his figures or color his conclusions, and after the most painstaking analysis of all his calculations he is wont to add 15% to 25% as a factor of safety.

Your builder and leader of great industrial enterprises is cast in a different mold. He is essentially an idealist, imaginative, enthusiastic, impulsive, intensely human, a dreamer of dreams with the power to make the dreams come true—in short an artist capable both of great imaginative conception, and fine technical execution; possessed of the power both to conceive and do. A glance at the history of American industry during the last fifty years will show that the great figures are all men of this type: Vanderbilt, Hill, Ripley, Carnegie, Schwab, Rosenwald, Woolworth, Armour, McCormick, Cudahy, McElwain, Endicott, Ford, Westinghouse, Coffin, Vail.

## Reasons for Success

As one excellent example take Vail of the telephone company. Distinctly less remarkable than some of his predecessors in intellectual power, and scientific training he took the company when it seemed about to go upon the financial rocks and left it the most shining success of any public utility in the world, having steered it through the most difficult period for companies of this kind that we have ever known. His success was due, not to commanding intelligence but to imaginative power and the capacity to select and direct men. And look at our dear Henry Ford with all his sins of ignorance upon his head, who has, as it were overnight, leaped from nowhere into the multi-millionaire class. On most subjects his ignorance seems to be colossal, and one is almost tempted to think that he knows one thing only—human nature.

The reason why such men succeed is obvious. They have faith; they believe in things they cannot prove, possess the courage to stake their reputation and their future on their ability to make their dreams come true, and obtain from these qualities the power to inspire with enthusiasm and loyalty the great bodies of men under their command who are their necessary tools, controlling them with the precision and power with which the great painter handles his brush.

The foregoing are examples of shining success and the reasons for it. But we learn more, as a rule, from our failures. Fifteen or twenty years ago the nation witnessed a magnificent crop of organizations known as trusts, designed often for the purpose of monopolizing the market, shutting out competition, and thereby realizing unreasonable profits. I fancy it is generally believed that the failure of the great majority of these organizations was due to governmental action, but such was not the fact. The ones that failed bore the seeds of failure within themselves. The men who organized and led them had a false vision of the market, the customer and the public, and they were wholly lacking in the vision, enthusiasm and courage which are essential to successful leadership.

But perhaps the most striking illustration which we have today of failure is in the railroad business. Many reasons are assigned for the collapse of the railroads, and like all other human things, there is doubtless no one cause. But it is very striking to note the change in type of the men who now lead the great railroad systems as compared with the men who led them when they were successful. In the earlier days our great railroad leaders were primarily traffic men—men whose vision naturally focussed upon the market, who saw the thing to be done and found some way to do it. Now, the leaders of our great railroad systems are all operating men; in other words, essentially men of engineering training and the scientific type.

It is doubtless true that whatever the ability of these men might have been, success has been made impossible by the systems of regulation under which they have been placed. Holding the ignominious position of responsibility without power, it is no wonder if they have failed in successful leadership. But it is undeniable that they have failed conspicuously. The huge army which these men command, far from being inspired by the enthusiasm and loyalty which are essential to success, is admittedly upon the verge of mutiny. For years the relation of the great railroad executives to their employees has been such as to breed disloyalty. The effect of government regulation as designed and administered during the last 20 years has been to develop in railway executives and in leaders of the great railway unions the most conspicuous and magnificent example which the world has ever seen of the great game of "pass the buck."

## Training Natural Handicap

In all great operations whether new or old the leading dominating spirit must be that of the idealist, the promotor, the great salesman, rather than the student or man of science. Such an attitude of mind is very difficult for the typical engineer both on account of his temperament and his training. His natural position is that of the hand which executes rather than the mind that conceives. Leadership is not native to him, his enthusiasms have been put under stern control; locked up so that they cannot warp his judgment, they cannot easily be released to inspire others. In fact, they are often atrophied.

I do not say, nor do I believe, that it is impossible for an engineer to be a great leader and manager of industry. All that I can maintain is that his natural handicap is increased by our present methods of training to such an extent as to make him an unpromising candidate for promotion to such positions, and I say this with full knowledge of the fact that his selection to fill them has become increasingly common of late years especially in public service corporations.

## The Engineer's Opportunity

If this fact seems to you extraordinary the reason is not far to seek. The directors and officers of corporations are in theory elected by the owners (to wit, the stockholders), but nothing is farther from the fact. Stockholders are in practice a flock of sheep incapable of concerted intelligent action but eager to follow any leader, so that the task of selecting corporation managements falls upon the banker, or financial godfather of the enterprise. Such men, cautious by nature, and made doubly so by experience yearn for a sure thing and welcome the engineer with his mathematical accuracy. Your engineer *at least* will not exceed his estimates, will tell them in advance what he will do and do it, while your most visionary promoter must forever be watched and guided. With an engineer at the wheel the company will run itself and the banker and director can sleep in peace. But there is apt to be a rude awakening when he discovers that the business has gradually evaporated, wages have shown a disconcerting tendency to eat up profits, and customers are becoming surly.

In this case, as in all others, the search for the sure thing fails; temporary peace is purchased at the cost of the ultimate failure and the practice must be abandoned. The bankers must select men of enthusiasm, courage and vision, and must put over them boards of directors who are capable and willing to direct. Your dreamer without direction will wreck you faster and more certainly than your man of science. But with adequate direction and control he is your safest man; and if our engineers are to occupy such positions with success their education and training must be profoundly modified.

# Tables for Designing Non-Pressure Water and Sewer Tunnels

By Julian Hinds

Engineer, U. S. Reclamation Service, Denver, Colo.

A PAPER on the "Hydraulic Jump and Critical Depth in the Design of Hydraulic Structures" was presented by me in *Engineering News-Record*, Nov. 25, 1920, p. 1034. Inquiries subsequently received indicate that the principles outlined may have an important bearing upon the design of water-supply and sewage non-pressure tunnels.

Where horse-shoe or circular cross-sections are used the labor of testing for the critical depth or the hydraulic jump is materially reduced by use of the tables submitted herewith. These tables are intended to supplement tables of "Areas, Wetted Perimeter, and Hydraulic Radius of Circular and Horse-shoe Conduits," by George Henry Ellis, published in *Engineering News*, June 17, 1915, p. 1182.

Suppose that it is desired to find the critical depth for 650 sec.-ft. flowing free in a 9-ft. diameter circular conduit. $Q/D^{5/2} = 650/243 = 2.675$. Entering Table I, column 3, with this value, the corresponding value of $d/D$ is found to be 0.701. The critical depth

TABLE I. VELOCITY HEAD AND DISCHARGE AT CRITICAL DEPTHS AND STATIC PRESSURES IN CIRCULAR CONDUITS PARTLY FULL

| $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ | $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ | $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 0.01 | 0.0033 | 0.0006 | 0.0000 | 0.34 | 0.1243 | 0.6657 | 0.0332 | 0.67 | 0.2974 | 2.4464 | 0.1644 |
| 0.02 | 0.0067 | 0.0025 | 0.0000 | 0.35 | 0.1284 | 0.7040 | 0.0356 | 0.68 | 0.3048 | 2.5182 | 0.1700 |
| 0.03 | 0.0101 | 0.0055 | 0.0001 | 0.36 | 0.1326 | 0.7433 | 0.0381 | 0.69 | 0.3125 | 2.5912 | 0.1758 |
| 0.04 | 0.0134 | 0.0098 | 0.0002 | 0.37 | 0.1368 | 0.7836 | 0.0407 | 0.70 | 0.3204 | 2.6636 | 0.1816 |
| 0.05 | 0.0168 | 0.0153 | 0.0003 | 0.38 | 0.1411 | 0.8249 | 0.0434 | 0.71 | 0.3286 | 2.7414 | 0.1875 |
| 0.06 | 0.0203 | 0.0220 | 0.0005 | 0.39 | 0.1454 | 0.8671 | 0.0462 | 0.72 | 0.3371 | 2.8188 | 0.1935 |
| 0.07 | 0.0237 | 0.0298 | 0.0007 | 0.40 | 0.1497 | 0.9103 | 0.0491 | 0.73 | 0.3459 | 2.8977 | 0.1996 |
| 0.08 | 0.0271 | 0.0389 | 0.0010 | 0.41 | 0.1541 | 0.9545 | 0.0520 | 0.74 | 0.3552 | 2.9783 | 0.2058 |
| 0.09 | 0.0306 | 0.0491 | 0.0013 | 0.42 | 0.1586 | 0.9996 | 0.0551 | 0.75 | 0.3648 | 3.0607 | 0.2121 |
| 0.10 | 0.0341 | 0.0605 | 0.0017 | 0.43 | 0.1631 | 1.0458 | 0.0583 | 0.76 | 0.3749 | 3.1450 | 0.2185 |
| 0.11 | 0.0376 | 0.0731 | 0.0021 | 0.44 | 0.1676 | 1.0929 | 0.0616 | 0.77 | 0.3855 | 3.2314 | 0.2249 |
| 0.12 | 0.0411 | 0.0868 | 0.0026 | 0.45 | 0.1723 | 1.1410 | 0.0650 | 0.78 | 0.3967 | 3.3200 | 0.2314 |
| 0.13 | 0.0446 | 0.1016 | 0.0032 | 0.46 | 0.1769 | 1.1899 | 0.0684 | 0.79 | 0.4085 | 3.4112 | 0.2380 |
| 0.14 | 0.0482 | 0.1176 | 0.0038 | 0.47 | 0.1817 | 1.2399 | 0.0720 | 0.80 | 0.4210 | 3.5050 | 0.2447 |
| 0.15 | 0.0517 | 0.1347 | 0.0045 | 0.48 | 0.1865 | 1.2908 | 0.0757 | 0.81 | 0.4343 | 3.6019 | 0.2515 |
| 0.16 | 0.0553 | 0.1530 | 0.0053 | 0.49 | 0.1914 | 1.3427 | 0.0795 | 0.82 | 0.4485 | 3.7021 | 0.2584 |
| 0.17 | 0.0589 | 0.1724 | 0.0061 | 0.50 | 0.1964 | 1.3955 | 0.0833 | 0.83 | 0.4638 | 3.8061 | 0.2653 |
| 0.18 | 0.0626 | 0.1928 | 0.0070 | 0.51 | 0.2014 | 1.4493 | 0.0873 | 0.84 | 0.4803 | 3.9144 | 0.2723 |
| 0.19 | 0.0662 | 0.2144 | 0.0080 | 0.52 | 0.2065 | 1.5041 | 0.0914 | 0.85 | 0.4982 | 4.0276 | 0.2794 |
| 0.20 | 0.0699 | 0.2371 | 0.0091 | 0.53 | 0.2117 | 1.5598 | 0.0956 | 0.86 | 0.5177 | 4.1465 | 0.2865 |
| 0.21 | 0.0736 | 0.2609 | 0.0103 | 0.54 | 0.2170 | 1.6164 | 0.0998 | 0.87 | 0.5392 | 4.2721 | 0.2938 |
| 0.22 | 0.0773 | 0.2857 | 0.0115 | 0.55 | 0.2224 | 1.6735 | 0.1042 | 0.88 | 0.5632 | 4.4056 | 0.3011 |
| 0.23 | 0.0811 | 0.3116 | 0.0128 | 0.56 | 0.2279 | 1.7327 | 0.1087 | 0.89 | 0.5900 | 4.5486 | 0.3084 |
| 0.24 | 0.0848 | 0.3386 | 0.0143 | 0.57 | 0.2335 | 1.7923 | 0.1133 | 0.90 | 0.6204 | 4.7033 | 0.3158 |
| 0.25 | 0.0887 | 0.3667 | 0.0157 | 0.58 | 0.2393 | 1.8530 | 0.1179 | 0.91 | 0.6555 | 4.8725 | 0.3233 |
| 0.26 | 0.0925 | 0.3957 | 0.0173 | 0.59 | 0.2451 | 1.9146 | 0.1227 | 0.92 | 0.6966 | 5.0603 | 0.3308 |
| 0.27 | 0.0963 | 0.4259 | 0.0190 | 0.60 | 0.2511 | 1.9773 | 0.1276 | 0.93 | 0.7459 | 5.2726 | 0.3384 |
| 0.28 | 0.1002 | 0.4571 | 0.0207 | 0.61 | 0.2572 | 2.0409 | 0.1326 | 0.94 | 0.8065 | 5.5183 | 0.3460 |
| 0.29 | 0.1042 | 0.4893 | 0.0226 | 0.62 | 0.2635 | 2.1057 | 0.1376 | 0.95 | 0.8841 | 5.8118 | 0.3537 |
| 0.30 | 0.1081 | 0.5225 | 0.0255 | 0.63 | 0.2699 | 2.1716 | 0.1428 | 0.96 | 0.9885 | 6.1787 | 0.3615 |
| 0.31 | 0.1121 | 0.5568 | 0.0266 | 0.64 | 0.2765 | 2.2386 | 0.1481 | 0.97 | 1.1410 | 6.6692 | 0.3692 |
| 0.32 | 0.1161 | 0.5921 | 0.0287 | 0.65 | 0.2833 | 2.3067 | 0.1534 | 0.98 | 1.3958 | 7.4063 | 0.3770 |
| 0.33 | 0.1202 | 0.6284 | 0.0309 | 0.66 | 0.2902 | 2.3760 | 0.1589 | 0.99 | 1.9700 | 8.8263 | 0.3848 |
| | | | | | | | | 1.00 | | | 0.3927 |

$D$ = Diameter of circle.
$d$ = Depth of water.
$h_c$ = Velocity head for a critical depth of $d$.
$Q$ = Discharge when the critical depth is $d$.
$P$ = Pressure on cross section of water prism at critical depth. To get $P$ in pounds, when $d$ and $D$ are in feet, multiply by 62.5

TABLE II. VELOCITY HEAD AND DISCHARGE AT CRITICAL DEPTHS AND STATIC PRESSURES IN HORSESHOE CONDUITS PARTLY FULL

| $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ | $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ | $\frac{d}{D}$ | $\frac{h_c}{D}$ | $\frac{Q}{D^{5/2}}$ | $\frac{P}{D^3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 0.01 | 0.0033 | 0.0009 | 0.0000 | 0.34 | 0.1427 | 0.8421 | 0.0421 | 0.67 | 0.3208 | 2.7402 | 0.1877 |
| 0.02 | 0.0067 | 0.0035 | 0.0000 | 0.35 | 0.1472 | 0.8854 | 0.0449 | 0.68 | 0.3283 | 2.8155 | 0.1937 |
| 0.03 | 0.0100 | 0.0079 | 0.0001 | 0.36 | 0.1518 | 0.9296 | 0.0478 | 0.69 | 0.3362 | 2.8922 | 0.1999 |
| 0.04 | 0.0134 | 0.0139 | 0.0002 | 0.37 | 0.1563 | 0.9746 | 0.0508 | 0.70 | 0.3443 | 2.9702 | 0.2062 |
| 0.05 | 0.0168 | 0.0217 | 0.0004 | 0.38 | 0.1609 | 1.0205 | 0.0540 | 0.71 | 0.3528 | 3.0499 | 0.2125 |
| 0.06 | 0.0201 | 0.0312 | 0.0007 | 0.39 | 0.1655 | 1.0673 | 0.0572 | 0.72 | 0.3615 | 3.1311 | 0.2190 |
| 0.07 | 0.0235 | 0.0425 | 0.0010 | 0.40 | 0.1702 | 1.1148 | 0.0605 | 0.73 | 0.3707 | 3.2140 | 0.2255 |
| 0.08 | 0.0269 | 0.0554 | 0.0014 | 0.41 | 0.1749 | 1.1633 | 0.0639 | 0.74 | 0.3802 | 3.2987 | 0.2321 |
| 0.09 | 0.0305 | 0.0703 | 0.0018 | 0.42 | 0.1795 | 1.2125 | 0.0675 | 0.75 | 0.3902 | 3.3853 | 0.2385 |
| 0.10 | 0.0351 | 0.0879 | 0.0024 | 0.43 | 0.1843 | 1.2626 | 0.0711 | 0.76 | 0.4006 | 3.4740 | 0.2457 |
| 0.11 | 0.0397 | 0.1069 | 0.0030 | 0.44 | 0.1890 | 1.3135 | 0.0748 | 0.77 | 0.4116 | 3.5650 | 0.2525 |
| 0.12 | 0.0443 | 0.1272 | 0.0037 | 0.45 | 0.1938 | 1.3652 | 0.0786 | 0.78 | 0.4232 | 3.6584 | 0.2595 |
| 0.13 | 0.0489 | 0.1487 | 0.0045 | 0.46 | 0.1986 | 1.4178 | 0.0825 | 0.79 | 0.4354 | 3.7544 | 0.2666 |
| 0.14 | 0.0534 | 0.1714 | 0.0054 | 0.47 | 0.2035 | 1.4712 | 0.0865 | 0.80 | 0.4484 | 3.8534 | 0.2737 |
| 0.15 | 0.0579 | 0.1953 | 0.0063 | 0.48 | 0.2084 | 1.5253 | 0.0907 | 0.81 | 0.4623 | 3.9557 | 0.2809 |
| 0.16 | 0.0624 | 0.2203 | 0.0074 | 0.49 | 0.2133 | 1.5801 | 0.0949 | 0.82 | 0.4771 | 4.0616 | 0.2882 |
| 0.17 | 0.0669 | 0.2465 | 0.0085 | 0.50 | 0.2183 | 1.6361 | 0.0992 | 0.83 | 0.4930 | 4.1716 | 0.2956 |
| 0.18 | 0.0714 | 0.2736 | 0.0098 | 0.51 | 0.2234 | 1.6928 | 0.1036 | 0.84 | 0.5102 | 4.2863 | 0.3030 |
| 0.19 | 0.0758 | 0.3019 | 0.0111 | 0.52 | 0.2285 | 1.7505 | 0.1081 | 0.85 | 0.5289 | 4.4063 | 0.3105 |
| 0.20 | 0.0803 | 0.3312 | 0.0125 | 0.53 | 0.2337 | 1.8092 | 0.1127 | 0.86 | 0.5494 | 4.5325 | 0.3181 |
| 0.21 | 0.0847 | 0.3615 | 0.0140 | 0.54 | 0.2391 | 1.8688 | 0.1174 | 0.87 | 0.5719 | 4.6660 | 0.3258 |
| 0.22 | 0.0891 | 0.3928 | 0.0156 | 0.55 | 0.2445 | 1.9294 | 0.1223 | 0.88 | 0.5969 | 4.8080 | 0.3335 |
| 0.23 | 0.0936 | 0.4251 | 0.0173 | 0.56 | 0.2500 | 1.9911 | 0.1272 | 0.89 | 0.6251 | 4.9605 | 0.3413 |
| 0.24 | 0.0980 | 0.4583 | 0.0191 | 0.57 | 0.2557 | 2.0537 | 0.1322 | 0.90 | 0.6570 | 5.1256 | 0.3492 |
| 0.25 | 0.1024 | 0.4926 | 0.0210 | 0.58 | 0.2615 | 2.1174 | 0.1373 | 0.91 | 0.6939 | 5.3065 | 0.3572 |
| 0.26 | 0.1069 | 0.5277 | 0.0229 | 0.59 | 0.2674 | 2.1821 | 0.1425 | 0.92 | 0.7371 | 5.5077 | 0.3653 |
| 0.27 | 0.1113 | 0.5638 | 0.0250 | 0.60 | 0.2735 | 2.2479 | 0.1478 | 0.93 | 0.7889 | 5.7354 | 0.3733 |
| 0.28 | 0.1158 | 0.6009 | 0.0271 | 0.61 | 0.2797 | 2.3148 | 0.1532 | 0.94 | 0.8528 | 5.9996 | 0.3813 |
| 0.29 | 0.1202 | 0.6389 | 0.0294 | 0.62 | 0.2861 | 2.3828 | 0.1587 | 0.95 | 0.9345 | 6.3157 | 0.3894 |
| 0.30 | 0.1247 | 0.6777 | 0.0317 | 0.63 | 0.2926 | 2.4519 | 0.1643 | 0.96 | 1.0446 | 6.7114 | 0.3976 |
| 0.31 | 0.1292 | 0.7175 | 0.0342 | 0.64 | 0.2994 | 2.5221 | 0.1700 | 0.97 | 1.2053 | 7.2417 | 0.4058 |
| 0.32 | 0.1337 | 0.7582 | 0.0367 | 0.65 | 0.3063 | 2.5936 | 0.1758 | 0.98 | 1.4742 | 8.0392 | 0.4140 |
| 0.33 | 0.1382 | 0.7997 | 0.0393 | 0.66 | 0.3134 | 2.6663 | 0.1817 | 0.99 | 2.0804 | 9.5780 | 0.4223 |
| | | | | | | | | 1.00 | | | 0.4306 |

$D$ = Diameter of horse-shoe.
$d$ = Depth of water.
$h_c$ = Velocity head for a critical depth of $d$.
$Q$ = Discharge when the critical depth is $d$.
$P$ = Pressure on cross section of water prism at critical depth. To get $P$ in pounds, when $d$ and $D$ are in feet, multiply by 62.5

is therefore $d = 9 \times 0.701 = 6.31$. The critical velocity head is likewise found to be $hv = 0.3214 \times 9 = 2.893$, which gives a critical velocity of $V = 13.63$. This information determines whether the flow at a given point is above or below the critical depth, and provision may be made for any contingency likely to occur.

Column 4 gives the hydrostatic pressure upon the cross section of the water prism. The tabular values must be multiplied by $D^3$ to give pressures in cubic units of water. The pressures thus found are equivalent to the term $P$ used in constructing the $(Q/g \times V) + P$ curves in the discussion of the hydraulic jump, above referred to. These curves furnish a means for determining the height and location of the jump. If the pressure is required in pounds, multiply the tabular value by $62.5\ D^3$.

Table II is identical with Table I, except that it is computed for a horseshoe section of the proportions indicated. Tables for other forms of conduit can readily be prepared.

## Temporary and Permanent Garbage Disposal Methods at Baltimore

UNTIL the contract for garbage disposal by reduction entered into between the city of Baltimore and the Sanitary Reduction Co. goes into effect on Jan. 1, the garbage of the city will be disposed of by burial at the site of the old hog-feeding plant on Bodkin Creek. This work is being done by city forces under the direction of the highways engineer, who assumed charge of it on Sept. 1. After transportation by scows the garbage is transferred by a gasoline-operated crane into industrial railway cars and hauled about 1,000 ft. to the burial site.

Trenches for burial are being excavated to a depth of about 4 ft. and a width of about 12 ft., by means of a small steam shovel, which also covers the garbage immediately after being dumped, with from 1 to 3 ft. of sandy loam from the excavation.

The amount of garbage buried in September averaged about 340 cu.ft. or 220 tons per day. The cost of burial in that month approximated $1 per cu.yd. or about $0.65 per ton, including unloading from scows and hauling to the trench. This takes into consideration the fuel used and the rental of a small steam shovel, but it does not consider interest or depreciation on the crane and industrial railway, which are owned by the city.

At the start, the burial trenches were 2 ft. deep and 5 ft. wide. Experience indicated the wisdom of a wider and deeper trench and it is proposed to experiment with a trench 25 ft. wide.

The adoption of garbage disposal by reduction is in accordance with the report by Henry G. Perring, chief engineer, Department of Public Improvements, summarized briefly in our issue of April 21, 1921, p. 698, except that a city-owned garbage reduction plant was recommended in the report. Mr. Perring informs *Engineering News-Record* that it was finally decided to have the garbage disposed of by contract instead of by the city direct since, in order to finance a city-owned plant, it would have been necessary to get authorization from the state legislature of 1922 and then to secure approval by referendum vote. The matter was considered too pressing to wait that long.

Accordingly, bids for disposal by contract were invited. Besides the bid from the Sanitary Reduction Co. (John T. Daily, president, Central Savings Bank Building, Baltimore), one was received from William F. Huse for disposal by burial at a cost to the city of $1.50 per ton. The accepted bid, from the Sanitary Reduction Co., was for $2.70 per ton, to be paid by the city to the contractor, the city guaranteeing to supply not less than 40,000 tons of garbage each year. The engineers of the Department of Public Improvements of Baltimore unanimously recommended that the award be made for disposal by reduction. The contract becomes effective Jan. 1, 1922, and runs for ten years. The city is to deliver the garbage to the reduction plant, which is located on Bodkin Creek, about 11 miles below the city, immediately across the creek from the old hog feeding plant.

The Sanitary Reduction Co. is building a new plant to use the Arnold-Edgerton process. The garbage will be unloaded from the scows by steam-operated grab buckets, which will dump into a hopper, feeding a trough conveyor, which will convey the garbage from the wharf up and over the top of the digestors. There will be 28 digesters, each with a capacity of ten tons. They will be brick lined and the vents will run into a collector pipe, connected with a jet condenser to prevent the digester fumes from spreading over the plant and in the community. Live steam from a battery of six 125-hp. return tubular boilers will be injected into the digesters and cooking continued about eight hours, at which time the digesters will be discharged by gravity into seven receiving tanks, one tank for a group of four digesters. Each receiving tank will feed an Edgerton roll press. The pressed tankage will be moved by a belt conveyor to scows for disposal as fertilizer base.

The liquid pressed out by the rolls will flow through gutters to catch basins, where the grease will be skimmed off and further refined by heat, after which it will be barrelled and disposed of commercially. The water remaining in the catch basin will be passed though sand filters before its final discharge. The fine solids remaining in the bottom of the catch basin will be run through screw presses to recover the tankage, while the grease removed by this process will be recovered in catch basins similar to those previously mentioned.

The mechanical plant will be housed in one large, well-lighted, structural steel building, which is the property of the Sanitary Reduction Co., and was previously used for a similar purpose. The plant is located on a 100-acre tract with adequate wharfage, owned by the company.

## City Planning Proposed for Canton, China

Sun Fo, mayor of Canton, China, has written to the mayor of San Francisco asking for maps of the larger cities and other material bearing upon "schemes of street planning, drainage, sewerage, playgrounds, civic centers, water supplies, bridges, water fronts, electric lights, street illumination and tramway systems, etc.," which would be of assistance in "remodeling the city of Canton along modern lines." This opportunity for remodeling has arisen, the letter states, "in consequence of the recent demolition of our old city wall." The letter is published in full in the October *National Municipal Review* (New York City) in the hope that its publicity in this country will lead representatives of other cities than San Francisco to send helpful material to Mayor Sun Fo.

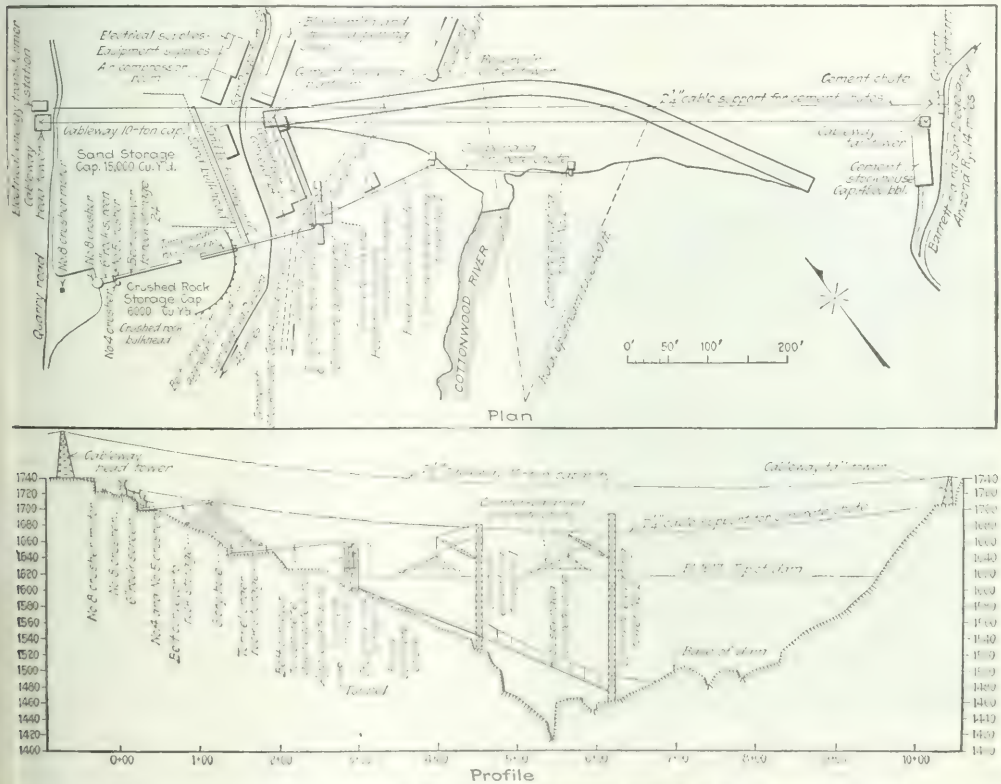
# Proportioning and Making Concrete on Barrett Dam

**Material Transported from Quarry at Damsite by Gravity Through Mixer to Dam — Unusually Large Aggregate Used in Predetermined Percentage of Four-Sized Aggregate**

By H. N. Savage
Hydraulic Engineer, City of San Diego, San Diego, Cal.

IN the construction of the Barrett Dam for the City of San Diego, Cal., special attention is being paid in the concrete to the selection of materials, sizing, proportioning, production and delivery. A quarry has been opened up in a granite formation nearby, the quarry floor being about 400 ft. above the level of damsite, from which the rock for concrete aggregate is being obtained, crushed, stored and delivered to the mixers, all in a horizontal distance of about 1,000 ft. A prominent feature of the concrete is the use of a predetermined per cent of four-sized aggregate, the larger size automobile trucks. It will be a gravity, arched type, concrete structure, 215 ft. high above lowest foundation, with 24 ft. deeper pressure grouting; 750 ft. long on top, forming a reservoir with maximum depth of 170 ft. and maximum length of four and one-half miles. The concrete masonry will total about 136,000 cu.yd., and the reservoir capacity 14⅓ billion gallons.

Preliminary operations were started in October, 1919, just prior to a municipal bond issue of $1,000,000 which was voted Nov. 25, 1919. Work with bond funds was begun Feb. 1, 1920. Up to Aug. 1, 1921, a total of




PLAN AND PROFILE OF CONCRETING PLANT FOR BARRETT DAM, SAN DIEGO WATER SUPPLY

assing a 6 in. screen, some of the individual pieces unning in longest dimension as high as 14 in., all eing run through the mixers and chutes to place in ie masonry.

The Barrett Dam, being constructed by the City of an Diego with city forces, is located on the Cotton-ood River 36 miles easterly from San Diego, the dis-tnce by highway being 43 miles. Carload shipments iove 67 miles by rail and continue 14 miles back by

60,000 cu.yd. of excavation for foundation had been taken out and 70,000 cu.yd. of concrete had been placed.

The quarry is located adjacent to and downstream from the right end of the dam. The quarry floor has an elevation of about 400 ft. above the original streambed. The rock is typical granite of about average grain and hardness, well suited for crushing and, when crushed, for concrete aggregate. Initial quarry drilling is accomplished with a 6-in. blast-hole oil-well drill-

ing machine. The alignment of the holes is parallel with the quarry face and spaced about 30 ft. back from the average face of quarry; the holes have an average depth of about 115 ft. and are spaced about 20 ft. centers. A battery of about 6 holes are usually drilled for a shot. The rock is transported to the crusher by means of all steel high two-wheeled one-horse carts, each using successively about five underhung, detachable skips, each skip having a capacity of 1½ cu.yd. solid measurement.

A No. 8 crusher installed adjacent to the quarry floor, immediately above the end of the dam, is the first unit of a continuous concreting plant which produces and delivers the concrete to place in the structure. The layout of the construction plant and the stages in the process of construction and preparation and transporting materials are indicated on the accompanying drawing.

These stages are, successively, as follows: First, a No. 8 crusher, the crusher run material from which passes 6-in. round holes in 48-in. circular screen and is delivered by gravity onto a 24-in. belt conveyor to the rock aggregate stock pile. The oversized material rejected by the screen adjacent to the No. 8 crusher automatically passes by gravity to a secondary No. 4 crusher

QUARRY IN MIDDLE BACKGROUND SUPPLIES ROCK WHICH RUNS THROUGH CRUSHING AND MIXING PLANT TO BARRETT DAM

which is set to produce the predetermined per cent of the smaller sized rock required and delivered by gravity also to the same 24-in. belt conveyor.

About one-half of the total sand required is furnished by the crusher run. The balance of the sand is obtained from natural deposits in the floor of the reservoir, is loaded with mobile, power elevators and hauled in automobile trucks up to the quarry floor and is either dumped into and passes through the initial crusher onto the 24-in. belt conveyor running to the rock stock pile, or is dumped into a sand stock pile

QUARRYING CONCRETE AGGREGATE

located adjacent to the crusher run stock pile. Th crusher run stock pile has a storage capacity of 5,00 cu.yd.; the sand stock pile has a capacity of 15,00 cu.yd.

Sand required to finish the job is now being salvage and stocked in advance of the winter drainage basi runoff. A 24-in. belt conveyor is installed in a tunn underneath the rock stock pile taking supply throug a "glory hole" and discharges into the 48-in. by 40-ft long circular screen over the concrete aggregate bin The "glory hole" feed is automatic and actuated by chain drive from the shaft of the belt conveyor at th stock pile end. The rock stock pile and the sand sto pile are limited in areas by means of timber bulkhead

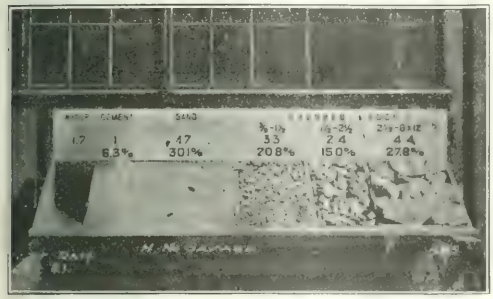
Sand in addition to the crusher run as required i discharged through ports along the bulkhead onto a 1 in. belt conveyor which operates at right angles to th belt conveyor from the rock stock pile and discharg thereupon. The individual sizing aggregate screens a located on top of the battery of four separate aggrega bins. The aggregate is sized by the screens into san (⅜ in. and less) rock (⅜ in. to 1¼ in.), rock (1¼ to 2½ in. rock (2½ to 6 in., by up to 14 in. in occasional longe dimension.) The crusher run is entirely used. A tendency toward deficiency in the smaller sized aggr gate is cured by regulating the secondary crusher. A temporary excess in any of the smaller sized aggrega bins is automatically discharged through side por at the top of each bin into the adjacent next larg sized aggregate bin. The sand aggregate bin is ke filled from the sand stock pile.

The aggregate rock and sand is discharged from t bottom of the four bins through closed box chutes a the predetermined per cent of individual sized aggr gate measurement is accomplished by means of a r ceiving box with partitions spaced as required. T discharge from the chutes is controlled by a bin ga actuated with hydraulic pressure. Cement is intr duced through an independent chute. The material charged from the measuring hopper into the mixers required, control being by means of another hydrau actuated bin gate.

A battery of two 81 cu.ft. capacity, dry measu mixers has been installed. So far it has been necessa to use only one mixer at a time, although a deflecti

gate is installed by means of which discharge from the hopper may be alternately diverted to either mixer. The concrete after being fully charged into the mixer is required to be retained in the mixer and mixed for a minimum of one full minute and no less period of mixing is permitted. A time clock is installed directly in front of the mixer operator and sufficient engineering inspection is maintained to insure a full minute minimum mix of every single batch. Notwithstanding the unusual size of the mass aggregate being used and mixed in the mixers and transported in the chutes, no disastrous wear has occurred. The lining and vanes in the mixers require frequent replacing but this work is performed by the mechanics on the job, thick, common steel plate being used.

After being discharged from the mixers, the concrete flows down a fixed 20-in. chute, of wood, steel lined, on




A CONTINUAL EXHIBIT OF CONCRETE PROPORTIONS

At Barrett Dam this set of bins is kept outside the engineers' office as an object lesson to the workmen and visitors of the ingredients which go to make up the mass concrete of the dam.

a 1 to 2½ slope and is discharged through movable steel chutes by gravity into place in the masonry. It is also sent by means of side gates alternately as required into elevating hoppers in either of the two concrete elevating towers. A considerable portion of the concrete in the base of the dam was poured by gravity without requiring to be hoisted in the towers. The movable chutes are 16 in. in size and bottom wear is provided for by lining the chutes; the lining lasting for about 12,000 yd. of concreting.

The concrete is proportioned by the Fuller and Abrams methods, with such modifications as are found to be desirable in the interests of workability, the object being to obtain a concrete of maximum density from the materials available, within the limits of workability of these materials. As an aid, all the aggregate crushing handling and concrete machinery is dust jacketed to retain the fine particles of the crusher run, the portion of the sand supply obtained from natural deposits being somewhat deficient in fine material.

Only the minimum amount of water required to permit the concrete being handled with chutes is used. The resulting concrete has proved uniformly workable and satisfactory; it arrives at place in the dam thoroughly mixed, without excess water and does not separate but remains homogeneous. To facilitate chuting the dryest practicable concrete, one or more laborers continuously ride the chutes and prevent clogging.

The amount of cement required is determined by frequent tests of 8- x 14-in. cylinders made of concrete taken from the chutes beyond the mixers. This size of specimen is used instead of the standard 8 x 16 in. size on account of the limitation in vertical clearance between the heads of the testing machine. Sufficient cement only is used to produce a 28-day compressive strength averaging about 1,650 lb. per sq. in. In molding the test specimens, the aggregate above 2½ in. in size is rejected as this is considered the maximum size suitable for use in a test specimen of this diameter.

Tests, however, with substitution for the rejected rock of an equal amount of material below the 2½ in. limiting size, show approximately the same strength at the 28-day period, and lead to the conclusion that the test cylinders give a fair indication of the compressive strength of the masonry of this age in mass. A representative grading of the aggregates, showing proportions of the several sizes, and including cement and water is shown in the accompanying view of an exhibition bin, which is maintained in front of the technical office at all times for the information of the public. The cement content is varied as warranted by the increasing strength and hardness of the quarry rock, as development of the quarry progresses, with a view to maintaining practically a constant average unit compressive strength as indicated above. The water content is varied as required by the moisture in the sand and the temperature of the air.

Following is a typical estimated cost of masonry.

| | Per Cu.Yd. |
|---|---|
| Cement (delivered to mixers) | $3 46 |
| Labor (mixing and placing) | 40 |
| Labor (forms) | 20 |
| Form lumber, wire and materials | 08 |
| Crushed rock (delivered to bins at mixing plant) | 1 08 |
| Sand (delivered to bins at mixing plant) | 37 |
| Blacksmith shop, operation and maintenance | .05 |
| Electrical energy (concrete mixing and placing) | .10 |
| Repairs and plant maintenance | 10 |
| Grout washing | 03 |
| Superintendence and unclassified | .08 |
| General expense and engineering | .25 |
| Total (exclusive of plant charges) | $6.20 |

W. A. Stebbins is construction engineer, resident on the job. S. R. Nelson is chief clerk in charge of mess, dormitory and clerical work. Purchasing is handled by the Municipal Purchasing Bureau, E. D. Williams, superintendent. The writer is in charge of the project.

## Decision Against Antioch in Suit Over Brackish Water

The California Supreme Court, on Sept. 14, reversed the decision of the Alameda County Superior Court and dissolved the injunction granted last January to the town of Antioch restraining irrigators, including certain irrigation districts, from diverting water from the Sacramento River in quantities that would reduce the flow of that river at Antioch to an amount less than 3,500 sec.-ft. A resume of the case and the decision of the lower court appeared in *Engineering News-Record*, Mar. 24, p. 513. The Supreme Court decision holds that Antioch, as a mere appropriator of water from the river at a point near its outlet to the sea, does not acquire the right to insist that subsequent appropriations above shall leave enough water flowing in the stream to hold back the incoming tide to a point below the city's diversion. The case was declared to be unprecedented in that the plaintiff does not contend that anything is placed in the stream by the defendants that effects the purity of the water, but rather that the irrigators, by taking water from the river, (an act which is within their legal right), have caused more salt water to reach the vicinity of Antioch than would have reached it had there been no depletion of the

# Henry Ford Gives His Ideas on Railroading

### Would Reduce Weight of Equipment, Expedite Car Movement, Remove Lawyers and Simplify Accounting

*HENRY FORD, in an article in the* Nation's Business, *gives his views on how to run a railroad, illustrating some of his points by telling what has been done with the Detroit, Toledo & Ironton, which he acquired last year. He would get the ownership into the hands of those who operate it, cut down the weight of equipment, speed up the moving of cars, reduce the legal force and simplify the accounting. Says Mr. Ford, in part:*

The real purpose of a railroad is to serve the public. There is no reason why it should be diverted from that service and set to doing an entirely different thing—putting money into the pockets of stockholders who make no contribution to the road's actual operation. . . . There is a possible and practicable system of financing railroads by which those contributing the money will be in positions to aid directly in the success of the undertaking. If the brakeman on a railroad owns stock in it, he has an additional inducement to competent service. Better service is a valuable by-product which will come from his ownership of stock. If the railroad is a success, it is due to him and his fellow-workmen, and they are entitled to the profit.

Railroads should not have to go to banks for money. Make it possible for people to use the railroad as much as they want to. Then there will be no trouble about finances. The trouble is that we start with finance and expect finance to make the road go.

Proper financing would, of course, be easier on new roads. On the old ones, however, it should be possible to retire the parasite, the non-contributing stockholder and get the ownership into the proper hands.

After removing this dividend drain, the second step would be to remove the great physical burden of the railroads—needless weight of its rolling stock. Overweight of rolling stock is the prime mistake on the mechanical side of railroading. Engines and cars are four or five times as heavy as they should be. On the Detroit, Toledo & Ironton we are using up the old types of engine and car, but they will be displaced by better types.

The third step, an immediate step which should be taken in the operation of any great railroad system would be that of expediting the journey of the freight carrier. On the Detroit, Toledo & Ironton we tolerate no idle men, idle cars or idle engines. Loaded cars or trains on side tracks are proof of inefficient operation. They can be made to keep moving. . . .

Our experience illustrates this [the waste of shippers' money due to slow delivery] excellently. The road we have acquired runs north and south and crosses most of the transcontinental lines. By speeding up our freight on this preliminary part of its journey we have been able to shorten the time of its delivery by periods ranging from 7 to 14 days. This means that our product gets to the people to whom we sell it from 7 to 14 days quicker than it used to. It means that we carry on our books $30,000,000 less undelivered product than we otherwise would.

Most railroads have enough lawyers working for them to operate them if they were engaged in useful work. One of the first things is to dispense with the legal staff. A well-managed road needs less of that sort of service. We did just this on the Detroit, Toledo & Ironton. The lawyers are mostly in the claims department. Any small claim against a railroad is very likely to knock about the claims department for weeks or months, to require endless clerical attention, to clog the machine, to cost many times as much as it would to pay it. Proper organization would lead, at the time it is first presented, to establishing the facts about it and settling it on the basis of justice. It would keep all this detail off the books. Few claimants would refuse to settle on the basis of the facts.

The bookkeeping of railroads is complicated far beyond all necessity. The amount of unnecessary work you can find in the accounting system of even a little railroad, the amount of duplication and red tape, is almost beyond belief. We have simplified this department, reduced its cost, and have transformed it into an actual help to the railroad instead of a vexation and a burden. How did we do it? By viewing the whole proposition as a service to the users of railroads and making everything fit into that, instead of having the fear of stockholders and dividends before our eyes. Our faith is that service will pay. Finance does not come first. Work comes first.

We don't claim to have done anything new in railroading—yet. We have only taken the old system of operation and cut off its obvious absurdities. Even the old system of railroading, brought up to efficiency, would be an immense change for this country. We have simply cut out the loafing of men, the loafing of engines and the loafing of cars. The result seems to have surprised many people. But there is no mystery or magic about it. Anyone can do it. If the introduction of plain, everyday good management will create such a change, what may we not expect from really new ideas?

# Cape May Hangar for Dirigible Built From Two Small Ones

### Sheds at Montauk and Cape May Re-erected on New Base Sections To Produce Hangar of Greater Capacity

WITH the completion of the new hangar for giant dirigibles at Cape May, New Jersey now has two sheds capable of accommodating the largest aërial conveyances yet built. The Cape May hangar, while considerably smaller than the great Lakehurst structure (described in *Engineering News-Record*, May 6, 1920, p. 892) is similar to it in type but differs in one interesting respect, namely, in having been constructed by piecing together two smaller hangars, at the same time raising them 40 ft. by setting them up on new base sections. This unusual reconstruction was carried out by the Associated Contractors, of New York, and the

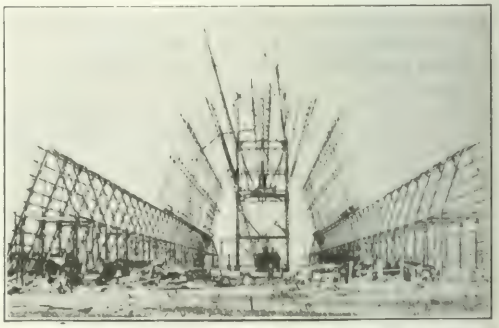


FIG. 1. NEW CAPE MAY HANGAR DURING ERECTION

Bethlehem Steel Bridge Corporation, which latter erected the steel frame.

The completed new hangar is 156 ft. wide, 710 ft. long, and 110 ft. high in the clear at the door; the clear width of the door opening is 106 ft. A lean-to 16 x 122 ft. extends across the end opposite the door. The original smaller hangars, which were identical, were located at Montauk, N. Y., and Cape May, N. J., respectively. Each was 250 ft. long, and had a framework of

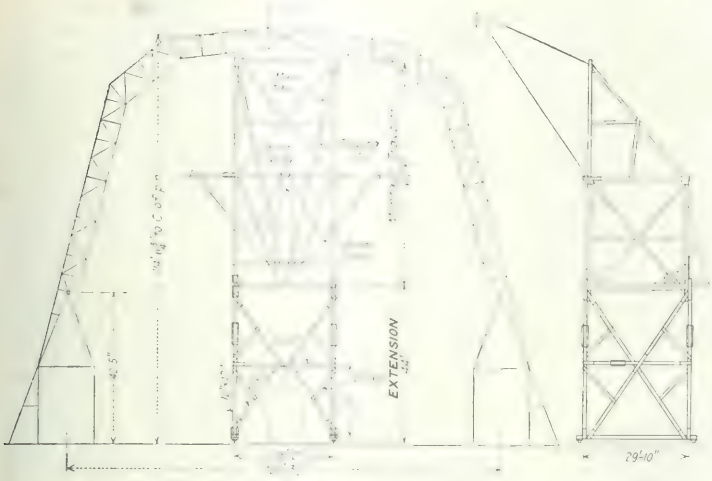



FIG. 2. FRAMEWORK OF OLD HANGAR AT CAPE MAY

three-hinged steel arches of 122 ft. span, spaced 20 ft. 10 in. apart center to center. In the new structure these arches are set on steel base frames 41 ft. high, making the height of the new structure 113 ft. 6 in. from floor to crown pin; and an additional amount of framework for a 210-ft. length of structure was provided.

In taking down the Montauk hangar a wooden tower traveler 28 ft. square by 64 ft. high, with two 55-ft. wooden booms seated halfway up the tower, was used to handle the steel. Both booms were operated by one steam hoisting engine. The half arches, weighing 6 tons, were handled each by one of the booms. Only the last arch had to be guyed temporarily. The traveler moved forward on a track on the concrete floor as the dismantling progressed. The steel members were match-marked before removal to facilitate re-erection. The traveler was then re-erected at Cape May, but was increased in height 44 ft. by a bottom extension, to take care of the greater height of the new hangar; the hoisting engine remained in its old location on the lower cross-framing of the original traveler, now 46 ft. above ground. Both the dismantling of the old Cape May hangar and the erection of the new one were handled by the traveler thus raised.

Erection of the new structure was greatly facilitated by the use of a 30-ton locomotive crane as assistant to the traveler. The 70-ft. boom of the crane, fitted with a

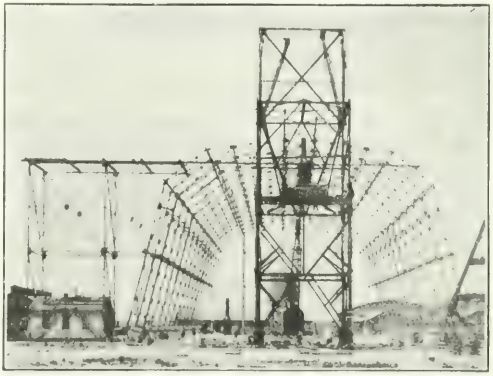


FIG. 4. ERECTION TOWER

20-ft. extension, served to hold up arch sections while the traveler booms erected adjoining sections, drove pins, and filled in between the arches. The 55-ft. traveler booms were extended by 20 ft. for this latter work.

The old hangars contained each about 350 tons of steel, of which 284 tons in one case and 238 tons in the other were used in the new structure.

The hangar was designed to be part bolted, but as the work was carried out all field connections were riveted.

Each of the three-column base bents rests on a reinforced-concrete girder foundation, carried on clusters of wood piles. The mastic floor of the hangar contains two box-shaped docking rails, 90 ft. apart, extending through the whole length of the hangar and 1,000 ft. beyond into the landing field. Within these rails operate the trolleys to which the airship is attached for landing and entering.

The sides of the building were sheathed with wood covered with asbestos shingles, while the two sliding doors, which in construction are substantially identical with the doors used at Lakehurst, are covered with cor-

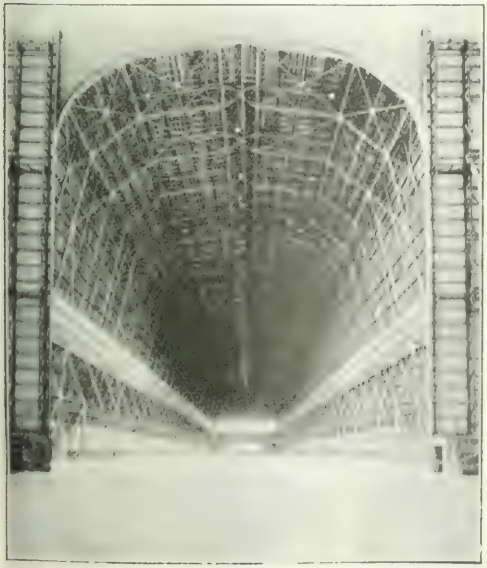


FIG. 3. THE COMPLETED HANGAR FROM THE ENTRANCE

rugated asbestos. In the construction of the packing or cushion strip at the meeting edges of the doors an essential change was made, however. The original design called for this strip to be a sheet of ¼-in. rubber cloth, its edges bolted to the flanges of the steel channel forming the edge of the door, and its middle portion held out to a semi-circular contour by curved strips of No. 16 gage spring steel 4 in. wide, every 3 ft. along the length of the door edge. As built, the cushion consists of pure rubber sheets backed by a continuous strip of wood of segmental cross-section, which is held out from the door channel by spiral springs.

The hangar was built for the navy by the Bureau of Yards and Docks, and under direction of the Fourth Naval District, League Island, Rear-Admiral F. R. Harris, public works officer. Lt.-Com. J. N. Laycock was in field charge.

# Atmospheric Conditions Hasten Initial Set of Cement

## Standard Physical Test Fails To Detect Sub-normal Initial Setting Time Disclosed by "Hot Water and Warm Closet" Test

By C. L. Jenken

Construction Engineer, Maricopa County Highway Commission, Phoenix, Ariz.

During the warm summer months it has been noted on the highway construction work under way in Maricopa County, Ariz., that often the fresh concrete would take its initial set in the pavement so rapidly that within 30 minutes after mixing, belting of the surface was almost impossible. This condition, which occurred with the use of cement that had passed tests made most carefully according to standard methods, was studied until a means was developed for detecting cement having such characteristics. This is now accomplished by mixing the test samples of cement with water after both water and cement have been warmed to a temperature of 100 deg. F., and, in order to approximate in the laboratory the conditions that obtain in the field, keeping the samples at this same temperature in a damp closet until the initial set has taken place.

After a series of tests made on the job and in the laboratories of the cement manufacturers in California, and checked by other laboratories, it was conclusively shown that cements would take their initial set in one to two hours less time in Phoenix than in Southern California. This difference was believed to be due to the arid climatic conditions in Phoenix, which is noted for the low atmospheric humidity and high temperatures between June 15 and Sept. 10. The accompanying table giving data of two winter months, and two summer months shows the extraordinary

TYPICAL CLIMATIC CONDITIONS IN PHOENIX, ARIZONA

| | Mean Degrees F. | | Precipitation Inches | Wind Velocity Miles per Hour | | Relative Humidity per Cent | |
|---|---|---|---|---|---|---|---|
| | Max. | Min. | | Mean | Max. | Max. | Min. |
| January... | 66.2 | 37.5 | 0.13 | 3.069 | 3.315 | 4.5 | 67 | 35 |
| [illegible] | 73.3 | 43.[illegible] | 0.11 | 5.122 | 3.639 | 5.4 | [illegible] | 24 |
| [illegible] | 111.4 | 68.2 | 0.04 | 12.822 | 3.761 | 5.2 | [illegible] | 14 |
| July | 101.3 | 77.1 | 0.38 | 12.081 | 4.634 | 6.2 | 59 | 32 |

dryness and other climatic characteristics of the locality where the Maricopa County highway work is under way.

It appeared therefore that some method other than standard physical test must be developed to detect cement that would take its initial set in the pavement too quickly to permit of its being properly handled. After some experiment such a method of testing has been developed, which has proved very satisfactory. The method of carrying out these tests is as follows.

After the regular standard physical test has been made, a second test of initial set only is made from the cement sample. First, the dry cement is warmed to a temperature of 100 deg. F., or very nearly, then mixed with a mixing water of the same temperature. This usually required from 1 to 3 per cent more mixing water to obtain normal consistency, and a much more vigorous kneading than the standard test to thoroughly mix the paste. Two test pieces are made from this paste, one in the standard hard rubber ring for the Vicat needle and one standard pat for the Gilmore needle. These are run in duplicate for the purpose of a check. The test pieces thus made are stored in a moist closet which is kept at a temperature between 90 and 100 deg. F. until the initial set takes place.

The accompanying table showing the result of initial set tests under different temperatures, clearly shows the effect of temperature. Tests A, B and C were made from the same sample of cement. Test A being the result of the standard test, which gave an initial set of 2 hours and 1 minute. Test B was made under a higher temperature and in this case set in less time than the standard test. This temperature, however, does not consistently cause set in less time and is not dependable. Test C was made in accordance with the above described method and in this particular case set in 49 minutes. This same cement was observed in the field while being placed in the pavement and was found to set in about the same length of time. About 1 hour for the initial set under this method was found to be about the minimum length of time to work properly in the field. Cement which took an initial set, in this test, in less than one hour, especially on extremely warm or warm and windy days, invariably set too soon to allow the proper belting of the finished road surface.

| Test | Laboratory Atmos. Temp., Deg. F. | Dry Cement Temp., Deg. F. | Mixing Water Temp., Deg. F. | Normal Consistency, per Cent | Initial Set — Vicat | Initial Set — Gilmore | 24 Hr. Pat 5 Hr. in Steam | Moist Closet Temp., Deg. F. |
|---|---|---|---|---|---|---|---|---|
| A | 76 | 78 | 78 | 23 | 1 hr. 26 min. | 2 hr. 1 min. | O. K. | 76 |
| B | 96 | 80 | 78 | 24 | 1 hr. 6 min. | 1 hr. 47 min. | O. K. | 80 |
| C | 96 | 100 | 100 | 26 | 31 min. | 49 min. | Slightly soft | 96 |

This seems to prove conclusively the contention previously made that the extreme dryness and high temperature is responsible for this peculiar behavior of the cement. With the aid of the manufacturers' co-operation and through their effort to furnish a slow setting cement this difficulty has been almost entirely eliminated.

### Exports of Road-Making Equipment

Road-making machinery to the value of $73,108 was exported during September. This shows a slight increase over exports of September of 1920 when the value of such machinery exported was given as $67,169. The figures are those of the Department of Commerce.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Ills of Excessive Mechanization

Sir—That excessive mechanization of industry has denied many workers the true significance and physical benefit of of labor is the opinion of Mr. Beck and forms the subject of recent editorials in *Engineering News-Record* and other journals.

This opinion presents a problem as to whether or not engineers should design industries with a view of using automatic machinery, and of accomplishing a given task with a minimum number of motions. The correct solution of this problem depends upon the comprehension of the fundamental nature of man.

A number of late thinkers have proposed the doctrine that man is fundamentally a "time-binder," (this term is used by Alfred Korzybski, on "Manhood of Humanity"), that he differs from vegetables and animals in that he begins where his predecessors left off. Ants build their hills in precisely the same manner forever; men develop their race. Man grows two blades of grass where one grew before, and this is possible because man can integrate all the accomplishments of his predecessors into a desired end.

With this view of man we need apprehend no fear of man becoming a mere machine tender. Machines should be made which require a minimum amount of tending. There is inspiring work enough for all. Just as a workman in James Watt's day was congratulated if he made a cylinder only three-eighths of an inch out of true, today he is congratulated if he makes a cylinder only three-ten-thousandths of an inch out of true.

WILBERT BERNHARDT,
South Bend, Ind., Sept. 24. Hydraulic Engineer.

## Design of the Birkenhead Covered Reservoir

Sir—I am greatly interested in the 40,000,000-U. S. gal. covered service reservoir for Birkenhead, England, which, in your issue of Sept. 29, p. 535, you describe as an "amazing structure," and "a curious structural layout." But why so designate it? When all the facts are understood the design will be seen to have followed rational principles.

As I was associated with the engineer of the reservoir, the late Dr. Deacon, and his successors, Sir Alex Binnie, Son & Deacon, from its inception in 1906 to the completion of the contract drawings in 1912, a word from me on the basis of design will not be out of place. The construction, I understand, was held up due to the Great War. In the design of this reservoir it was decided not to follow the precedents of reservoir design to any great extent but to start afresh on sound principles and follow them to their ultimate and proper conclusions; that is to say, it was to be designed, not copied from earlier, less important examples. It was felt that such an important work should possess character, should be economical in design and should properly fulfil the purpose for which it was to be constructed in that, among other things, it should be entirely free from leakage, and these requirements have been met entirely. The reservoir is constructed on a site where underneath the surface deposits of a variable character lie open jointed porous sandstones into which any leakage would find its way. Puddled clay could not be economically secured and as all concrete linings of service reservoirs leak more or less it was decided to use bitumen in bulk since the water-tight layer throughout and most of the peculiarities of this reservoir are due to this material placed as a vertical layer within the body of the walls—it being supported on the inside by brickwork in the form of horizontal arches with counterforts at intervals stiffened by the vertically placed steel beams and on the outside by concrete backed with earth. The inside lining of vitrified brickwork was adopted owing to its superiority to concrete and as it could be constructed without forms. The principal use of the so-called reinforcing at the groins of the roof is not structural; it served a useful purpose during construction in preventing displacement of the tops of the high columns.

The decision to use a cover of domes laid out on a hexagonal plan arose from the fundamental fact that domes of concrete can be more easily supported on a hexagon at six points than on a square at four points; or, in other words, a hexagonal roof plan required a less number of columns to support it than a square plan with the same condition of loading. As the number of columns affect the cost and column points in the floor are invariably points of distress and leakage, requiring special attention, the less their number the better. In this feature there was probably also the element of boldness, character and freedom, the absence of which makes many engineering structures drab and commonplace. WILLIAM GORE,
Toronto, Ont. Consulting Civil Engineer.

## Long-Lived Pine Stakes

Sir—In your issue of Sept. 29, page 530, is a short article on life of redwood stakes in California, some of the stakes being in good condition after standing forty-seven years. I can go you one better.

In 1835 the City of Pensacola, Fla., attempted to build a railroad northward toward Montgomery, Ala. Some ten or twelve miles of roadbed were graded and the right-of-way cleared for a much greater distance. The project failed in 1837.

In 1908 I made a survey over the old grade, which had grown up with long leaf pines from 6 to 15 in. in diameter. I counted as many as 67 annular rings on some of the trees that were cut by my axmen.

I found five lightwood knot fat pine stakes of the original survey, two on the center line and three on the slopes. In size they were about 2 x 3 x 36 in. All of the stakes were sound, and seemed to be in as good condition as when placed, over seventy years before. J. M. GARRETT,
Montgomery, Ala. Civil Engineer.

## To Prevent Sand-Drifts on Roads

Sir—The note on how Fresno scrapers were used to keep sand-drifts off plank roads in Imperial County, Cal., (*Engineering News-Record*, Sept. 29, p. 518) suggests the possibility of combating these sand-drifts with a beach-grass called "helm" celebrated in Holland, which has done and still does effective work over there. This material planted along California highways would go a long way toward eliminating sand-drifts. This beach-grass or "helm" spreads its rough roots, with numerous long lateral sprouts, close to the surface and to a distance of 20 ft. This grass is coarse, yellow and greenish in color and grows to a height of 3 ft. Its use would undoubtedly save Imperial County great sums of money.

The California Highway Commission should build on its road berms vertical mats 3 ft. high, woven from local material such as two-year-old willow shoots or water reed, placed at a distance of 100 ft. apart. These mats have to be stiffened by stakes at 3 ft. distances, thoroughly tied into the mats with good twine or galvanized wire. The stakes, 3 in. in diameter, should be solidly driven into the berm.

If the winds blow most of the year from one direction the mats must be on the side from which the winds blow and bear against the stakes. When placed on the berm at right angles to the road or on a slight angle, the mats accomplish about the same work as groins do in protecting the river shore line against scour. They catch the suspended silt, which deposits, causing the shore line to advance and raise itself.

The roads should be at an elevation higher than the surrounding level to prevent sand or snow from settling on the surface. If the Imperial County roads happen to

be in a cut with wide berms, there is no reason to postpone the mat work.

If the planting of helm is to be done on slopes, they must not be too steep, preferably a slope of 1½ to 1 or if possible of 2 to 1 in order to give the beach-grass a fair chance to grip the sand soil. C. KOOY.

New York City, Oct. 8,

## Actual Traffic Loads on Bridges: Ohio River Bridge at Ironton

SIR—I read with interest the article in your issue of Oct. 13 descriptive of the bridge now being built across the Ohio River between Ironton, O. and Russell, Ky. There has been need for a bridge at this place for a long time, and it is a credit to those who successfully raised, by popular subscription, money enough to completely finish the structure without an issue of bonds or other indebtedness.

There is some doubt in my mind as to the live-loads assumed for the determination of stresses. The article states that live-load stresses were computed for two electric cars, each weighing 45 tons, and 30 tons on the remaining 16 ft. width, distributed over a length of roadway and sidewalk of 90 ft., and a road roller weighing 18 tons applied at any point. It is probably true that stresses due to the road roller have been used in designing only those members in which the stresses due to it exceed those caused by other live-loads. The other live-loads specified amount to 120 tons on a unit length of 90 ft. This question arises: Were the stresses determined from the passage of a single 90-ft. length of load across the bridge, or were they determined from a continuous series of 90-ft. loaded lengths? The statement in the article mentioned indicates that the stresses were determined from the application of a single unit of length, or a total live-load of 120 tons, distributed over a length of 90 ft. and applied in various positions successively.

If it is assumed that the facts are as just indicated, it is found that the total live-load, when applied to the anchor arm, amounts to 686 lb. per lin.ft., when applied to the suspended span it amounts to 640 lb. per lin.ft., when applied to the channel span it amounts to 331 lb. per lin.ft., and when applied to the 200-ft. approach span it amounts to 1200 lb. per lin.ft.

A continuous line of loaded street cars, such as are in service in cities, will weigh about 1400 lb. per lin.ft. Suburban cars are somewhat heavier. From actual observation it has been found that the weight of a continuous line of automobiles and power-driven trucks is about 500 lb. per lin.ft. and of a mixed line of street cars, automobiles and trucks about 800 lb. per lin.ft. It therefore appears that a possible live-load may be:

| | Lb. per lin.ft. |
|---|---|
| One line of street cars | 1400 |
| One line of automobiles and trucks | 500 |
| One line of sidewalk at 50 lb. per sq.ft. | 300 |
| Total | 2200 |

It is however, probable that there will never be a continuous line of street cars on the bridge and that automobile trucks will not all be fully loaded so it is probable that the maximum load per foot that the bridge may be required to carry will not exceed:

| | Lb. per lin.ft. |
|---|---|
| For a mixed line of street cars, automobiles and trucks | 800 |
| One line of automobiles and trucks, not all fully loaded | 400 |
| One line of sidewalk | 300 |
| Total | 1500 |

A load like this might occur on any occasion that would attract crowds onto the bridge, as is possible in connection with an opening celebration. This load is 4½ times that for which the main channel span has apparently been designed. Even the wind load in the plane of the floor is greater than the load apparently assumed for the channel span.

It is to be hoped that the statement in regard to the live loads used in computing the stresses is in error, otherwise, I believe the facts in the cast should be brought to the attention of the proper parties in order that there may be a thorough understanding and that such steps as seem desirable may be taken to safeguard the public.

Pittsburgh, Oct. 21. CHARLES S. DAVIS, Consulting Engineer.

## Making Water Meters Misdemeanors: A Rejoinder

SIR—Referring to the edtiorial note in your issue of Sept. 29, "Making Water Meters Misdemeanors," I think you are the body "having so little information and judgment." Have you not concluded that what may be good and necessary for a large city in the East is good for Stockton?

Have you duly considered the fact that Stockton is nearly all small residences and is located in an arid region having 8 to 10 in. of average yearly rainfall with maximum daily temperatures during the summer of from 100 to 110 deg. F., combined with air of a very low relative humidity; and that as a consequence of his, without liberal sprinkling, lawns and flowerbeds would disappear in less than a week, to the great detriment of the people. That the dead grass, etc., does constitute a serious fire hazard can hardly be denied.

Here in Fresno, thanks to a progressive water superintendent who thoroughly understands the situation, we have a flat monthly rate estimated for each residence. For an average five or six-room bungalow on a lot of say 50 x 150 ft., this rate is $1.75 during the summer and $1 in the winter for all the water needed. There is, no doubt, some waste of water, but not anything like enough to pay for meters.

If you could compare the appearance of Fresno with Berkeley, where vegetation needs far less water, but where water meters would run the price of properly watering the average small bungalow lawns and gardens up to $6 or $8, to say nothing of the necessity of spending an additional $4 for drinking water, as was the case a couple of years ago, as the water was unfit for drinking purposes, although no doubt absolutely safe, you would get a far better understanding of the question you are discussing. This is not the fault of the water meter, to be sure, but its effect. Let us not forget that when a property owner keeps his lawns and flowers green and pretty it is worth something to everyone who sees this, and with water meters and the consequent much higher rates he could probably not afford to do this.

I do not believe you can mention a single city or town with water meters where water is as abundant, as good, and as cheap as here in Fresno. B. F. JAKOBSEN.

Fresno, Cal., Oct. 7.

[The water meter prevents wanton waste and where such is persisted in makes the wasters foot the bills instead of putting the burden on the careful consumer. If the meter rates, including minimum charges, are properly framed there will be no reason for letting lawns dry up to keep down water bills. Moreover, the provisions of the Stockton ordinance which we condemned were sweeping in making the installation of any water meter a misdemeanor, regardless of whether the water were to be used for irrigation or some other purpose. Such legislation is like using a bludgeon instead of brains.—EDITOR.]

## Labor Supply and Demand

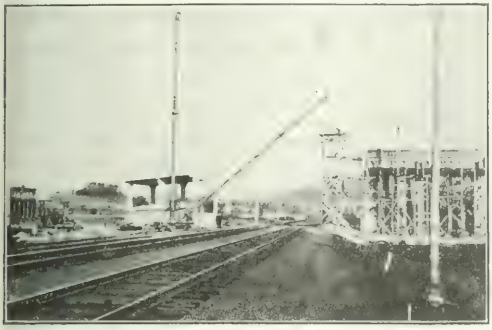
Reports from the Division of Employment of New York State, covering operations of employment offices in six cities, show that the ratio of workers applying for work to each 100 places available was 125 in July. This indicates an improvement over the employment situation of the preceding month, when the ratio reported was 139. Reduction in unemployment from June to July was largely due to a temporary absorption of some of the unemployed into the agricultural industry for harvest work.

# HINTS FOR THE CONTRACTOR

## Concrete Gang Reduced Through Intensive Use of Mechanical Equipment

By H. W. Yonts
Ravenna, Ohio

IN THE construction of a reinforced-concrete bridge, 148 ft. long with a 24-ft. roadway, consisting of two approach spans and a steel girder concrete-incased span over the Philadelphia & Reading Ry. at Malino, Pa., the contractor so arranged his mechanical plant that he was able to operate successfully and without expensive shut-downs with an average crew of eight men. The bridge was built in order to provide an overhead crossing for the highway from Hamburg to Pottsville, Pa., and was constructed during 1920, when there was a



ARRANGEMENT OF MECHANICAL PLANT

labor shortage and the contractor was forced to resort to intensive use of mechanical equipment.

The plant consisted of a 10-ton derrick with an 85-ft. boom and an 82-ft. mast, equipped with a 1½-yd. clamshell, which unloaded and stored all the sand and crushed stone needed for the work; and a large bin holding 65 cu.yd. of stone and 35 cu.yd. of sand, with the concrete mixer located in front of the bin and fed by gravity from it. The bin was filled each morning, the filling occupying about 2 hr., and the derrick was used to handle the concrete from the mixer to the forms. The bin held enough material for a run of 7 hr., or 65 cu.yd. of concrete. The mixing crew consisted of one hoisting engineer, one mixer runner, one bin man, one man at the forms to dump the derrick bucket, two men spading concrete and placing reinforcing steel, and one foreman. When this crew was not concreting, it assisted the carpenters in building the forms.

A 10-cu.ft. gasoline-driven mixer was used with a power loader which slid under the bin and was loaded with the proper amount of sand, stone, and cement. The cement was unloaded from the cars by a chute to a portable cement house and the mixing plant was located at the door of the cement house so that the cement did not have to be raised by laborers. With the use of the large derrick it was possible to store all materials as they arrived and expensive shutdowns due to waiting for materials were eliminated. The contractor eliminated 80 per cent of labor trouble in mechanically handling all aggregate.

The work was done under the direct charge of Edward Gorman, division engineer, Philadelphia & Reading Ry., assisted by D. F. Duffy, inspector. The contractor was Thomas Sheahan, Hagerstown, Md., with H. W. Yonts as superintendent.

## Clean Concrete With Burning Gasoline

GASOLINE poured over asphalt joints between concrete slabs or on concrete surfaces and then ignited constitutes a method of cleaning the surface that is quick, inexpensive and does not damage the concrete, according to the Waterproof Paint Co. of Lankershim, Cal., from which the following notes were obtained. Using tools to remove the asphalt from a narrow joint often breaks out the side walls in an unsightly way and is a slow process.

A convenient way of removing the coating is to use a small oil can filled with gasoline. Several applications may be required to entirely remove all the old asphalt compound, the operator walking along the joints, each time leaving a trail of gasoline which is then ignited. It is better to use a small quantity of gasoline and repeat the process, rather than to use a larger volume which might be dangerous in inexperienced hands.

Where the method is used in concrete reservoirs covered with wooden roofs, care should be exercised to see that adequate ventilation is provided before the gasoline is used. The picture shows several tons of asphalt being moved from a reservoir surface by this method which left the surface perfectly clean. On this job one man removed a ½-in. asphalt coating from an area of 15,000 sq.ft. in two days. As a safeguard in avoiding damage to the concrete when treating large

BURNING ASPHALT FROM CONCRETE RESERVOIR

areas, a continuous fire should be avoided. The work can be done in sections, starting fires with small quantities of gasoline and returning later to reburn where necessary. Working in this manner one man can ordinarily clear the surface quicker than a dozen laborers employed in scraping off the compound.

# NEWS OF THE WEEK

New York, October 27, 1921

## Favor Narrows Tunnel and New York Belt Railway

**Engineering Committee from Board of Estimate Recommends Staten Island Project**

In a preliminary report just rendered to the Board of Estimate Apportionment, New York City, by an engineering committee headed by Arthur S. Tuttle, chief engineer of the board, to study the project for a Narrows freight tunnel which the state legislature recently directed the board to construct, the committee strongly recommends that such a tunnel be built It states, however, that the tunnel will be inexpedient unless it is connected with all the railways serving the city so as to provide direct rail interchange between railways and industries, between the metropolitan districts of New Jersey, Long Island and Manhattan and the mainland on the east side of the Harlem, and between freight cars and ships. To this end the committee recommends that as part of the tunnel project a great outer belt line be constructed around the city, extending from Haworth, N. J., west and south through Glen Rock, Paterson, the upper Passaic Valley, Summit and Scotch Plains to a high level crossing of Arthur Kill at the southwestern part of Staten Island, and thence via a huge classification yard northerly to the Narrows tunnel; and that on Long Island the tunnel be connected with the Long Island R. R., the New York Connecting R.R., and an industrial waterfront elevated railway to be built in Brooklyn.

### Follows Wilgus Report

In its main course the belt line follows a route recommended some years ago by William J. Wilgus and a similar route surveyed later by J. B. Snow. The former is now consulting engineer and the latter tunnel engineer to the committee. Separate reports from these two engineers and J. F. Sullivan, another consulting engineer to the committee, accompany the main report. Mr. Wilgus and Mr. Snow differ on the preferable location of the Narrows tunnel and the type of construction, the former favoring a northerly route and the construction by the trench method, while the latter favors a southerly route and shield construction. Mr. Sullivan concurs in Mr. Wilgus' recommendations. In a separate report by Mr. Sullivan, a tunnel connection from the New York Central freight tracks along the Hudson River in upper Manhattan to the railway lines in the eastern part of Bronx borough is recommended; this would pass under 168th St., crossing under the Harlem River, to the line of the New York Connecting R. R. Mr. Wilgus concurs in this recommendation.

An investment of $141,000,000 will be required to carry out the project. Of this total, $42,000,000 is for the belt line, $51,000,000 for the freight and passenger tunnel under the Narrows (including separate rapid-transit connection from Staten Island to the Fourth Ave. subway in Brooklyn), $25,000,000 for the Brooklyn industrial elevated railway, and $23,000,000 for the Manhattan-Bronx tunnel. The system would return a profit of $5,000,000 per year over and above operating and fixed charges, the committee estimates.

## Expect Early Vote on Conference Report of Highway Bill

*(Washington Correspondence)*

Since the conferees completed their work, the fight for federal aid highway legislation has been behind the scenes. The fact that no word concerning this bill has been uttered in the meantime, in either hall of Congress, was no indication that the opposition had quit and the fight was over. The opponents of this measure have fought to the last ditch, but as this is written, it seems practically certain that the House will vote on the conference report before the end of the week. The opponents of the measure evidently have exhausted their last resource which they could use against the measure. Once that the parliamentary way can be cleared of obstacles, the result is assured. The House will approve the $75,000,000 appropriation carried by the bill and it is believed the President also will.

That the enemies of the bill were waging a good fight with their parliamentary weapons may be judged from the fact that the weight of Secretary Hoover's influence was made use of by the proponents of the legislation.

## Lack of Funds May Slow Up River and Harbor Work

*(Washington Correspondence)*

An understanding is said to have been reached on Capitol Hill to the effect that a very small amount is to be carried in the next river and harbor bill. Practically all of the accumulated surpluses of river and harbor funds will have been expended by the end of the present fiscal year. These surpluses accumulated during 1919 and 1920 when the work was held up by the high price of materials. Since only $12,400,000 was carried in the last river and harbor bill practically all of the accumulated surpluses will have been expended by the end of the current fiscal year.

## Paving Conference Opposes Long-Term Guarantees

**Philadelphia Meeting Discusses Recent Developments and Recommended Changes in Paving Practice**

Almost unanimous opposition to the current practice of demanding from contractors long-term guarantees on paving construction was expressed at the City Paving Conference held Oct. 20-21 in Philadelphia, under the auspices of the Engineers' Club of that city, with the co-operation of the municipal highway bureaus of Philadelphia, Baltimore and New York, the University of Pennsylvania and the Advisory Board on Highway Research of the National Research Council, Washington, D. C. The attendance at the five sessions, varying from fifty to more than one hundred, was not confined to Eastern city representation, as delegates were present from parts as far west and south as Chicago, St. Louis and New Orleans. A program covering recent developments and changes in practice in the design and construction of all the standard paving types in addition to such subjects as research, sub-structures, inspection and guarantees, was completed in a business-like manner. It is planned to repeat the conference next fall, at which time a summary of answers to a questionnaire on paving methods, which is to be sent to all cities having a population of 10,000 or more, will be presented.

### Asphaltic Filler Favored

In the consideration of details of paving practice a marked sentiment favoring the use of asphaltic filler for both brick and granite block developed, following papers by P. C. Painter, city engineer of Greensboro, N. C., and C. D. Pollock, consulting engineer, New York. It was also emphasized, in the case of brick paving, that with a bituminous filler a thin sand cushion, from ½ to 1 in. thick, is preferable to a cement-sand bed, on grounds of both service and economy. Mr. Pollock was insistent on the need of thorough hand ramming for granite blocks and decried the substitution of road rollers for this operation.

In wood block practice, according to a paper by Ellis R. Dutton, of Minneapolis, there have been no recent developments; for best results it is desirable, he said, to have a smooth concrete base, uniform length of block, a thin bituminous cushion and a bituminous filler so applied as to leave no excess of filler material on the top surface of the block. The discussion brought out the

fact that so little wear from abrasion by traffic had been observed in the case of wood block paving that blocks thinner than those ordinarily used could be employed to advantage. Two Pennsylvania cities, Lebanon and Tyrone, have laid wood block only 2½ in. thick.

Asphalt paving methods and materials were considered in papers by Major F. S. Besson, Corps of Engineers, Washington, D. C., Julius Adler, Bureau of Highways, Philadelphia, J. S. Miller, chief chemist, Barber Asphalt Paving Co., and Dr. Felix Kleeberg, Department of Public Works, Manhattan, New York. Major Besson described methods developed by him for proportioning asphaltic surface mixtures to prevent shoving and cracking. Defects in asphalt paving, according to C. M. Pinckney, Bureau of Highways, Manhattan, New York, are often due to lack of thorough mixing of the material at the plant. The probable extension of motor bus service in New York and other cities, he pointed out, justifies more care in the design and construction of asphalt surfaces than ever before, to withstand the heavy loadings which will be imposed on streets. Displacement of surfacing by heavy traffic is Philadelphia's chief problem in asphalt paving maintenance, according to Mr. Adler, who urged quality as against mere quantity production in this line of work.

### Against Guarantees

Prof. S. A. Stephenson, Jr., of Rutgers College, New Brunswick, N. J., with his paper on guarantees and inspection of paving, precipitated the keenest discussion of the conference. The guarantee, he held, should be limited to cover the faithful performance of the requirements of the contract and specifications, and should not be camouflaged as a long-term maintenance fund. This view found wide support among the highway engineers present, and it was noted that the Pennsylvania State Highway Department recently eliminated the guarantee from its contracts and now depends on rigid inspection and co-operation with the contractor to secure good results. New York City, Mr. Pinckney announced, is considering the reduction of the term of its paving guarantees to one year. W. H. Connell, formerly chief of the Philadelphia highway bureau, stated that a guarantee may sometimes be desirable in cases where an engineer, due to the injection of politics in highway administration, is deprived of complete control over his organization.

Both R. A. MacGregor, Department of Public Works, Manhattan, New York, and Col. R. Keith Compton, of Baltimore (through a representative of the City Paving Bureau) urged the adoption of policies preventing the cutting of newly laid paving for repair or extension of sub-surface structures, such as gas or water mains, electric light conduits and sewers. Advance notices to public utility corporations, individual property owners and other city departments of intention to pave should be sent out and warning given to have all extensions and repairs on underground structures completed before the pavement work starts.

Mr. Pinckney's papers on factors determining the selection of pavement types brought out discussion on the advisability of limiting vehicular loads on city streets. Flint, Mich., according to Ezra Shoecraft, has found it necessary, on account of increased traffic, to thicken all new pavement foundations to 8 in., as against 6 in. formerly adopted. Until highway engineers have control over the loads which pavements will carry, Mr. Pinckney pointed out, types of construction cannot be intelligently selected.

### Research

The conference opened with a paper by A. T. Goldbeck, engineer of tests, U. S. Bureau of Public Roads, in which it was pointed out that paving design, because of the extreme loads which vehicular traffic of today imposes, has become a problem in mechanics. Mr. Goldbeck reviewed the research work in the fields of drainage, soil investigation, impact and wearing qualities of surface which the Federal Government is now conducting. Much of the discussion dealt with the influence of moisture in reducing the supporting power of sub-grade material. Plastic clays are particularly troublesome and tests thus far carried out indicate possibilities in the mixture of dry cement with the clay to change its properties. It remains for the future to disclose, according to Mr. Goldbeck, whether such methods of subgrade treatment will prove economical or not. Prof. W. K. Hatt outlined the work which the Advisory Board on Highway Research, of the National Research Council, is doing. He pointed out that there are now completed or under construction six experimental concrete roads, tests of which are expected to yield data of great value in the design of such types.

In his paper on repair and maintenance problems, P. C. Sharples, of the Barrett Co., urged that more attention be given to the lower types of roads and described repair methods by cold patching. J. C. Grinnalds, of Baltimore, showed how the selection of paving types is facilitated by city planning.

## Power Development Right Granted Northern Ontario Railway

The Ontario government has granted the Timiskaming & Northern Ontario Ry. Commission the right to develop power in the vicinity of the Big Bend on the Abitibi River north of Cochrane. It is understood that the commission proposes to utilize the power which is variously estimated at from 15,000 to 30,000 hp. for the electrification of the road, or a section of it, and surplus to be sold to mining companies or other consumers.

## One-Fourth of Railway Operatives Only, Pledged to Strike

Only one-fourth of the unionized transportation employees of the country remain pledged to strike on Oct. 30. These are all included among the "Big Five" brotherhoods and the telegraphers. Fourteen union organizations directly concerned with railway transportation and who would be expected to go out in the case of a general strike, have voted against such action. One organization, the signalmen, has as yet not voted.

The total number of men now who stand against the strike order issued to take effect progressively on Oct. 30 approximate 1,400,000. The membership of the "Big Five" composed of the brotherhoods of railway trainmen, locomotive engineers, firemen and enginemen, the order of railway conductors, and the switchmen is about 325,000. Together with the telegraphers the number of transportation operatives who still stand instructed to carry out the strike order is about 404,000.

Anticipating that the strike order will be made effective according to schedule municipalities the country over are making plans for the mobilization of other available means of transportation for the movement of food and fuel. In New York the New York Port Authority has been charged by the governor with the co-ordination of all facilities and the preparation of a plan that could press into immediate service every state agency, should the strike take place. Gen. G. W. Goethals has been appointed to take full charge of fuel and food distribution in the New York district.

## Changes Ordered in Panama Canal Administration

Following the report of the Connor Commission, consisting of Brig.-Gen. W. D. Connor, Capt. A. B. Fry, F. A. Molitor and H. A. Wilson, on the various administration problems of the Panama Canal (noted in *Engineering News-Record*, Oct. 13, p. 627), Secretary of War Weeks has ordered certain changes, but is withholding action on the major part of the recommendations of the commission. The changes ordered are in connection with the payment of rent by employees, the extension of employment of tropical labor, capitalization of auxiliary activities, and minor pay readjustments. The larger questions of open shop, etc., noted in the original report, have not yet been passed upon.

## Commission Recommends Standard Gage for Australian Roads

A standard gage of 4 ft. 8½ in. for all railroads in Australia has been recommended by the Uniform Gage Commission, say cable advices to the Department of Commerce. The commission estimates that the change to that gage would entail a cost of £57,000,000.

## Port Authorities Meet in Seattle

The tenth annual convention of the American Association of Port Authorities was held in Seattle, Wash., Oct. 11-14, with over a hundred in attendance. Twenty papers were presented, some merely descriptions of specific ports, but most of them taking up an engineering problem of port design or control. Besides pledging support to the War Department's investigation of port terminal charges and practices in America, the convention voted to join a movement to petition the governments at Washington and Ottawa to pass laws to overcome the floating oil menace in harbors. The petition will point out the fire danger to terminals and shipping presented by this menace. Benjamin Thompson, of Tampa, Fla., was re-elected president and M. P. Fennell, Jr., of the Harbor Commission of Montreal, continues as secretary.

## Candidates Named for Am. Soc. C. E. Annual Election

The nominating committee of the American Society of Civil Engineers has selected the following candidates for offices to be filled at the annual election Jan. 18:

For president: John R. Freeman, Providence, R. I.

For vice-president: C. E. Grunsky, San Francisco, and Robert Ridgway, New York.

For treasurer: Otis E. Hovey, New York.

For directors: C. M. Holland, New York; J. J. Yates, Jersey City; F. E. Winsor, Providence, R. I.; John N. Chester, Pittsburgh; A. J. Dyer, Nashville; W. L. Huber, San Francisco.

## National Societies To Discuss St. Lawrence Project

Under the auspices of the New York sections of the four national engineering societies the St. Lawrence ship canal and power project will be discussed at a meeting to be held in New York City, Nov. 14. W. L. Saunders is chairman of the committee making preparations for this event.

Gov. Henry J. Allen of Kansas will discuss the project from the standpoint of the producer of the Middle West. Dr. R. S. MacElwee, former director of the U. S. Bureau of Foreign and Domestic Commerce, will deal with the economic features of the project. H. I. Harriman of Boston will discuss "The Power and Transportation Features of the Project, Translated Into the Economics of New England and the East." Definite acceptances have been received from these speakers. Ex-Governor W. L. Harding of Iowa is also expected to deliver an address. Herbert Hoover has been invited to preside.

## Am. Soc. C. E. Sections

The American Society of Civil Engineers now has 31 local sections and 34 student chapters.

## Cities Lay Plans to Allay Unemployment

That cities all over the country are alive to the opportunity presented in relieving the unemployment situation through a greater activity in public works construction is indicated in reports received by Col. Arthur Woods, chairman of the committee on community, civic and permanent measures of the President's Conference on Unemployment. Though information has not come in from numerous centers, it is evident that municipalities are acting upon the recommendations made at the conference, recently closed.

Dayton, Ohio, has voted $500,000 with which to continue public work. Only citizens of that city will be given employment. Lakewood, Ohio, has disposed of about $2,000,000 in bonds through the sinking fund commission of Columbus, in order to carry forward a pavement and public-improvement program. Public work estimated to cost $1,000,000 is being carried forward in Springfield, Mass., and a representative citizens' and business man's committee examines those seeking employment.

Plans for additional work are being rushed in Buffalo, where now about $12,000,000 worth of work is being done. Portland, Me., Worcester, Mass., and Tulsa, Okla., are other cities from which communications have been received by Col. Woods.

## Federal Highway Council to Cease Activities

Through a resolution passed at a recent meeting of the executive committee of the Federal Highway Council, that organization which for four years has been a factor in the discussion and working out of highway transportation problems, is to cease functioning, at least temporarily. The business depression has cut the contributions so that the council faces a deficit. A recent appeal for funds was entirely unsuccessful.

Various committees of the council are permitted to carry on research and investigations, though they are constrained from incurring any financial obligation that would fall upon the council.

## Sanitary District of Chicago To Have Expert Commission

A commission of experts in sewage disposal has been employed by the Sanitary District of Chicago to recommend the most practical process of sewage disposal with special reference to the proposed north side plant on which studies have been made by the engineers of the district for more than a year. The commission consists of Harrison P. Eddy, Boston; George W. Fuller, New York, and T. Chalkley Hatton, Milwaukee. The proposed plant is to care for the sewage from a population of 750,000 expected in 1930 and 1,250,000 by 1950.

## Railway Bridge and Building Association Meets

### Cinder-Pit Construction, Station-Platform Surfacing, Tunnel Relining Chief Topics

Cinder-pit construction, station-platform surfacing, and relining of old tunnels were the chief subjects of technical discussion at the meeting of the American Railway Bridge & Building Association held at New York, Oct. 18-20. The attendance was larger than at any prior meeting of the association. Addresses by W. G. Besler, president of the Central Railroad of New Jersey, and L. F. Loree, president of the Delaware & Hudson Co., which made reference to the threatening strike of the railroad brotherhoods, gave the meeting a tone distinctly out of the ordinary. Expressing its support of the sentiments set forth in these addresses, the association passed a formal resolution deploring the threatened strike and reaffirming the loyalty of its members to the railroad service.

#### Cinder-Pit Construction

Reporting on cinder-pit construction, a committee headed by G. K. Nuss classified pits into dry pits, water pits, and pits equipped with mechanical ash removers. Representative structures of the several types were shown by drawing and view. Reference was made to the deterioration of the faces of concrete pit walls under the action of hot cinders. Some roads, it was reported, use crushed slag as aggregate in place of stone in the concrete "as a precaution against hot cinders coming in contact with the concrete while the pit is without water." Others use firebrick lining on the sides of the pits. Various types of construction of platforms of wood, earth or cinder fill, concrete, brick and asphalt, and experiences on different roads were reported by a committee headed by F. E. Weise. Experiences were shown to vary, especially in the matter of the comparative advantages of concrete and brick surface. Wear of the surface appeared to be a much less important factor than solidity of foundation and freedom from slipperiness in freezing weather. The voluminous report of the committee on "Lining Tunnels Under Traffic," W. C. Harman, chairman of committee, recorded methods used on the Southern Pacific in concreting timber-lined tunnels, on the Lehigh Valley in concreting two brick-lined tunnels, on the Canadian Pacific in lining the Rogers Pass tunnel, and on the Puget Sound in lining the St. Paul Pass tunnel shortly after construction. Further tunnel lining experiences are to be added to the report.

The new officers of the association are C. R. Knowles, president; Arthur Ridgway, J. S. Robinson, J. B. Wood, C. W. Wright, vice-presidents; C. A. Lichty, secretary-treasurer; new directors, F. C. Baylis, M. Johnson, O. F. Dalstrom.

## McGill Celebrates Centennial

McGill University, Montreal, celebrated recently the hundredth anniversary of its founding with a series of brilliant functions participated in by many of Canada's most distinguished men. The central feature of the celebration was the Centennial Convocation on Oct. 13, attended not merely by the distinguished guests and graduates but by delegates from universities all over the world. Addresses were made by the principal of the University, Sir Arthur Currie; Lord Byng, Governor-General of Canada; Sir Auckland Geddes, British ambassador to the United States; Premier Taschereau of Quebec; Dr. James Rowland Angell, president of Yale University, representing sister universities, and Dr. C. W. Colby, representing the graduates. Fifty-five honorary degrees were conferred, among the recipients of the degree of Doctor of Laws being the folowing well-known civil engineers: W. W. Colpitts, of Coverdale & Colpitts, consulting engineers, New York; George H. Duggan, president, Dominion Bridge Co., Montreal; Phelps Johnson, president, St. Lawrence Bridge Co., Montreal; George F. Porter, of the Canadian Bridge Co., Walkerville, Ont.

Among the other important events of the week were the unveiling of a tablet in honor of the McGill men who were killed in the Great War, a reception of huge proportions and a meeting of the Graduate Society at which it was determined to create an endowment fund, the income to be devoted, under the society's direction, to betterment projects.

Of the many interesting smaller events of the week, was a luncheon given by the Montreal branch of the Engineering Institute of Canada in honor of the engineers upon whom honorary degrees had been bestowed. These engineers, in addition to those already mentioned, were C. V. Corless, of the Mountain Nickel Co., Coniston, Ont., and James A. MacPhail, of Queens University, Kingston.

More than 2,800 graduates registered for the celebration.

## Colonel Russel Promoted

Colonel Edgar Russel, chief signal officer of the Second Corps Area, has been promoted to the rank of Brigadier-General. General Russel is now engaged on important duty in his area which composes New York and New Jersey.

## Bridge Makes Big Profit

According to the August report of the Interstate Bridge Commission on the bridge connecting Portland, Ore., and Vancouver, Wash., the net income of the bridge during the month was about $800 a day over and above operating costs, salaries, and interest on bonded indebtedness. Multonomah County, Ore., gets about $15,000, and Clarke County, Wash., about $10,000 of the total profit for the year.

## Hoover Sends Editors Message

Though unable to be present at the recent National Conference of Business Paper Editors in Chicago, because of the pressure of official duties, Secretary of Commerce Hoover has sent that body a message, part of which follows:

"We have indeed great problems, yet I can not but feel that if these problems are considered as human and not as material questions we can find their solution. We are dealing with questions of railways, of farms, of shops, and of instruments of commerce and industry. But in the background of every person's mind there is the fact that we are dealing not with mechanical things but that we are concerned with the problems of men, women and children. There must be in our discussion of these matters the dominating thought that the better control of economic forces is in fact simply the better comfort of the country. Those several organizations within the Department of Commerce which we have developed and set at work within the past few months are conceived in this spirit and it is a fine augury of our industrial future to know that the programs and purposes of these various departmental activities have come from our manufacturers, merchants, and engineers themselves.

"The editors of the business press have shown a fine spirit of service. Your opportunity for leadership is unique and unchallenged. Upon you rests in large measure the responsibility of the control of industrial thought and opinion in the detail of the industrial, economic, and technical problems which confront us."

## Chicago Zoning Body at Work

Since its appointment July 28, the Chicago Zoning Commission has organized its twenty-two members, chosen a zoning expert, Edward H. Bennett, and now has several engineering parties in the field obtaining information on which to base a zoning ordinance, later to be presented to the City Council. H. T. Frost, assistant to Mr. Bennett, is directly in charge of the field and office work. The commission is headed by Charles Bostrom, commissioner of buildings. Other city officials are the chairman of the Board of Local Improvements, commissioner of health, corporation counsel, chairman of the Chicago Plan Commission and eight aldermen. Among the citizens at large are an architect, E. R. Graham, of Graham, Anderson, Probst & White, and two civil engineers, William Artingstall and Charles B. Duke.

## Tennessee Issues Highway Bulletin

The State Highway Department of Tennessee has issued the first number of a quarterly publication called "Tennessee Highways." Its aim is to give the people of the state a clear understanding of the road-building work now in progress and planned.

# State Highway Engineers Favor Fall Lettings

### More Replies Received to Inquiry As to Policy for Coming Year's Construction

*The letters which follow conclude the list of replies received by Engineering News-Record in response to an inquiry which it circulated:*

**California**—Conditions in California are so different from those in the East and Middle West that the subject matter of the article referred to in your letter has little application here. The California Highway Commission is now working on the $40,000,000 bond issue for state highways, in addition to the federal-aid allotments, and this will provide a very considerable use of labor, both skilled and unskilled.

"The climatic conditions in California are such that there is very little seasonal difference in the volume of highway work in progress. It is true that in the northern part of the state for a few weeks in the winter months rains make difficult paving operations, but it is also true that in some portions of the southern part of the state highway work can be done with success during the winter months only.

"It is expected that the letting of contracts for state highway construction will be fairly continuous for two years or more from this date. When possible, for the last year or two, it has been the policy of the commission to order materials in advance of the awarding of contracts, and this plan doubtless will be continued. Where this method entails in some instances an added expense due to the necessity for moving some of the materials a second time, it often happens ultimately that a saving is made, as, when the materials are delivered in advance on the work ready for use, the commission is not subjected to claims for delay in delivery."—*By A. B. Fletcher, State Highway Engineer.*

**Utah**—"We are endeavoring to get all our projects shaped up for advertising and lettering at the earliest possible date. We have several projects that will be let this fall, which we are in hopes will materially benefit conditions locally. It is our plan to do everything possible along the lines that your letter suggests."—*By Howard C. Means, State Road Engineer.*

**Texas**—"We have no closed season for highway work in this state—we let contracts and start work during each month of the year. The movement that is now on foot in your section of the country to encourage the fall letting of highway contracts is not applicable to Texas. There is hardly a week passes during the entire year that we do not award several contracts and work on them is started immediately. I believe, however, that the adoption by the northern states of the policy you are advocating will facilitate highway work."—*By Rollen J. Windrow, State Highway Engineer.*

Tennessee—"As a matter of general policy it is the desire of the Tennessee Highway Commission to let as many contracts as possible during the fall for two principal reasons: (1) To keep as many men employed as possible during the winter, not only in the department itself, but in the contractors' organizations. (2) To insure stability of fills, as no artificial compaction of fills by means of road rollers, tampers, etc., equals the natural settlement of the soil in place in the fill allowed to remain through the winter and be acted upon by the continuous rain, freezing weather, etc.

"There are, unfortunately, some other considerations of which cognizance must be taken in our particular case, one of which is that our funds are not always available just at the proper time to let all our contracts in the fall. Therefore, we are compelled from this one practical consideration to let at least a number of our contracts at other seasons during the year. It is the policy of the department to let highway contracts at some time during the fall or early winter whenever practicable."—*By D. Q. McComb, Chief Engineer, Department of Highways.*

Idaho—"This department believes it would be advantageous to the state to let the bulk of our highway contracts in the Fall, but owing to the fact that the state treasurer has just succeeded in selling the highway bond issue and also advises that it will probably be the latter part of November before this money will become available, the amount of work let this Fall will necessarily be curtailed."—*By D. P. Olson, Director of Highways.*

Minnesota — "This department has adopted a policy of providing for an early letting on all highway construction which can be prosecuted to any advantage during the fall and winter months. In line with this policy we hope to receive bids on a large proportion of our gravel surfacing and paving construction for 1922. These lettings will be held during November and December, and definite dates will be announced as quickly as necessary details can be taken care of."—*By O. L. Kipp, Construction Engineer.*

North Dakota—Owing to the usual severe winter conditions that prevail in these latitudes it is impractical to carry on extensive road improvements during the winter months. Plans are being made, however, to place considerable gravel surfacing during the coming winter.

"The bulk of the work will be advertised during February, March and April of next year. It will be impossible to prepare plans earlier than this date as we are still awaiting the action of Congress on future federal aid. As soon as this question has been settled we will then have to make preliminary surveys and prepare plans before contracts can be let."—*By W. H. Robinson, Chief Engineer and Secretary.*

## New York Engineers Hear Financing Discussed

At a joint meeting of the New York sections of the national societies of civil, mechanical, electrical and mining engineers, Oct. 19, A. B. Leach, of the New York banking firm of A. B. Leach & Co., discussed the present world situation as affecting the financing of public utilities and large engineering enterprises. He detailed the various factors which have caused such a demand for money that rates of return have been pushed to levels which, at the minute, seriously discourage the financing of public utilities and large engineering enterprises. The situation will right itself, he declared, but just now we must get the very highest production from existing plants and not expect money for new developments. He emphasized also that an essential requirement for public-utility financing was the redeeming of public confidence by utility enterprises.

Philip Cabot of Boston, member of the banking firm of White, Weld & Co., discussed the engineer's failure as a manager. His paper will be found abstracted elsewhere in this issue.

# ENGINEERING SOCIETIES

## Calendar

### Annual Meetings

CITY MANAGERS ASSOCIATION. Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE. New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION. New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

**The Engineers Club of Seattle** has closed negotiations with the owners of the present College Club quarters to take over that building as headquarters when the new College Club building is finished. On Oct. 13 the Engineers Club of Seattle in co-operation with other engineering organizations tendered a luncheon to the visiting engineers attending the tenth annual convention of the American Association of Port Authorities. Maj.-Gen. Lansing H. Beach, Chief of Engineers, U. S. A., was the principal speaker.

**The Texas Section, Am. Soc. C. E.,** at its annual meeting, Oct. 28-29, in Dallas, will hold an inspection tour of the Trinity Portland Cement Co. plant and of the newly finished Dallas-Ft. Worth concrete highway. After a dinner given by the Dallas Technical Club on Oct. 28 there will be an illustrated lecture on the San Antonio flood by Terrell Bartlett of San Antonio and a talk on "The Engineer and City Planning" by E. A. Wood of Dallas. On the morning of Oct. 29, there will be an inspection of the new 29 story Magnolia Building.

**The Colorado Society of Engineers,** at its September meeting, was addressed by Walker Young on "Problems of the Colorado River," with particular reference to the development of lands in the lower Colorado River basin by the construction of the Boulder Canyon reservoir.

**The American Water Works Association, Iowa Section,** will hold a meeting Nov. 1-3, in Omaha, Neb.

**The Society of American Military Engineers, Philadelphia Post,** at its Oct. 27 meeting will be addressed by Col. Edward Carpenter, chief of staff, 79th Division, on "Proposed Organization of the Reserve of the Army of the United States."

**The Engineers' Club of Cincinnati,** was addressed Oct. 20 by Dr. Burtis B. Breese, professor of psychology, University of Cincinnati, on "Personality and the Attempts to Measure It."

# PERSONAL NOTES

J. M. HERBERT, of St. Louis, was elected president of the Dallas Terminal Railway & Union Depot Co. at a meeting of directors and stockholders held in the office of the company Oct. 11. Other officers are: F. W. Green, Tyler, vice-president; J. F. Lehane, vice-president in charge of traffic; E. M. Reardon, treasurer; R. T. Allen, secretary and auditor, and G. K. Warner, assistant secretary and assistant auditor.

MAJOR-GEN. GEORGE GOETHALS arrived in Dallas, Texas, Oct. 9 for the purpose of making a survey to determine the feasibility of building a large lake in the Trinity River bottoms instead of leveeing the river as originally planned. Gen. Goethals is accompanied by several engineers of his firm and is collaborating with the city, county and other local engineers.

FLOYD W. PARSONS, formerly editor of *Coal Age* and for the past two years in charge of the department entitled "Everybody's Business" in the *Saturday Evening Post,* has become editorial director of the *Gas Age-Record.*

J. P. J. WILLIAMS has resigned as editorial assistant of the American Society of Civil Engineers and has joined the faculty of Cooper Union, New York City.

W. T. CHEVALIER has resigned as general manager of the Wailes Dove-Hermiston Co., manufacturers of bitumastic compositions, New York, to become vice-president of the Brearley Service Organization which is engaged in advertising and publicity work, specializing on public relations. During the war he served as lieutenant-colonel with the 11th Engineers, one of the earliest contingents sent to France.

JAMES ZANOLIO, recently with the Colorado State Highway Commission on work near Durango, Col., is now engaged on railroad location for the Rio Grande Ry. in Utah.

E. F. KULTCHAR has been appointed district engineer, maintenance of way, of the Illinois district, Chicago, Burlington & Quincy R.R., with headquarters at Galesburg, Ill.

C. P. RICHARDSON, assistant engineer, Dakota division, Chicago, Rock Island & Pacific Ry., has been placed in charge of special work in the engineering department at the general offices in Chicago.

JOE C. THOMAS, formerly chief engineer for the John T. Milliken interests in Oklahoma, is now with the New Mexico State Highway Department on work between Socorro and San Antonio.

S. P. REES, formerly with the Pittsburgh Filter & Engineering Co., Pittsburgh, Pa., has been made manager of the municipal filtration department of the International Filter Co., Chicago.

## OBITUARY

F. W. CAPPELEN, for 24 years city engineer of Minneapolis, Minn., died Oct. 16. He was born in Grammen, Norway, in 1858, and studied at the Technical School of Cerebro, Sweden, and the Dresden Polytechnic Institute at Dresden, Germany, from which he was graduated in 1880, entering the service of the Northern Pacific Ry. as a draftsman. A year later he was made assistant engineer in charge of location and construction work. For two years he was bridge engineer for the St. Paul & Northern Pacific Ry., at Minneapolis, and designed for that road the substructure of the 1,600-ft. bridge over the Mississippi at Minneapolis. From 1886 to 1893 he was assistant city engineer of Minneapolis during which time he designed and built three large bridges over the Mississippi River, one of which is the Franklin and reinforced-concrete bridge now under construction with a 400-ft. span, the longest of its type in the world. He also designed and built the North Minneapolis water-works. Since 1893, except for a 4-year period when he was engaged in private practice, he filled the position of city engineer of Minneapolis. Mr. Cappelen was a member of the committee on classification and compensation of engineers of Engineering Council and was also one of the two engineering members of the Minnesota State Board of Health.

PERRY A. HAVILAND, surveyor of Alameda County, Cal., for the past 16 years, died Oct. 12 after a brief illness. He was, until recently, senior member of the firm of Haviland & Tibbetts of San Francisco.

## BUSINESS NOTES

THE CHAIN BELT CO., Milwaukee, Wis., has opened offices in Buffalo, N. Y., with T. E. Crocker, formerly assistant engineer with the New York Central R.R. at Buffalo, as district manager. He will handle the Rex line including chain, sprocket wheels, traveling water screens, elevators and conveyors.

A. T. MERCIER, formerly district engineer for the Southern Pacific lines at Los Angeles and more recently superintendent of the Oregon lines of the Southern Pacific Co., has been appointed general manager of the San Diego and Arizona Ry., with headquarters at San Diego, Cal.

THE AUSTIN MACHINERY CORP., Chicago, Ill., announces the incorporation of the Canadian Austin Machinery, Ltd., Woodstock, Ont., as sole manufacturers and distributors in Canada of the complete Austin line of earth-moving and concrete-mixing equipment.

THE WISCONSIN CONSTRUCTION CO., general contractors and engineers, will in the future be known as the Paul C. Kroeck Co., with offices in Milwaukee, Wis.

## EQUIPMENT AND MATERIALS

### Vertical Lift Pier Shed Door

Double-leaf vertical lift pier shed doors which permit cargo being stored close to the interior face of the door are being made by the McHarg-Barton Co., of New York. Two sample doors have just been installed on piers 17 and 18 of the Stapleton development for the City of New York.

The door consists of two leaves made of steel frames covered with crimped metal, each approximately 18 ft. wide by 10 ft. high, the upper leaf hanging above and just outside of the lower leaf with the face of the two doors overlapping and touching at the center of the door opening. As the door is opened the lower leaf rises vertically until suspended back of and touching the upper leaf, when both leaves rise together as a unit following a concave circular path until they rest suspended in a horizontal plane overhead above the cargo storage space. In this operation the door leaves are guided by curved steel channels attached to the roof trusses. This action is effected by means of an ingenious arrangement of two continuous chains attached to the two leaves of the door on either side passing over sheaves and so counterbalanced that the mechanism is always is perfect mechanical balance at all positions whether one leaf or two is being raised or lowered. It is easily operated by one man by means of a hand chain operating through a set of gears; the doors can be fully opened to their horizontal position close to the roof of the structure in from 45 to 60 sec., or closed in the same time.

### Five-Ton Bucket

A 5-ton bucket designed especially to handle coal and ore from pile to car and vice versa, though having other uses, has recently been manufactured by the Blaw-Knox Company, Pittsburgh, Pa. The bucket, which is known as the Algoma, is massively

designed to give the maximum service combined with great closing power. The closed length of the bucket is extremely small as compared to the open length. The weight of the Algoma is a little more than five tons and is capable of picking up a load its own weight.

### Goose-Neck Boom

In adapting a P&H 206 crane of the type shown in the accompanying illustration to the handling of loads such as unit packages of lumber from high piles, it was found that the length of the lumber interfered with the straight or standard-crane boom. To

overcome this and eliminate much of the costly labor required to handle lengths of lumber, pipe, etc., Pawling & Harnischfeger Company developed the goose-neck boom. This boom may be lifted almost straight up without having the load interfere.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Cement Production and Shipments Heavy in September

The movement of portland cement continued on a large scale throughout September, more than 11,300,000 bbl. having been shipped from mills, according to figures compiled by the U. S. Geological Survey. Shipments during the third quarter of the year were approximately 33,970,000 bbl., a record for this quarter. For the nine months ending Sept. 30, 1921, the shipments amounted to 74,045,000 bbl. which exceeds the former record volume moved in the corresponding period of 1920.

Favorable operating conditions are indicated by the large September production of 10,027,000 barrels of finished cement, which established a record for that month. The average daily production was greater than that of August, and had there been as many days in September as in August the September production would have shown the larger total.

Stocks of cement at the mills were drawn upon to supply demand during September, as is customary in the season of active demand. At the end of the month stocks of finished cement at mills were approximately 6,953,000 bbl. compared with 8,280,000 bbl. at the beginning of the month. This is about 135,000 bbl. below the average for the month of September, 1917-1921.

The production, shipments, and stocks of finished portland cement in the first nine months of 1921, are shown in the following table:

| Month | Production (Barrels) | Shipments (Barrels) | Stocks at End of Month (Barrels) |
|---|---|---|---|
| [illegible] | 4,098,000 | 2,549,000 | 10,300,000 |
| [illegible] | 4,379,000 | 3,331,000 | 11,400,000 |
| [illegible] | 6,763,000 | 6,221,000 | 12,000,000 |
| [illegible] quarter | 15,240,000 | 12,091,000 | . . |
| [illegible] | 8,651,000 | 7,919,000 | 12,600,000 |
| [illegible] | 9,281,000 | 9,488,000 | 12,450,000 |
| [illegible] | 9,296,000 | 10,577,000 | 11,150,000 |
| [illegible] quarter | 27,228,000 | 27,984,000 | . . |
| [illegible] | 9,568,000 | 10,301,000 | 10,414,000 |
| [illegible] | 10,244,000 | 12,340,000 | 8,280,000 |
| [illegible] | 10,027,000 | 11,329,000 | 6,953,000 |
| [illegible] quarter | 29,839,000 | 33,970,000 | . |
| Total..... | 72,307,000 | 74,045,000 | . . |

## Average Wage Reduction So Far This Year Is 16 per Cent

Wage reductions during August and September from 3 per cent to 50 per cent and averaging 14.9 per cent for over 400,000 additional workers in 259 industrial groups and establishments, are shown in a special digest made by the J. L. Jacobs Company, engineers and statisticians, Chicago. This average of 14.9 per cent compares with the average reduction of 15.9 per cent in wages for over 4,450,000 employees in 693 other establishments and group industries throughout the country reported during the first seven months of this year.

Summarizing the wage reductions made during the last 60 days and for the first seven months of the year, the analysis shows an average reduction of 16 per cent affecting almost 5,000,000 workers in 952,000 establishments or industrial groups in practically every key industry in the country.

By deducting 1,879,000 railroad and express employees who received an average wage reduction of 12½ per cent, the average reduction for the other 950 groups and establishments is 18.1 per cent.

In the buildng trades the more important changes reported included wage reductions in Chicago, Detroit, Dayton, Ohio; Fort Wayne, Ind.; California, and Westchester County, New York.

## American Locomotive Company Receives Large Order

Recent orders received by the American Locomotive Company include the following: For the Chilean State Railways, 20 broad gage Mikado type engines, 195 tons each; for the Chicago, Rock Island & Pacific R.R., 14 Mikado type engines, 168 tons; for the Mississippi Central, two Mikado type engines, 80 tons; for the LaCrosse & Southeastern R.R., one ten-wheeler, 67 tons. The firm has also recently finished 47 engines for the Pekin-Suiyuan, 7 of which are the largest engines ever exported from the United States. The placement of an order by the Chicago, Rock Island & Pacific for 14 Mikado type engines is one of the largest domestic orders placed in some time.

## Unemployment As It Affects the Building Trades

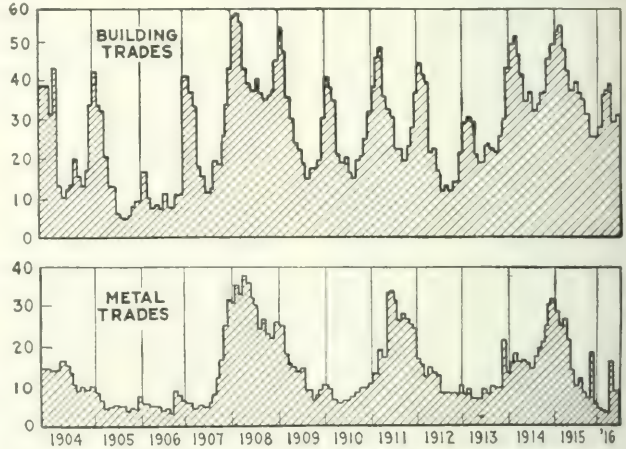
### Climatic Conditions Governing Factor —Three Winter Months Hardest

By Ernest S. Bradford
Economist and Statistician, New Rochelle, New York

The unemployment existing from year to year in the building trades is shown in one of the charts reproduced herewith as presented to one of the committees of the President's Conference on Unemployment. The data from which this chart was compiled were taken from the state of New York and, while not purporting to apply in exactly the same ratios to the entire country, are nevertheless believed to be in many respects fairly typical of the ups and downs of the construction industry.

A study of the building unemployment situation as shown by certain charts and figures kept over a long period of years may reveal in time respects in which seasonal lack of work can be reduced by making some provision for other work for building employees during slack periods. Such a suggestion was made by the economic advisory committee of the unemployment conference. Until this is done, the winter will mean in all northern cities a marked curtailing of construction work and increased idleness due to that cause. The present year, however, is clearly an exceptional one which requires unusual effort to assuage what may become an abnormally high unemployment season.

As compared with the metal trades, the building trades curve shows a




PERCENTAGES OF UNEMPLOYMENT OF ORGANIZED LABOR IN THE BUILDING AND METAL TRADES—NEW YORK STATE

much greater fluctuation and a wider range of unemployment. One interesting feature of the chart herewith is the low percentage of unemployment during the winter of 1905-6, and again the winter of 1912-13. The explanation which at once suggests itself, that this was due largely to the mild winters of those years, is confirmed by reference to the files of the United States Weather Bureau. During the winter of 1905-6 the entire period from January to March was mild enough to allow the carrying on of construction almost continuously.

Figures from which the accompanying chart was made were collected for more than a dozen years and extend over a long enough period to justify the conclusion that they represent a clearly marked movement in the industry. No figures were collected after the middle of 1916 inasmuch as funds were lacking. How valuable definite figures would be for the current year, collected consistently by a responsible statistical body, and comparable with previous years, is manifest. Knowledge of the extent of existing unemployment in the building and other trades would assist in measuring the extent of the problem confronting us this winter and taking intelligent action regarding it. Relief for unemployment could thus be expedited and the improvement of the general business situation would be hastened.

It is apparent that a thorough study is necessary before the problem of unemployed building trade mechanics can be handled. As yet little attention has been paid to discovering what occupations will dovetail with construction and furnish work from December to March. This is a field in which enterprising employers of building labor or practical students of unemployment problems can perform a service to the country by developing a plan which will eliminate some of these seasonal fluctuations.

## Employment in Selected Industries Quickens

Comparing the figures of September, 1921, with those of identical establishments of September, 1920, the Bureau of Labor Statistics finds increases in the number of persons employed in eight industries and decreases in six industries. The most important increase, 59.2 per cent, appears in the woolen industry, while an increase of 18.4 per cent is shown for boots and shoes, and one of 13.9 per cent for cotton finishing. Decreases of 42 per cent, 35 per cent, and 31.6 per cent appear in iron and steel, car-building and repairing and paper making respectively.

Comparative data for September and August of this year show that in eleven industries there were increases in the number of persons on the payroll in September as compared with August, and three decreases.

## New York Construction Materials and a Railroad Strike

New York is so favorably situated that even a serious railroad strike will not keep out necessary supplies. With barge and lighter service supplementing, the railroads terminating in Jersey City and Manhattan, New York producers and dealers believe that there will be no serious interruption in supplies of construction materials. Producers and dealers have foreseen the possible stringency as follows:

Steel—A large dealer advises he has ample warehouse stocks in Jersey City, which will be shipped to the metropolitan district by trucks, except in the contingency of a ferry tie-up. Of course mill shipments will be out of the question except in the event of emergency operation of the railroads.

Sand and gravel—Unlimited supplies may be shipped by water.

Crushed Stone—As stone is shipped by water the only possibility of shortage can come from a protracted strike cutting off fuel supplies for tow-boats. An important producer advises that he has two months' supply of coal and one month's supply of powder.

Common Brick—There is no reserve stock, but the kilns supplying New York district can supply any demand on short notice by barge from the Hudson River district.

Hollow Tile — Reserve stocks are large and can be shipped from Perth Amboy by truck, coming in either by New Jersey or Staten Island ferries.

Cement—Liberal supplies already in New York warehouses will be augmented by shipments from both the Lehigh and Hudson River districts, the latter predominating. Supply is safe except in the case of a protracted strike.

Lime — Warehouse stocks are heavy and can be reinforced by water shipments.

Steel Pipe — Heavy warehouse stock will afford ample supply for a reasonable length of time.

## Industrial Association Idea Spreads on Pacific Coast

The Industrial Association of San Francisco, which was one of the outgrowths of last summer's building strike in that city has rapidly gained popularity as the principles for which it stands have been put into effect. Reference to this organization appeared in *Engineering News-Record* Sept. 8, 1921, p. 427. Early in October reports from other Pacific Coast centers indicated that the industrial association plan now in effect in Los Angeles and San Francisco is more or less definitely being considered in other Coast cities.

The program being followed is that of giving equal consideration to all three interests involved in industrial relations, namely: The public, capital and labor. Union organization is not discouraged in any way, but union activities that work contrary to public interest are vigorously opposed.

## Railway Wins Pay Cut Order From Labor Board

The United States Railroad Labor Board has authorized a 20 per cent wage reduction for engineers, motormen, firemen, conductors, and brakemen of the Electric Short Line Railway Co., Chicago. In ordering the cut the Labor Board took into consideration, for the first time in its deliberations, the financial condition of the petitioning railway. It was pointed out that unless a reduction was allowed, the road must become bankrupt. The reduction was made retroactive to Oct. 16.

## To Start Railroad Work in Texas Costing $425,000

The first work on roadbed improvements, totaling $425,000 to be made by the M. K. & T. Ry. Co. in Texas will begin Nov. 1 with the laying of new rails between Hillsboro and Waco and continue until Jan. 1. About $25,000 of the expenditure will be for flood damages incurred during the recent San Antonio storm. A meeting of the district superintendents of the maintenance of way department was held in Dallas Oct. 10 with W. M. Whittenton, assistant chief operating officer, presiding.

## Average Earnings of Factory Employees in New York

According to figures compiled by the chief statistician of the New York State Department of Labor, the average weekly earning of New York state factory workers declined 45c. during July. The July average weekly earning in the factories as a whole was $25.26, which is $3.67, or 13 per cent, less than the record average earning of last October. The rise in weekly earnings since June, 1914, is 99 per cent. Reductions in working time were again responsible for the larger part of the decrease in average earnings.

## Increased Demand Further Reduces Idle Cars

According to reports just received by the car service division of the American Railway Association, increased demand for transportation facilities has resulted in a further reduction in the number of idle freight cars. For the period from Oct. 1 to Oct. 8 this decrease amounted to 29,450 cars, making the total idle freight cars 345,920. Of this number 202,950 were in need of repairs and the remaining 142,970 were in good order and could be placed in service immediately if traffic conditions warranted. This figure compares with 172,420 surplus freight cars in good order on Oct. 1.

## Residents Get Preference on New Jersey State Work

Residents of the state will be given preference when it comes to the employment of skilled and unskilled labor on state work of the Department of

Institutions and Agencies, State of New Jersey. This announcement has been made by Commissioner Burdette G. Lewis, and is in keeping with a determination on the part of the state board of control to contribute as far as possible to the solution of the unemployment problem in New Jersey.

### British Columbia Prepares For Winter Road Work

The British Columbia Government at Victoria has sold government bonds to the value of $2,000,000 to provide money for active road construction during the winter months, Hon. John Hart, minister of finance, announces. The bonds are six per cent, run for 25 years, and are payable as to interest and principal in Canada only.

### Seattle Building Increases

Substantial increases in the volume of construction undertaken in Seattle during September were noted, and indications point to an increasing volume of business in the construction field during the balance of the year. During the month of September, permits valued at $1,355,430 were issued, something like $500,000 higher than for September of last year.

### Dallas County Rejects Bids on Road Bonds

The Dallas County, Texas, Commissioners' Court has recently rejected a number of bids made for the second series of road bonds amounting to $2,700,000 because the court did not believe that the best price offered was either what the bonds were worth or all that could be gotten for them. The first series, disposed of last year, amounted to $2,100,000, bore 5 per cent interest and sold for a premium amounting to almost 7 mills. The series now offered for sale bears 5½ per cent and the best bid offered was 94¼c.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 6, the next, on November 3.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2 88 | $4 00 | $4.00 | $2.88 | $3.16 | $3.75 | $3.70 | $4.00 | $4.00 |
| Structural rivets, 100 lb | 3 70 | 5.25 | 5.50 | 3.68 | 4.15 | 4.25 | 5.50 | —4.50 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.78 | 3.20 | 3.50 | 2.78 | 3.18 | 3.57½ | 2.35 | 3.75 | 3.75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 52 65–5% | 45% | 65½% | 58.9–5% | 38% | 51.8% | 55% | 5% |
| Cast-iron pipe, 6 in. and over, ton | 45.30 | 40.50 | 54.30 | —42.60@44.10 | 47.80 | 52.00 | 50.00 | —53.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | 2.40 | —2.60 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.10 |
| Gravel, ¾ in., cu.yd | 2.00 | —2.00 | 2.25 | 1.65 | —1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.25 | 1.65 | —.50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 45.00 | 38.00 | 35.00 | 48.00 | 36.00 | 50.00 | 29.00 | 24.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | —22.00 | 27.50 | 21.00 |
| Lime common, lump, per bbl | 3.69 | 1.60 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | —18.40 | 11.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .14 | .124 | .0821 | .092 | .09 | .12½ | .10 | .15 |
| Hollow partition tile 4x12x12, block | .11370 | .14 | .124 | .0657 | .092 | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal | .73 | —.85 | .93 | —.80 | —.76 | —.92 | .83 | .79 | .90 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | 72½ | 50 | .50@.55 | .75 | .50@.60 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted along side dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb net. **Dallas** quotes lime per 180 lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine, and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag charge is 8c. per bbl. Discount of 10c. per bbl for payment within 20 days from date of shipment.

## Changes Since Last Week

Steel plates are quoted at the Pittsburgh mills at $1.60@$1.65 for small tonnages; but business has been done as low as $1.50@$1.55 per 100 lb. Structural shapes are quoted at $1.50@$1.65 as against last week's price of $1.60@$1.75 per 100 lb. Reinforcing bars are quoted at $1.50 with small tonnages selling at $1.60@$1.65 per 100 lb. Mill shipments, New York, of structural steel shapes and plates are quoted at $1.98@$2.13; bars at $1.88@$2.03 per 100 lb. Minneapolis quotes mill shipments of steel shapes at $2.51 via all rail; $2.45 per 100 lb. by lake and rail. Reinforcing bars are quoted in Seattle at $4.50 as against $5 per 100 lb.

Decreases in cast-iron pipe are reported in two cities. Seattle quotes $53 as against $55 and Chicago $42.60@$44.10 as compared with $45.60 per ton.

Atlanta reports a drop of 9c. per bbl. in the price of cement. Gravel prices have declined 50c. in Minneapolis and 13c. per cu.yd. in Atlanta. Minneapolis quotes sand at 50c. as against $1 per cu.yd. at pit. Hydrated finishing lime is quoted at $22 as compared with $25.40 per ton the previous quotation.

Common brick is quoted in New York at $15 wholesale as against $15.50@$16; $18.40 per thousand delivered.

A decline of 1c. per gal. in the price of linseed oil is reported in Denver, Atlanta and Chicago; while Minneapolis quotes a drop of 5c. per gal. in 5 bbl. lots.

Building crafts in Colorado Springs, Col. are reported as having ceased work October 20 when the wage reduction, approved by the State Industrial Commission, was placed in effect.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
*Editor*

Volume 87 — NEW YORK, NOVEMBER 3, 1921 — Number 18

## Defeated by Public Opinion

SELDOM has there been a more striking example of the force of public opinion than in the capitulation of the railroad brotherhoods last week. The public not only expressed its thorough disapproval of the strike, but that disapproval backed up the railroads and public officials in their plans for meeting the emergency. As Mr. Sheppard, president of the Order of Railway conductors put it, the opposition of the public and the Administration made it plain that the brotherhoods could not obtain their "objectives."

## Working Rules Paramount

BECAUSE the Labor Board has agreed to consider all current working rule disagreements before taking up any new wage reductions, there has been a too wide-spread feeling that the brotherhoods have once more in effect won what they set out for. The fact is that the working agreements are more important than the wage scales. The cost of running the railways, which after all is what must be made less if all of us are to prosper, can be reduced by a rational revision of the working rules much more quickly and justly than by any straight wage reduction. If the Labor Board approaches these working rules with a fair mind and with a judicious consideration of what they mean in operating costs, its decision in their settlement will make the matter of base wage scales of secondary importance.

## Hydraulic Dam Cores

IN THE light of the observations on the slope washout at the Englewood dam reported in the news columns it seems necessary to revise some current notions on hydraulic dam construction. The essential question has been whether a water-deposited puddle core consolidates rapidly or remains semi-fluid for a time. Much has been said concerning this question. The discussions, with its background of the large-scale accidents at Necaxa and Calaveras, has tended to cause doubt as to the advisability of using what is certainly the cheapest, and many think the best, method of building earth dams, namely the hydraulic fill method. But the facts of the Englewood core exposure make it plainly evident that a hydraulic core may be so built as to be solid even up to the top layers, just deposited. The section of the dam in which the washout occurred had been built up at much more rapid rate than the rest, because it was the closure of the gap at a temporary spillway maintained last season; yet consolidation, or perhaps we may say precipitation of the core silt was so prompt that the much-discussed semi-fluid zone was not 80 ft. deep, nor even 20 ft., but was actually non-existent. Moreover, the core mass laid bare proved to be not merely a solid substance but a tough substance, one possessing distinct structural value. These facts clarify effectively a field in which doubts have had a harmful influence. The same facts, it is said, have been revealed in other aspects on various earlier experiences in the Miami dam work. It is to be hoped that these will soon be laid before the profession in full.

## Joint Committee Report Not Final

ALTHOUGH the progress report rendered last June by the Joint Committee on Concrete and Reinforced Concrete was expressly labeled "tentative" there are a number of engineers who are disposed to use it as a finished document. Such is the finality printer's ink confers. The committee took this chance when it presented a unanimous report but there seemed to be no other way in which prospective specification could be gotten before the thousands of members of the constituent societies. It is only fair to the committee to say that there was by no means agreement on all of the provisions of the report but that expediency pointed to a unanimous acceptance of the preliminary draft. Criticism would thereby become more concentrated and final acceptance made more easy. This criticism will have its first voice at a three-day meeting proposed by the American Society of Civil Engineers in December. The other societies will follow with similar meetings, and until these meetings are reported and the basis of the opposition revealed no one should assume any finality to the provisions of the specifications.

## Improvement of Plant Railways

POSSIBILITIES of economy in the operation of the industrial railway systems at large manufacturing plants are suggested by the recent paper on electric operation of the railways of steel plants by R. B. Gerhardt, abstracted in *Engineering News-Record*, Oct. 20, p. 652. As a rule such a plant railway is apt to receive little attention as to cost, being regarded as a minor expense in the operation of the plant. Consequently there are unsystematic track layouts, inadequate maintenance, inconvenient service and high but unknown or unrecognized operating costs. It is probable, then, that material economies may be effected in the construction and operation of many railways of this class, irrespective of a change in traction. It is of particular interest to note that although the third-rail contact system is usually considered undesirable for yard service, Mr. Gerhardt regards it as entirely practicable. In fact, it appears to be necessary, in order to meet a certain condition in steel plants. But as this condition is not universal, most plants would be free to compare the two systems on their merits. As decided economy in favor of electric operation is indicated by the paper, it would be of value to be able to check against the author's views the actual results of an electrified plant railway. They would be of much value, too, to those having to deal with plant design and operation.

## San Francisco Bay Bridge

THERE has never been any consolidation of cities on San Francisco Bay. Oakland, Richmond, Berkeley, Alameda, San Mateo and others are independent municipalities, grouped around a central city whose area is only 46.4 sq. miles. San Francisco is like New York City before the five boroughs were united to form one municipality. The last census figures show the San Francisco metropolitan area to have a population of approximately 1,000,000 but means of intercommunication between the city and the suburban districts are not good. The air line distance between the San Francisco and Oakland city halls is only 8½ miles, but by rail or highway it is nearly 90 miles. The direct route involves a water trip of 20 minutes, besides a street car ride in both cities. Via the auto ferry route, the trip is still longer, requiring 40 minutes at best. Because of this long trip and delays due to congestion, the automobile traffic has been only nominal. The automobile ferry operated by the Southern Pacific Co. handled an average of 1,667 pleasure cars per day during 1920. This might be considered a large number for a city of the same size in another part of the country, but California has more automobiles, on a per capita basis, than any other state—one for every 6.2 persons in 1919. On a Sunday or a holiday, as many as 30,000 pleasure cars have been counted leaving San Francisco over the one well-paved highway "down peninsula."

It is this tendency toward much auto travel that launched the present campaign for a transbay bridge. The commuters' desire for something better than the present passenger ferry service, of course, increased popular interest in the bridge project, but so far as the time element is concerned it is doubtful if the running time of interurban trains over the majority of the proposed bridge routes would materially decrease the time between terminals. It may be, rather, that the most satisfactory service for the regular commuter, within the reach of economic investment, would be gained by building a viaduct from the Oakland side to Goat Island, thereby reducing the ferry trip from 2.85 to 1.5 mi. But putting a roadway for vehicles on that viaduct and using auto ferries would be no means satisfy the automobilist. In California, at least, experience with auto ferries is that peak loads are so great that it is not economical to maintain the equipment necessary for adequate service at such times. For these reasons a distinction should be made between the service the commuter wants, that is, the quickest means of reaching destination, and that which the automobilist insists upon, a continuous through route. To the automobilist it will not matter that the through route is a little longer than the air line distance, but he will in nowise be content with the interrupted travel of a ferry.

Thus if a crossing for automobiles can be provided at considerably less than the cost of a structure to serve both vehicular and rail travel, then the additional cost of a railroad bridge does not seem to be justified at present. The proponents of crossings designed to serve all kinds of traffic will not agree with this view. In fact, it has already been charged that to oppose a "road and rail" crossing is to lack confidence in the future of the city and to place limitation upon its growth. Quite the contrary is true. San Francisco Bay is destined to have many crossings and the present question is merely that of deciding on the type and location of the one which should be built first.

## The A. S. M. I. Convention

IN ANY engineering society whose field covers so wide a range as does that of the American Society for Municipal Improvements, which held its twenty-seventh annual convention at Baltimore last week, as reported in the news columns of this issue, the program of technical papers and committee reports must necessarily be comprehensive if all specialties are to be treated. It is questionable, however, whether the maximum of service is accomplished by attempting to dispose of any such volume of material as was scheduled at Baltimore. The program listed no less than 35 technical papers and 37 committee reports—a total of 72 addresses—to be disposed of in six sessions averaging 3 hours each, or a total of 18 hours.

If such a program is to be completed, it is obvious that an average time limit of 15 min. must be allotted to each paper or report, assuming they follow one another without interruption. On this basis, however, no time is available for discussion, admittedly one of the most important features of any gathering of engineers. Certainly one-third of the time of the technical sessions is not too much to give to discussion from the floor, especially if the membership present, representing a country-wide experience of many years in all branches of municipal engineering, is to give expression to details of practice and new developments of timely value. If, therefore, we deduct one-third from the total of 18 hours assigned to technical subjects, we would have 12 hours in which to dispose of 72 addresses, or an average of 10 min. for each paper. Any one who has been an attendant at engineering society meetings knows the futility of allowing as little time as 10 min. for the average paper or report; three times this amount would be nearer the actual requirements.

If some analysis of this sort had been made, it is doubtful whether the Baltimore program would have been so heavily overloaded as was the case. The result, of course, was an almost total elimination of discussion. In the face of this situation, however, the chair, throughout the four-day meeting, never once strove to relieve the tediousness of most of the sessions by imposing any time limit on any speaker. The incoming administration of the society will have an opportunity of exercising to a greater degree than was evident at this year's convention, businesslike methods in scheduling and actually conducting the technical program.

The fault noted is not confined to the American Society for Municipal Improvements, but that organization has been, for years, a consistent offender. Far more valuable than an attempt to pile up the largest possible volume of technical papers and reports would be an effort to inquire into what new developments had taken place in the various engineering specialties during the year, select men competent to present the chief points of interest, and request others to start discussion in the hope of bringing out, at the meeting, details of procedure which others have found useful.

Then, too, there is the important point of exercising discrimination in the placing of papers and reports on the program so that the new and important developments may be accorded more prominence than merely routine matters. Lengthy general descriptions of local engineering works, representing nothing but standard practice, should be curtailed and time devoted to what the year has brought out in methods, materials, or equipment that make for progress.

To be of maximum value to those who attend it, an engineering convention must receive a considerable amount of advance planning by men with an appreciation of relative values, and a generous amount of time should be allotted to discussion from the floor.

## Politics or Engineerin

SOME of the engineers who wrote the report on the Narrows tunnel for the New York City Board of Estimate object to our editorial comment on that report last week. They contend that this tunnel was authorized by the same legislature and governor as authorized the Port Authority and that blame for ignoring that Authority lies at Albany. They feel that our criticism implies a political bias to their report.

We refuse to consider the case of the Port of New York a political one; its future is so bound up in the life of the whole nation that it presents one of the foremost economic problems of the day. Both from an economic and engineering standpoint the port must be considered as a geographical unit, which means that it must either be in the joint control of the two states in which it lies or it must pass under national jurisdiction. The former solution has been initiated, but the City of New York—and by that we do not mean the mayor or the Board of Estimate or any of the so-called political elements alone, but also the real estate interests and most of the business bodies—have fought the merger of the port interests from start to finish. That is the reason why any report to a city body which ignores the Port Authority appears to be merely a phase of the same opposition.

There is no quarrel with the engineering features of the report—that was made plain in last week's comment—in fact, the figures and deductions are more concise and complete than we have seen in any similar analysis but we insist that the proprieties would have been better served by some reference to the Port Authority's report or activities. That Authority has been established; New York City has its rights and privileges guarded in the future actions of the Authority. A proper sympathy with the joint scheme of control would seem to require an acknowledgment of the rôle the Aufnority will play in the development of the port through the proposed tunnel and belt line. Would the engineers, for instance, have recommended elaborate changes in channel deepening or location without reference to the War Department's control or approval? And yet in justification of an interborough tunnel scheme they emphasize the value to the port of a new railroad in the neighboring state and object when it is suggested that they might have accorded some recognition to an interstate body that has been formed to control just such a railroad.

The conflict between the city and the interstate idea has been so acrid that to disregard it even in an engineering report is to throw the weight of those making the report against the joint port idea. To criticise such an omission is not to ascribe sinister political motives to the engineers. Their offense, if any, is not positive but negative and is serious in that it may be taken as indicating a state of mind in the city of New York which does not augur well for the joint port idea. The Port Authority itself is by no means blameless; it has shown little disposition to concede anything or explain anything to the city authorities. Both city and interstate body need instruction in the art of compromise.

## Lessons of the Crisis

THERE are various lessons to be learned from last week's crisis—one of preparation and the other of the folly of flying in the face of a policy that has solid support. Of preparation, the lesson can be put in the old adage, "In time of peace prepare for war." Public opinion—combined with efforts to run the roads—would have defeated the strike after it had come. But the victory before the battle was due to the energetic preparations by the railways and public officials to meet the situation. Many railroad and public officers believed even at the announcement of the strike that it would not occur. Nevertheless they did not remain idle. They worked under the theory that it would come. The railroads recruited new forces. Public officials made censuses of food and fuel supplies and organized trucking transportation. To them there was no other thought, as far as their actions were concerned, than that the war would come. Possibly we are not clear now of a railroad stoppage, and that eventually the brotherhoods will make the test. Should that occur the public will be several laps ahead in the lesson of last week, "In time of peace prepare for war."

On the brotherhoods' side we hope that they have learned the lesson that it is futile to work against a policy that has practically universal public approval. Just now the public favors price reduction. Particularly is it demanding lower railway rates. Furthermore, it is intolerant of efforts whereby one element of the community tries to maintain an advantage over the others. The farmers, the salaried workers and large groups of manual workers, both organized as well as unorganized, have suffered heavy pay cuts.

When it is appreciated that the support of these classes was absolutely necessary to the brotherhoods if they were to win, the absurdity of the proposed strike rises to the height of the ridiculous. In effect the brotherhoods were saying, "We know that your pay has been cut, but nevertheless we want you to go through the inconvenience of a great railroad strike and see your mines and factories close so that we may not have our pay reduced." It was a fine display of lack of good sense and generalship.

Not only the railroad brotherhoods but the mine workers as well need to realize the futility of antagonizing the whole public. The latter are preparing for a big strike on April 1 next; at least they refuse now to surrender the strike weapon by agreeing to arbitration in a new wage agreement, although the operators are ready to arbitrate. All those with the best information believe that the strike is almost certain. The issues are bound after a month or two to get into the public prints and the public will have an opportunity to prepare itself well in advance of the difficulty. Without attempting now to discuss the merits of the case it is apparent that the miners have lost the first engagement in refusing to agree to arbitration. It is also certain that the public is going to be ranged on the side that will tend to bring a reduction in price of coal. Coal prices are more galling to the individual than railroad rates. These factors must be taken into consideration by the mine workers or they are likely to find themselves next spring in the position the unions were in last week.

In any event the public is far stronger today than it was last week in meeting issues of that sort. If it backs up unanimous views by vigorous preparation it can save itself the sufferings inevitable in general strikes.

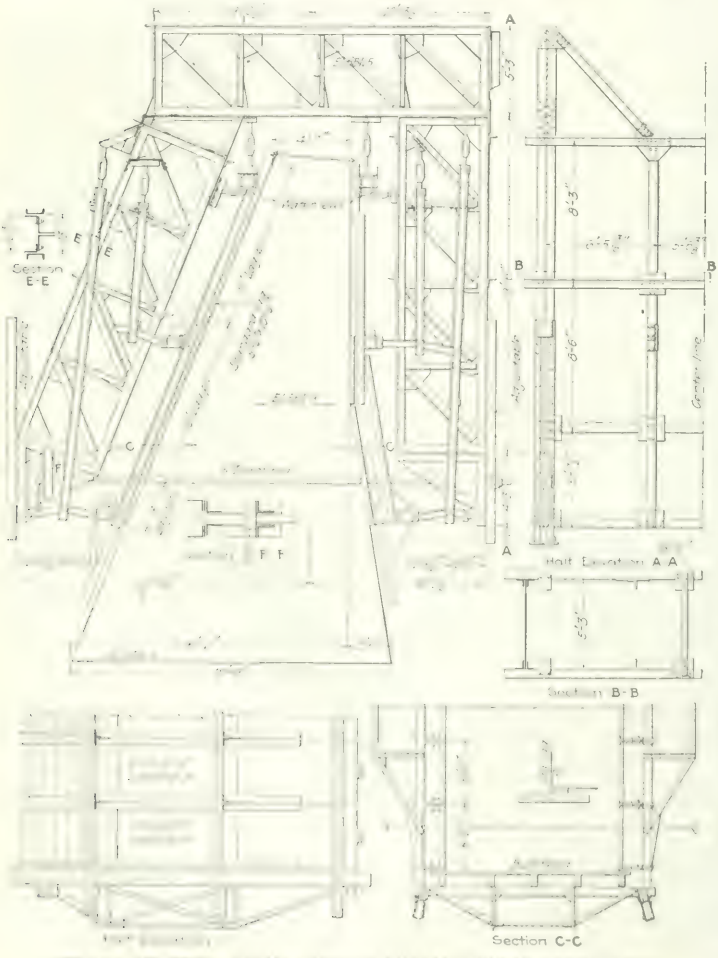
# Concrete River Wall Poured Inside Large Steel Form

## In Building Ohio Basin Terminal of Barge Canal at Buffalo Under Water Concrete Placed True to Line and Grade by Flexible System of Forms

HEAVY steel forms in units 40 ft. high and 20 ft. long are being used in the construction of the concrete dock walls of the Ohio Basin at Buffalo, N. Y., for the New York State Barge Canal. The forms were adopted for underwater concrete work after careful consideration of the relative cost and efficiency of the usual cofferdam method. While the investment in the steel forms is greater, it is expected that there will be a material saving due to the speed that can be made by the adopted method.

The major part of the work at Ohio Basin completed up to 1920 consisted of the entrance retaining walls founded on rock and built inside of cofferdam and the dredging of the basin to a depth of 20 ft. This work was done partly by the Walsh Construction Co. until suspended by war conditions and then taken over by the state authorities under the Walters Act until suspension for lack of funds. In 1920, proposals for constructing certain portions of the dock wall around the Ohio Basin were invited and the work subsequently let to the Great Lakes Dredge & Dock Co., Buffalo, N. Y.

The principal part of the present construction of this terminal consists of building a concrete gravity wall 1,550 ft. long and founded on the rock at elevations from 21 to 28 ft. below normal water, the complete wall being from 28 to 35 ft. high. The original proposed section had a vertical harbor face of 19.6 ft., then battered 6 on 1 to bedrock. The back had a top batter followed by offset steps. The lower section of the dock wall is built of third class concrete made of 1 part cement, 3 parts sand and 6 parts crushed stone or gravel. The upper section is built of second class concrete made of 1 part cement, 2½ parts sand and 5 parts crushed stone or gravel.

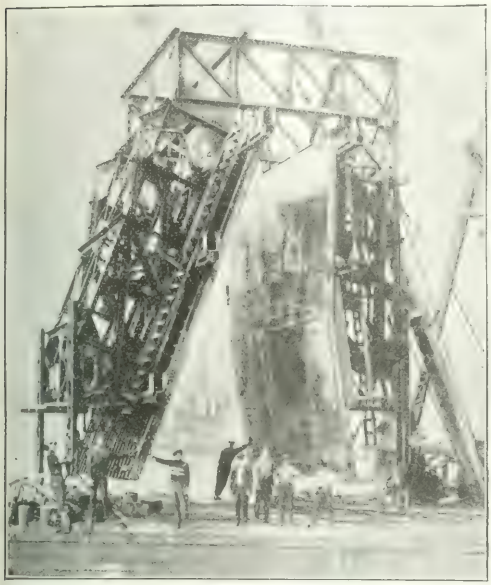



DETAILS OF STEEL FORM FOR CONCRETE BUFFALO BARGE CANAL WALL

Under the specifications the contractor, if he so desires, is allowed to place concrete under water to El. 561.9, which is 12 ft. below mean water surface. Concrete so placed shall have added thereto one extra bag of cement per cubic yard of concrete, and shall be placed by tremie or by any other method which may be acceptable to the engineer. All concrete above El. 561.9 shall be placed in dry. Permission was granted the contractor to build this wall by placing concrete under water.

Departing from the usual method of building submerged gravity walls inside cofferdam the Great Lakes Dredge & Dock Co. decided to develop a form which could be made to fit the variations in the rock surface, and could be lifted as a unit, and used continuously without being in any way destroyed or rebuilt except in so far as it was necessary to make the changes in the bottom to fit the variations in the rock. Such a form was designed and constructed by the Blaw-Knox Co. of Pittsburgh.

The form consists of a rigid frame made up of trusses rigidly braced in the vertical and horizontal direction and built to enclose the outline of the dock wall. From this frame the form for the front and back is suspended and supported by means of screw jacks and

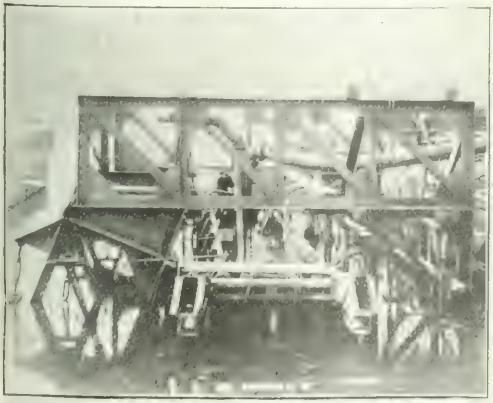


STEEL DOCK WALL FORM BEFORE BEING DROPPED OVERBOARD

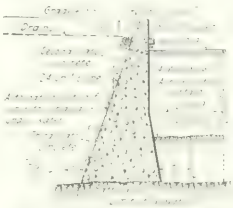
toggle arms in such a manner that the forms can be set exactly to the desired shape and dimension of the wall and afterwards, when the form has been filled and the concrete sets, released from the concrete from above without the help of a diver, and moved.

The general design of the trusses and the front and back form suspended from the trusses is shown in the views and drawings. The bulkheads for each end are made so that they can be either removed separately or handled with the form. They are held to the form by means of lugs riveted to the ends of the steel wales on the forms, into which wales the trusses of the bulkhead fit so that when the bulkheads are placed and the concrete poured the pressure on the bulkheads is transmitted into the longitudinal wales of the forms.

One of the views shows in larger detail the turn-



FORM IN PLACE—ROCK SURFACE BEING CLEANED WITH CENTRIFUGAL PUMP

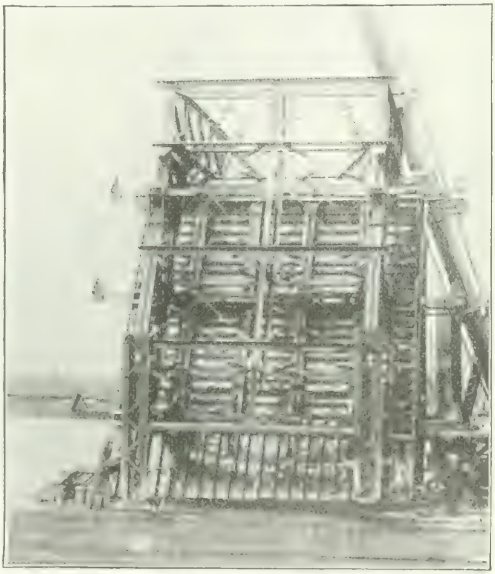


SECTION OF CONCRETE WALL

buckles and jacks which suspend the form from the frame by means of which the form can be set to exact elevation in the water and adjusted horizontally in relation to the trusses until the desired dimensions are obtained.

When submerged the form rests on four adjustable posts, one at each corner of the frame. These posts are adjustable in a vertical direction by means of a series of holes which bolt up to the frame or where quicker adjustment is needed by means of screw jacks. These corner posts are set at the right elevation while the form is out of water.

The correct elevation of the corner post is obtained by sounding the rock surface where the form is to be placed, using a specially built sounding raft, 60 ft. long and 30 ft. wide. This is built of 12 x 12-in. longitudinal, end and intermediate cross timbers, covered by 3 x 6-in.



HEAD-ON VIEW OF STEEL FORM

plank, spaced with 6-in. horizontal intervals, through which the soundings are taken with a wooden sounding pole shod with a steel point. Four steel pipes, 4 in. in diameter are used to steady the raft. These slide up and down within a 5-in. pipe, which projects several feet above and below the deck. In other words, these larger pipes slide up and down the outside of the smaller, when the raft rises and falls with the changing water level. A wooden staff gage is attached to the smaller pipe, which is adjusted to give elevations above tide water corresponding to the plans and profiles. The sounding raft is further steadied by four lines leading diagonally to anchors.

A fixed water opening for base line sounding is used, which corresponds to the face line of the dock wall, which is established by a point on shore and a distance

target. After the sounding raft is in exact position soundings are taken both longitudinally and transversely, which are corrected for the rise and fall of the water. Transverse soundings are then plotted on cross-section paper and carefully examined for any possible error.

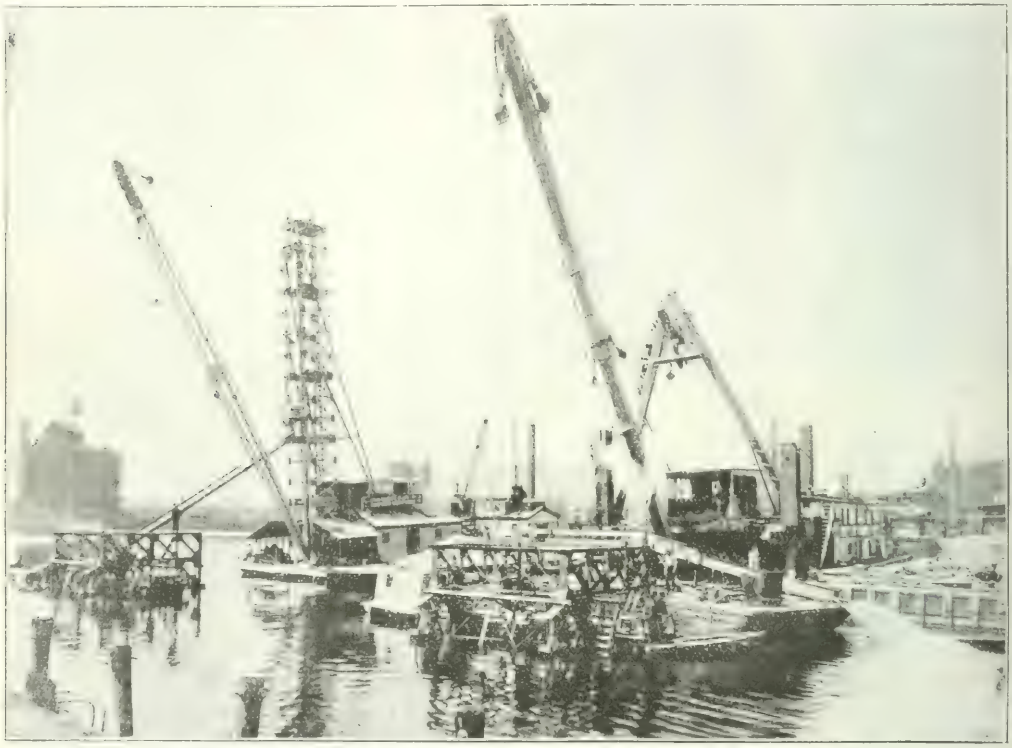
To facilitate obtaining the depth below the established water surface, a celluloid template is used, from which when correctly placed, the depths are read off a graduated edge. These depths are referred to the lower edge of the steel plates forming the side of the form. Measuring down from this edge nails are driven in the lower planks of the form and the form sawed to a curve corresponding to the bedrock surface.

When the forms were built the maximum and minimum of the bedrock was obtained and the lower timber part of the form fixed accordingly. The deepest portion of the dock wall was first poured, followed in sequence by the decreasing shallower ones. This allowed the timber to be steadily reduced, so that up to this time no shimming has been found necessary.

The forms weigh approximately 60 tons and are handled by a derrick barge of that capacity. This barge is the G. L. D. & D. Co. dipper dredge No. 8, the dipper arm being removed and a boom substituted.

After the form is set the rock surface is cleaned by a centrifugal pump operating a 12-in. suction pipe, which removes the mud loosened by water jets directed by divers. Examination of the bottom by a diver is also made before any concrete is placed.

When the wall to be built is less than 20 ft. in height, trusses are of sufficient strength to take the horizontal pressure. As these walls are more than this height, it was necessary to place one row of tie rods at the bottom holding the trusses together. These tie rods are placed in the form before it is lowered and pulled from above after the concrete has set. When a diver is available it is quicker to have him take off the nuts at one end before the rods are pulled or arrangement is made to pull the rods without a diver if necessary.



CONCRETING PLANT IN BACKGROUND. SINKING STEEL FORM IN FOREGROUND

The form is operated for alternate 20-ft. blocks. Two forms are used and the first is provided with bulkheads, casting blocks and leaving a gap between the blocks corresponding to the length of a block, so that the rear form overlapping two precast blocks will fill in the gap. Construction joints between the different blocks are provided and the recesses for same are cast in connection with the first forms carrying the bulkheads.

The Niagara River sand and gravel, which forms the aggregate for the concrete, is brought to the side of the floating mixer plant on scows and is transferred to the storage hopper placed over the mixer by a revolving crane operating a clamshell bucket. The concrete is placed in the form by means of a 2 cu.yd. bottom dump bucket operated from a steel boom supported on the mixer scow. Ordinarily 8 hours are occupied in filling a form to about one foot above water surface, the contents being about 250 cu.yd.

In order to examine the concrete, several 30-in. diam. test wells have been provided. Examination has shown

that the concrete is of excellent quality. These wells are filled before the top of the dock wall is poured—in the dry in the usual manner.

The method was conceived and designed by F. C. Hibbard, manager of the Great Lakes Dredge & Dock Co. at Buffalo, W. P. Feeley, division engineer and R. W. Reed, superintendent of the work. B. E. Failing, senior assistant engineer and Elias H. Anderson, assistant engineer, are in charge of the work for the State of New York, under the direction of Frank M. Williams, state engineer, and it was through their co-operation that the present method was made possible.

## The Tulsa, Okla., Water Situation

THREE different sources of water for Tulsa, Okla., the Arkansas River, Shell Creek and Spavinaw River, each have such strong advocates that the newspapers of that city are filled with columns of comment, some of which is personal and acrimonious. However, there does not seem to be much serious disagreement as to the engineering features.

At present the Arkansas River water, filtered, is the supply. It is hard and contains such a large amount of salt at times—up to 1,500 p.p.m.—that many people do not use it for domestic purposes. In boilers it foams and encrusts badly. Contracts have recently been let to increase the filter plant capacity from 6 to 12 m.g.d. However, few people in Tulsa apparently look upon the Arkansas as the ultimate source of water for the city.

The privately developed Shell Creek supply is impounded behind a hollow dam nearing completion, storing the water from a drainage area of 20 sq. miles which in dry years would probably not furnish sufficient water for the city's present needs. The quality is good and the controversy is over the expediency of utilizing it for a few years only at the high figure and on the conditions at which it may be obtained from the owner, Charles Page. A few thousand feet of pipe line will make it available. Mr. Page has already made a contract for a 36-in. pipe line from the Shell Creek reservoir to Sand Springs. This can be extended all the way to Tulsa within four months.

Ultimately it is the unanimous opinion that an adequate supply can only be obtained through a 50-mile conduit from the Ozark Mountains. Surveys have been made of a line to the Spavinaw Creek as the most likely source. All reports indicate that the quantity and quality are satisfactory. Estimates of costs are now being made.

Recently reports have been made by water-works engineers on all of these supplies. A report by C. Arthur Brown on the present condition of the filter plant (see *Engineering News-Record*, Aug. 1, 1918, p. 221, for description of the plant) indicated that it is in good physical condition but that recent poor results, putting muddy water into the city, were due to incompetent operation. Mr. Brown found that too many baffles had been removed to keep the water moving through the mixers. The diaphragms on the filter controllers he found clogged with mud which gained entrance during the period when the plant was improperly operated. A competent operator has recently been employed and the plant is being put back into shape. It can clarify and soften the water if properly handled.

W. R. Holway, consulting engineer for the water department, has just made a report on the Spavinaw supply. He has been able to locate a gravity conduit leading the water to within five miles of the city. It must then be pumped. The water requires no treatment.

A committee of the local chapter of the American Association of Engineers, headed by Donald Witten, consulting engineer, reported fully on the Shell creek supply and recommended its use but advised keeping up the Arkansas River plant as a reserve.

The last report made public was by George G. Earl general superintendent, New Orleans Sewerage and Water Board, and Prof. Edward Bartow, University of Iowa, Iowa City, the former representing the Tulsa Water Commission and the latter the Retail Merchants Association. They recommend (1) negotiating for a temporary supply from Shell Creek; (2) expediting the additions to the filter plant; (3) pushing the Spavinaw project to completion as rapidly as possible (three years is the earliest estimated time); (4) arranging as far as possible that the three systems be mutually supporting.

The situation appears to be decidedly complicated politically. The water-works officials are apparently against the temporary supply idea but the filter plant has been allowed to get into such shape that the poor water purveyed has proved to be a powerful factor in the hands of the adherents of the temporary supply. The fancied or actual financial advantages to be gained by Mr. Page through marketing a good water supply at 10c. per 1,000 gal. for a three-year period are held up to the public by the sellers of bottled water and other interests opposed to him in as profiteering a light as possible. Now that the filters have been put back into shape the water-works officials are opposed to repudiating their own plant by admitting a temporary supply that will entail high water rates.

C. S. Younkman is chairman of the Tulsa Water Commission.

## Cause of Chicago Grain Elevator Explosion

IGNITION of dust due to a fire in the drier "is by far the most probable cause" of the disastrous explosion at the Chicago & Northwestern grain elevator on March 19, according to a paper read recently before the Western Society of Engineers by David J. Price, engineer of development work for the Bureau of Chemistry, U. S. Department of Agriculture. The accident was described in *Engineering News-Record*, March 31, p. 560, and a paper by Mr. Price was published April 14, p. 634.

In the recent paper on the elevator explosion it is stated that the drier had been in operation until 1½ hours before the explosion, and that a week previously there had been a fire in the drier, supposed to have been due to the ignition of dust on the steam coil. This fire was discovered about 5 a.m. and though it was supposed to have been extinguished, it broke out again at 3 p.m., when it was necessary to run a hose line into the building. Furthermore, fires in the drier had been more or less frequent for some time, and it is assumed that this was one reason why that part of the plant was being given a thorough cleaning at the time.

Possibly dust which had lodged in the drier became ignited and during the cleaning was brushed or shaken from its lodging place, thus igniting the dust in suspension throughout the drier. The fact that the drier house was so completely destroyed is held to indicate that possibly there was an explosion with some violence in the drier before the flames spread to the basement.

# Non-Bacterial Population of Sewage Trickling Filters

## Review of Literature and Observations at Three Maryland Plants Indicate That Vegetable Growths Are More Harmful Than Helpful and Animal Growths Harmless or Beneficial—Methods of Control

By Charles R. Cox
The Department of Bacteriology, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Md.

ALL SEWAGE trickling filters depend in part for their efficiency upon the biochemical reactions resulting from the activity of the organisms induced to grow on the filtering medium by the abundant supply of organic food material from the sewage in the presence of atmospheric oxygen. The accepted theory of the action of these filters is that the organic solids in suspension and colloidal solution are adsorbed by the gelatinous film on the stones, after which they are acted upon by the enzymes of the bacteria constituting part of the film mass. The products of these biochemical actions are usually simpler compounds, such as carbon dioxide and ammonia and stable organic matter. Thus full credit for this action is given to the bacteria bringing about the liquefaction of proteins, carbohydrates and fats, and the nitrification of the ammonia resulting from the protein degradation. There is no doubt that this view is substantially correct, but as all active trickling filter mediums contain numerous organisms other than bacteria, the complete action may not be understood unless the significance of this higher life is also considered.

### Summary of Literature of the Subject

A search of available engineering and biological literature has failed to bring to light any extensive studies regarding the biochemistry of sewage disposal, other than those concerned with the well known specific actions of the bacterial enzymes mentioned above. With few exceptions, the only mention made of the higher organisms in trickling filters was when some type of growth was causing abnormal operation or nuisances. Few data were given regarding the normal flora and fauna. The following summary of the literature of the subject is given:

Fuller, in his "Sewage Disposal," states that most trickling filters contain "enormous numbers of several varieties of worms which undoubtedly play a considerable part in the elimination of organic matter." The most prevalent are the white larvæ of the small moth-like fly, Psychoda alternata, and small red worms similar to earthworms. The adult Psychoda are found in large numbers.

Metcalf and Eddy, in "American Sewerage Practice," state that excessive organic growths in England occur in winter and early spring, and that they could be removed by applying one liter of a 20 per cent solution of NaOH to each 1.6 cu.yd. of the stone filter medium. The efficiency of the filters, as measured by nitrification, was not impaired by this treatment. An experimental trickling filter at Andover, Mass., became clogged in 1906 by an amphorous jelly-like mass of bacteria and the larvæ of Psychoda (1). Both were removed by applying a strong solution of copper sulphate, or by resting the bed a few days. A pinkish growth appeared on the surface of several filters at the sewage testing station in Philadelphia (2). Resting the beds in warm dry weather destroyed the growth, which had to be washed out of the filters at times with a fire hose. As many as 115,000 gal. of water were required per acre of filter. Satisfactory results were also obtained by using hypochlorite of lime at the rate of two tons per acre, applied with the sewage through the nozzles. The most satisfactory method, however, was the continuous disinfection of the influent, which did not seem to interfere with the bacterial activity of the filters. At Worcester, Mass., growths occurred upon the advent of cold weather and disappeared during the summer. Two species of fungi caused the greatest trouble, pink to brown gelatinous colonies resembling Leptothrix, and white or grey filamentous growth resembling Leptomitus. Resting one-seventh of the filter area for one day each week served to control this growth. A rubber-like growth appeared on the Birmingham, England, filters in cold weather when fresh sewage was applied, but it disappeared when septic tank effluents were applied.

### Worms Aid Digestion of Organic Matter

Metcalf and Eddy state that the very large worm population of trickling filters undoubtedly aids in the digestion of large quantities of organic matter prepared for them by bacterial action, the final material being in a granular condition more easily unloaded from the filters. Large numbers of small worms similar to earthworms were observed in the Worcester filters. Deeper in the filter they were larger in size. When the digested organic matter sloughed off the stones numerous worms were washed out with it. Psychoda larvæ and adults appeared on the Worcester filters one month after they were placed in operation. The flies seek shelter in the stones during cold weather and are seldom visible, but at times swarms flew about a building 100 yd. from the filters.

At Fitchburg, Mass., (3) during the year December, 1914, to December, 1915, it was found that growths in early spring caused the pooling of sewage on the surface of sprinkling filters. Picking the upper 6 in. of the stones solved the problem. In summer the surface was covered with a green growth, but a few inches below the surface there was the usual film and swarms of "white worms," probably larvæ. On Feb. 25, white flies appeared, and caused a nuisance until they disappeared the last of May. A small black fly then appeared and stayed until the filters were shut down in September, causing no nuisance.

Dunbar, in "Principals of Sewage Treatment," states that the red mold, Piziza omphalodes, was sometimes present on trickling filters, as well as in the upper scum of septic tanks. This scum often contains also the brown mold, Pilobolus oedipus, the earthworms, Lumbricidæ, and the larvæ of Psychoda. It may be very easy, therefore, for a trickling filter to be seeded with these organisms if septic tank effluents are applied to them.

Leo F. Rettger (4) found a pink to black fungus clogging an experimental filter at Waterbury, Conn. The growth was greatest on cloudy days on top of the stones and was at times 0.4 in. thick. He states that the red color is probably due to iron. The identification was uncertain, but it was thought that the growth was the mold, Monilla. Resting the beds for a day or longer, and then washing with a stream of water from a hose, removed the growth and prevented clogging. Two days rest in seven followed by ordinary sprinkling also sufficed.

### Psychoda or Trickling Filter Fly

The trickling filter fly, Psychoda, was studied by Thomas J. Headlee (5) at the Plainfield, N. J., sewage-works in 1918. He found that the larvæ live in and consume the gelatinous film. Their number depended upon the thickness of the film, which was greater in winter and spring. The unloading of the filter in the summer reduces the food supply and in turn the number of larvæ. The presence of the flies and larvæ did not seem to influence the action of the filter, or to interfere with the society of organisms present. They were active in the filters at all seasons, but the

adults remained below the surface of the stones in cold weather. With the first advent of warm weather, and also at the latter part of summer, the flies emerged in great numbers and flew or were carried by winds at least ¾ of a mile. The small size of the adults enabled them to penetrate house screens and thus create nuisances. There is no definite knowledge whether the flies may carry intestinal parasites, but no doubt it would be best to assume that they can.

The adult lays her eggs in masses on the film, the young larvæ hatching and entering the film with their breathing tube projecting into the air. The transformation to pupæ takes place in the film. The front end of the pupae cases breaks open, and the adult flies emerge. The larvæ and pupæ are most numerous in the zone between 3 to 12 in. below the surface. The adults are not strong fliers, and thus spend most of their life resting upon the underside of the upper stones and side walls of the filters. The length of the life cycle naturally depends upon the temperature. Observations show that the eggs hatch at 70 deg. F. in 32 to 48 hr., the larval stage lasting from 9 to 15 days. The pupal stage lasts 20 to 48 hr. at this temperature.

Psychoda may be controlled by submerging the filter medium for 24 hr., which is sufficient to drown the larvæ and pupæ but not to deprive the ærobic bacterial film of all its free oxygen. The film is slightly putrefactive in 36 hr. and strongly so in 48 hr. Submergence once every two weeks permits the development of numerous flies, but once every 10 days is successful in completely controlling their development. The use of chemicals to kill the larvæ was not successful because a dose sufficient to control their growth also killed the bacterial film.

The part played by the non-bacterial population of contact beds was studied to some extent in England in 1913. James Crabtree (6) states that the fauna keep the beds "open" by "working over" the film. A bed with a low fauna population had very spongy films, whereas in the normal beds this material was more granular and easily washed off. There also seemed to be a selective action on the part of the protozoa with regard to their bacterial food, the normal sewage bacteria being consumed rather than the bacteria constituting the film. This action is not significant in reducing the number of sewage organisms, because of the constant supply of fresh material in the influent.

### Observations at Three Plants in Maryland

The growth on the surface of two small institutional trickling filters in Maryland, treating fresh Imhoff tank effluents, was examined in the summer of 1920. The material in both cases was a very dark green and adhered firmly to the upper stone surfaces. At the time the extent of the growth was not sufficient to cause pooling, but the depth of the green film increases apparently during the summer and fall. Unloading is greatly reduced in winter and thus the prolific summer and fall growths sometimes cause clogging in winter. At one of the plants clogging occurred when the temperature was 20 deg. F. The ashes resulting from small wood fires built to thaw some frozen nozzles quickly killed the growth. Since then a thin layer of wood ashes is spread over the filter when clogging occurs, and when the sewage is again applied a weak lye is formed, which soon kills the growth. Nothing is known of the effect of this treatment upon the bacterial film, but all life is probably killed.

Additional information upon the subject under discussion was obtained by frequent visits to a large sewage disposal plant at Back River, Maryland, during the first part of December, 1920. The disposal plant consists of the following units: Coarse bar screens, plain sedimentation (septic) and Imhoff tanks, fine screens, trickling filters, and final plain sedimentation tanks.

Following is a list of the organisms found on the top surface of the two institutional sewage trickling filters:

| *Maryland House of Correction* July, 1920 | *Maryland State Tuberculosis Sanatorium* August, 1920 |
|---|---|
| Sewage very weak and fresh.... | Sewage of medium strength, but fresh. |
| Algae—Ulothrix | Diatoma—Navicula. |
| Diatoma—Melosira. | Algae—Oscillaria, Plurococcus, Tribinema. |
| Rotifers—Few. | Protozoa—Amoeba: Arcilla and Cysts. Ciliates: Paramecium, Colpidium, Chaenia. |
| | Worms—Few Nematodes. |
| | Rotifers—Few. |
| | Bacteria—Numerous. Numerous large spirillae. |

The trickling filters have an area of 30 acres, being made up of 10 units of 3 acres each. The crushed stone, about the size of railroad ballast, is laid upon a system of underdrains to an average depth of 8.5 ft. The screened effluent of the sedimentation tanks is distributed to the filter units through a piping system and numerous spray nozzles, spaced 12 ft. apart. The nozzles are designed to deliver a square spray so that the whole filter area receives sewage. This desirable feature is not obtained in practice, however, due to partial clogging of the nozzles. There are portions of the beds, therefore, which do not receive sewage, at least at the surface, and any growth on the beds, induced by the food material in the sewage, is usually lacking in these areas. The probability is that the sprays cover about 80 to 90 per cent of the total area ordinarily. The flow of sewage to each bed is controlled by a gate valve and a motor-driven butterfly valve, which revolves once in about 8 minutes. The rate of flow is thus changed every 4 minutes from minimum to maximum. The gradual change in the rate of flow produces a corresponding change in the spread of the spray; thus every portion of the beds reached receives a dosage of sewage for only a few seconds at a time. The operation of the various beds is controlled by the specific, hand-operated gate valves. The length of filter runs may be varied at will, therefore, and advantage is taken of this to operate each bed on an independent schedule. The efficiency of the beds varies as a result, depending upon the length of time they are used. The growth on the stones also varies from bed to bed, but the difference is one of degree and not of character. Thus the Beds 1 and 2, which are used about 20 hr. per day, show the greatest growth, while the Beds 5 and 10, used only a few hours per day in times of peak flow, are practically free of growth and their efficiency is correspondingly low. The growth upon the filters is thus seen to be of great practical importance, and warrants much closer study than it has received in the past.

### No Good Picture of Available Food Material

Complete chemical analyses are not made at the disposal plant as a routine procedure, and thus a satisfactory picture of the available food material in the applied sewage is not to be had. Judging from past and present records, however, it appears that the settled and screened sewage admitted to the filters is devoid of dissolved oxygen at all times and contains no nitrites or nitrates. The settleable and total suspended solids, due to previous sedimentation, are only about 30 p.p.m. and 90 p.p.m., respectively. The effluent of the filters contains on an average about 70 p.p.m. suspended matter, indicating a reduction of solids by liquefaction, etc. The total solids in the influent and effluent during 1916

averaged 644 p.p.m. and 649 p.p.m., respectively, showing no losses by the production of gases. The physical aeration of the sewage in passing through the filter is sufficient to enable the nitrifying organisms to grow and produce an average of 7.1 p.p.m. nitrates in the effluent. The aeration also supplied the sewage with sufficient free oxygen to produce a relative stability averaging 94 per cent. During the period of observation the relative stability was around 90 per cent.

Few data are available regarding the effect on the bacterial flora in the sewage by their passage through the filters. The total plain agar counts and counts of acid colonies on litmus lactose agar are available. These vary greatly, but averages for the year 1919 show a great reduction in organisms growing on both media at 37 deg. C. The counts are as follows:

| | Total Count—37° C. Plain Agar | Red Colonies—37°C. Litmus Lactose Agar |
|---|---|---|
| Influent | 700,000 per c.c. | 60,000 per c.c. |
| Effluent | 190,000 per c.c. | 9,300 per c.c. |

Without doubt the total number of bacteria actually present in the filter effluent is greater than in the influent, due to growth of organisms in the filter which do not develop on the above-mentioned media. The heavy reduction in the red count is of great importance, however, showing that the environment is not well suited to some typical intestinal organisms.

### Controlling Environment at Back River

It will be seen from the above that the controlling environmental features in the Back River sewage trickling filters are as follows: An abundant supply of decomposing organic food material at all depths of the filters; a very limited supply of nitrates in the upper filter layers, but increasing in amount as nitrification progresses through the beds; an abundant supply of free oxygen throughout the filters but no doubt more abundant in the upper layers; a plentiful supply of water at most points in the beds; the limiting to exposure to light of all portions of beds except the upper few inches; and the temperature prevailing in the beds. The chief variables in the above list are the quality of the sewage, the temperature, and the intensity of light. The only marked variations in the growth to be expected, therefore, are slow seasonal changes, and those induced by limiting the supply of food material. Experience substantiates this conclusion. Thus, little if any change was observed in the growth of any specific part of a bed between Nov. 29 and Dec. 16, 1920, provided it was supplied with a fairly constant flow of sewage. The partial clogging of a nozzle, depriving a portion of the bed of sewage, soon resulted, however, in a great reduction in the surface growth.

The rates of flow onto the various beds differ, as mentioned before. A record is kept of the time they are used, which shows that a few beds, such as No. 1, are used about 6.5 days per week, whereas others may be used only for a few hours per day, totaling about two days per week. In order to obviate variations in the material studied, due to changes in operation, most of the observations were restricted to Bed 1. The material from this bed was compared frequently with that from the others to avoid incorrect general conclusions. The flow to Bed 1 was at the rate of 2.9 m.g.d. (24 hr.). The total sewage flow averaged 49 m.g.d. during the first part of December, 1920. The average flow for 1919 was 55 m.g.d., or 1.8 m.g. per acre per day.

The operator was questioned regarding the growth and its significance. He stated that no detailed study has ever been made of the materials, but that observation of the beds has shown that in spring the filter surface is covered with a greenish brown film, while in summer a grey growth appears. There would be numerous weeds in summer if the young plants were not pulled up. The fall and winter growth is similar to that existing during the period of observations. The filter flies are most numerous in September and early spring. The small earthworms are present at all times, but are discharged in the effluent in greatest numbers when unloading occurs in early spring, at the beginning of hot weather, and at the end of summer. The filter medium has been disturbed but little and, therefore, the vertical distribution of the various organisms is not known. Worms have been seen at least 6 ft. below the surface, however, whereas the larvae apparently remain in the upper foot or so of the filter beds. The operator stated that the new filters were "ripened" by applying sewage for about 1 hr. twice a day for a period of six weeks. In four weeks a growth was visible and by the end of six weeks the material had reached its full growth. Visible life is removed from near the surface of the beds by resting from 1½ to 3 days, and it appears again 5 to 6 days after the rested bed is placed in use in summer, and about two weeks afterwards in winter.

### Seasonal Variations in Growths

The observations made at the disposal plant during the first part of December, 1920, are difficult to record, because they do not lend themselves to tabular form. Visits of inspection were made Nov. 29, Dec. 2, 7, 9, 14 and 16. The only significant visible change in the life in Bed 1 during this period was the gradual spread of a pink fungoid growth on the upper surfaces of the top stones. On Nov. 29, this growth was restricted to about one-sixth the wetted surface area, but by Dec. 16 it had spread to about one-half this area. The surface stones of Bed 1 were covered with a greenish black granular film over that portion of the area between the sprays, and thus not directly wetted. The undersides of these stones were covered with a thin slimy grey deposit, in which numerous Psychoda larvae were living. The adult Psychoda were most numerous in this portion of the bed. A few small brown spiders were also encountered. The green film proved to be practically pure cultures of Protococcus. Upon removing the upper stones it was found that this green growth was restricted to the upper layer of stones. The Psychoda adults and larvae, and the grey film were encountered for at least 12 in. below the surface. It was impossible to enter the bed deeper while it was in operation.

The area reached directly by the sprays contained a greenish grey surface growth, with pinkish patches over part of the area. Upon disturbing the surface layer it was found that the pinkish and greenish grey growths were restricted to the upper surface of the top layer of stones exposed to light. The lower stones were covered with a slimy grey film in which swarms of larvae and the small red worms were living. A few adult Psychoda were also found here. The worms were often in dense clusters several inches in diameter.

The examination of the material from the stones under a microscope disclosed that comparatively few

higher organisms and masses of bacteria constituted the films. The drier portions of the surface stones were covered with Protococcus, whereas the wetted area was covered with greenish grey slime consisting of bacteria, decomposing organic matter, Protococcus and patches of Oscillaria, and a dense surface growth of a colorless fungus, to be described later. There were no worms, larvae, or protozoa on the upper surfaces exposed to the direct action of the sprays. The pink portion of the surface growth contained the same assortment of organisms, except that the pink fungus predominated. The stone surfaces not exposed to the light or direct action of the sprays were covered with a light grey slime. This material consisted of a dense growth of the colorless fungus, larvae and worms, and masses of bacteria. There were a few filaments of Crenothrix here and there, and occasionally black patches, which proved to be Beggiatoa. A very limited number of Chlamydomonas were also seen. Numerous clusters of Epistylis were observed attached to the fungi, as were also a few Scyphidia. A few small Nematodes were also observed. At very infrequent intervals green patches were seen on the surface stones, which were shown to be composed to clusters of Conferva. The following table gives a summary of the organisms found:

LIST OF ORGANISMS FOUND ON SURFACE OF STONES IN SEWAGE TRICKLING FILTER NO. 1, BACK RIVER, NOV. 29 TO DEC. 16, 1920

| Organisms | Where Found | Remarks |
|---|---|---|
| Algae: | | |
| Protococcus..... | Upper stone surfaces. | Greatest development in comparatively dry areas. Chief cause of greenish color in grey growth |
| Oscillaria ..... | Do..... | Limited in extent, but very firm growth. Could easily cause clogging if extensive. |
| Conferva..... | Do..... | Very limited in extent. |
| Protozoa: | | |
| Chlamydomonas | Under stones in grey film | Very limited in number. |
| Scyphidia ..... | Attached to hyphia of colorless fungi. | Limited in number. |
| Epistylis .. | Do..... | Numerous. Probably are instrumental in reducing number of sewage bacteria |
| Fungi | | |
| Unknown (pink)... | Upper surface of top stones. | Very firm, wrinkled growth over Protococcus. Pink by reflected light. Pale green by transmitted light. Apparently one of the Fungi Imperfecti. No fruiting bodies seen, but light green, detached spherical spores were observed in material. |
| Unknown (grey)... | On all surfaces of stones examined except in dry portions of area. | Commonest plant found. Was easily torn from stone surface. Complex cell structure and branch system. No fruiting bodies found. |
| Worms: | | |
| Nematodes.. | In grey film on undersides of stones. | Few—Of no significance |
| Chaetopoda | | |
| Lumbricolidae... (earthworms) | In all portions of bed below surface receiving sewage. | Very numerous. One of the three commonest organisms found. |
| Insects | | |
| Spiders..... | In dryer portions of bed, under the surface. | Small dark brown spiders. Sluggish. Apparently catch adult Psychoda. |
| Psychoda ..... | Do..... | Larvae numerous in portions of bed. Adult sluggish. Poor flier. Seldom seen on surface of beds. Not observed at any distance from filters. |
| Schizomycetes: | | |
| Zoogloea . . | On all stones receiving sewage. | Great [illegible] of bacteria were seen mixed with Chlorococcus, Beggiatoa, all the [illegible] surfaces. |
| Spirilla . | Do ..... | Large [illegible] bacteria were found [illegible] |
| Crenothrix.. | On underside of top stones. | Limited in extent. |
| Beggiatoa . | On filaments of grey fungus. | Fairly numerous |

The identification of the two mold-like fungi could not be made because of the absence of fruiting bodies on all of the numerous specimens examined. There was not time to grow cultures on artificial media. The pink growth on the upper surfaces of the top stones apparently did not grow unless exposed to light. A selection of those parts of the surface receiving the greatest flow of sewage was also characteristic of this growth. To the unaided eye the material had a pink to red color. The growth is firm, adhering to the stones so that the action of the spray does not loosen it. The surface is wrinkled, and made up of very numerous small mounds, apparently resulting from growth in bushy-like masses from many centers. The mold does not seem to interfere with the growth of the Protococci underneath. Under the microscope the material was pale green in color. The mycelia consisted of long celled filaments with few, irregularly spaced branches, having the same diameter as the parent stem. The whole mass apparently radiated from common centers, but the tree-like branched structure was lacking. Numerous spherical spores were observed, pale green in color and slightly less in diameter than the mycelia. These spores were actively developing, and produced slightly crescentic-shaped pointed cells, which developed into straight, many celled filaments, unbranched at first. This fungus probably belongs to the Mucedinaceae family of molds. Its pink color and spherical spores seem to indicate that it may be Monillia, which was found at Waterbury. Nothing could be learned in available literature regarding the morphology of Peziza omphalodes, the red fungus found by Dunbar on trickling filters in Germany. The similarity in color of this fungus and the pink one at Back River is of course insufficient evidence to warrant saying that the two are identical.

### Frungs Not Identified

The colorless fungus was found to constitute the bulk of the light grey film on the stones below the surface of the filter. The material was loose and easily detached from the stones, which probably is one reason why it was so easily superseded on the upper exposed surface by the pink growth. Under the microscope the material was seen to consist of pale green to colorless filaments, with firm short cells. Dichotomous branching occurred very frequently, with the result that very perfect tree-like structures were formed. These are grouped in dense, bushy clusters, radiating from common centers. The cells are 4 or 5 of their diameters in length. The cell divisions are very complete and definite. The protoplasm is pale green to colorless, and contains numerous vacuoles and granules. The protoplasmic structure is more complex than that of the common molds. The absence of any reproductive bodies made identification impossible. One would be inclined to believe that the organism was the green algae Cladophora were it not for the apparent absence of chlorophila, and the fact that the growth occurs below the light line. The classification as an unknown fungus, therefore, has been adopted.

No attempt was made to determine the species, and in some cases even the family of a few of the organisms found, because little practical importance can be attached to these more detailed biological data. Most of the organisms were identified with the aid of the keys in Ward and Whipple's "Fresh Water Biology," and Whipple's "Microscopy of Drinking Water." Dr. Root, of the School of Hygiene of the Johns Hopkins University, kindly identified the filter flies as Psychoda.

They are small, thickly haired, moth-like flies, with comparatively large, hairy wings, which lie roof-like over the abdomen when at rest. Their description can be found in Williston's "North American Diptera."

The results of the microscopical studies of the material from the sewage disposal plant are very surprising in showing that the number of types of organisms is very limited. This finding is unlike that resulting from a study of the life in sewage polluted streams. The most significant characteristic of most of the organisms found is their attached nature. If the very limited number of Chlamydomonas are excepted, all the organisms are attached in some way to the filter medium, or are sufficiently strong to resist the washing action of the sewage. This does not apply to the bacteria and the larger sulphur spirilla, but these live for the most part in the comparatively quiescent portions of the sewage between mold mycelia, etc. The two commonest Ciliates of sewage polluted water, Paramaecium and Colpidium, were not observed at any point. The outstanding difference between the material from the larger plant and that from the other much smaller Maryland plants is the presence of fungi and the comparative absence of algae at the former. It is thought that the septic condition of the applied sewage at the large plant, or in other words the complete absence of nitrates and dissolved oxygen, accounts for this difference. As nitrification starts at or near the surface in the filters some nitrates are formed, no doubt, near enough to the surface to support the limited algae growth present. On the whole, the presence of algae would seem to be detrimental, because they are likely to cause pooling, as at the plant of the Maryland State Sanatorium. In addition, they consume as food the stable, dissolved, mineralized, organic matter, and transform this to living protoplasm, which eventually dies and adds to the undesirable albuminoid ammonia content of the effluent.

### Schizomycetes Limited in Number

It is doubtful if any of the schizomycetes found, other than the very important saprophytic bacteria, are of any practical importance at the plant, because of their limited number. Sewages high in iron or hydrogen sulphide would no doubt feed much greater numbers of Crenothrix and Beggiatoa than found, and thus these organisms would then be of significance. The converting of soluble iron into the insoluble state would have little practical value, however, other than the ability to remove the insoluble iron by sedimentation in the final tanks. The physical aëration in the beds would bring about this result in any case. Hydrogen sulphide might easily be produced in sufficient quantities to cause local nuisances, and thus its conversion to sulphur by Beggiatoa would be beneficial.

The protozoa are too limited in number to be of any service in the filters. Their attached character restricts their activities to that of feeding. Large numbers of bacteria are no doubt consumed but the great removal of bacteria by the filters is probably due to physical adsorption followed by death. The beneficial effect of the "working" of the film by the motile Ciliates, as discussed by James Crabtree, is entirely lacking at the plant, because of the absence of such forms. Their presence in the filter at the Maryland House of Correction indicates that motile protozoa can maintain their existence in the environment of trickling filters as well as in contact beds, provided the applied sewage is suitable in character. The indications are, however, that the "working" effect is best accomplished by the much larger worms and larvae.

The two fungi types may be of significance in two ways: (1) In causing pooling, and (2), in the beneficial results which may be derived from enzyme digestion of the complex organic material. Pooling has never occurred as yet at the large plant, and little trouble along this line is to be expected, because of the facility of resting any particular bed. In small plants, however, trouble may be experienced such as that at Waterbury. This indicates the desirability of constructing even small trickling filters so that portions may be thrown out of service to kill off growths. It would seem that the light grey growth would not have the consistency necessary to cause pooling, but this does not apply to the pink growth.

### Action of Enzymes of Fungi

There are many data in literature regarding the action of specific enzymes of certain fungi upon various kinds of organic matter. No references could be found, however, which gave detailed data covering the conditions in trickling filters. It is known, nevertheless, that most fungi secrete specific enzymes, which liquefy proteins, carbohydrates, and fats. Thus the very high fat content of a dried sewage sludge was reduced in a few months from 20 per cent by weight to nothing by the secreted lipase of fungi. The aerobic decomposition of the complex carbohydrates by analytic enzymes of fungi is common in nature, as is also the liquefaction of proteins. It is impossible to say, however, whether the two fungi-like organisms found at Back River secrete these enzymes, and, if so, whether their limited number would materially affect the large amount of organic matter passing through the filters. Considerable work would be required before any definite conclusions could be reached. The liquefying power of fungi is no doubt greatly in excess of the needs of their metabolism. This excess of the material liquefied is the measure of their usefulness in a trickling filter. The soluble matter formed and absorbed is transformed into complex protoplasm, however, which increases the load on the filter when the growth dies. In the light of present knowledge, it would seem best to consider fungoid growths as nuisances, and likely to cause pooling or, at least, reduced aëration in the beds.

### Chaetopoda or Bristle-Bearing Worms

The very numerous bristle-bearing worms, or Chaetopoda, found at the large plant undoubtedly have a marked effect upon the organic matter in which they live. Like the well-known earthworms, they consume complex organic matter, which is digested and broken down in their intestines to much simpler materials. The family, Tubificidae, has become closely identified with the digestion of sewage sludge banks in polluted streams. It is safe to conclude that the Lumbriculidae found in the filter likewise consume and digest considerable organic material, although probably not as much as is claimed for the Tubificidae—amounts equal to their own weight per day. The constant passage of the forms through the organic film naturally keeps this material more porous than it otherwise would be. Aëration is thus favored, and no doubt this factor is

one of the most important effects of the presence of the higher organisms in the filters. There was no bed having a thick film and few worms at the Back River plant, so the effect of the absence of worms could not be ascertained. One would expect that the resulting film would be similar in character to the sticky spongy one observed in England by Crabtree when protozoa or other motile animals were absent. The few small Nematodes observed in the grey film are of little significance in themselves, but if numerous they could greatly aid in consuming the organic matter. It may safely be concluded, therefore, that the large worm population is beneficial to the processes going on within a trickling filter.

Only two types of insects were observed on or in the filters at the plant. Small brown spiders were seen on the underside of the upper stones of the drier portions of the beds, where the adult Psychoda were most numerous. They were evidently living on these flies, but of course did not materially reduce their number. Psychoda were very numerous. Their larvae lived in the film together with the worms, and, therefore, aided these organisms in consuming the deposited organic matter and in keeping the film "open." There have been times in the past when the adults created a nuisance on or near the beds, but the fly was not observed at any distance. It thus seems that the beneficial action of the Psychoda larvae makes this organism a valuable member of the filter population. Its growth should be aided, except where sewage trickling filters are near dwellings, and the adults are likely to be a dangerous nuisance.

### Conclusions

It may be concluded from the above data that growths on sewage trickling filters are of more importance than they are usually considered to be.

Vegetable growths on such filters are likely to cause pooling trouble, which far outweighs any benefits derived from biochemical changes induced by them.

The animal population of trickling filters is either harmless or greatly beneficial to the action of the filters.

The dissolved oxygen and nitrate contents of the applied sewage are probably the controlling factors in determining the character of the growths in the filters.

Objectionable life in filters may be prevented or killed by the use of chemicals, flooding, or resting the beds. The use of chemicals is expensive, or would require special supervision to be economically feasible. Flooding is usually not possible because of the open structure of trickling filters. The resting of clogged filter beds is, therefore, the most successful way in which to restore them to a normal condition.

The desirability of being able to rest portions of the filter area indicates that all trickling filters should be constructed with several independent units. The amount of reserve area required, however, is hard to proportion without advance knowledge as to the character of the growths to be anticipated.

*Acknowledgment* — The writer wishes to acknowledge the aid of Dr. Raymond Salter in the preparation of this paper by his helpful criticism.

### References

1. Report of the Mass. State Board of Health, 1905, p. 282.
2. Report of the Sewage Testing Station, Philadelphia, 1911.
3. Report on Year's Operation of Fitchburg Sewage-Works, *Engineering Record*, Nov. 4, 1916.
4. Leo. F. Rettger—Fungus Growths on Experimental Percolating Sewage Filter at Waterbury, Conn.—*Engineering Record*, Nov. 1, 1906.
5. Thomas J. Headlee—Spring Filter Fly—Jour. of Economic Entomology, 1918.
Practical Application of the Methods Recently Discovered for the Control of Sprinkling Sewage Filter Fly, Psychoda alternata. —Jour. of Economic Entomology, 1919.
6. James Crabtree—The Functions of the Non-Bacterial Population of the Bacteria Beds—Transactions of the Royal Sanitary Institute, 1913.
Ward and Whipple—"Fresh Water Biology."
Whipple—"Microscopy of Drinking Water."
Fuller—"Sewage Disposal."
Metcalf and Eddy—"American Sewerage Practice."
Dunbar—"Principals of Sewage Treatment."
Williston—"North American Diptera."

# Long Concrete Trestles to Cross Southern River Swamps

## Four Bridges To Improve South Carolina Coastal Plain Transportation—Concrete-Pile Type Proves Cheapest

By J. L. Parker
Bridge Engineer, South Carolina Highway Department, Columbia

SOUTH CAROLINA is crossed by two large rivers, the Santee and Pee Dee, and a third, the Savannah forms the boundary between the states of South Carolina and Georgia. None of these rivers is crossed by a highway bridge within 170 miles of the sea, and they have long been barriers to the proper development of the state. Provision was recently made for a highway bridge over the Santee River at Murray's Ferry, over the Pee Dee River at Mars Bluff-Ferry, over the Wateree River at Garner's Ferry, and over the Savannah River at Augusta and Savannah. These bridges will cost about $2,200,000. The largest, the Santee River bridge, will be described briefly. It is typical of the group.

The rivers referred to above flow through the Coastal Plain for 150 to 200 miles from the sea. As with nearly all rivers in the Coastal Plain, the main channels are small, carrying all of the water only under normal conditions, the greater part of the flood water being carried through swamps several miles wide. These swamps are low, with heavy timber and undergrowth, and are subject to frequent overflows.

Located at Murray's Ferry, about 65 miles above the mouth of the river, the Santee bridge will be an impor-

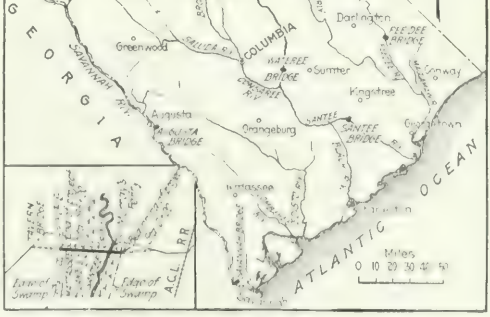



FIG. 1. RIVER CROSSING IMPROVEMENT IN SOUTH CAROLINA

tant link in the proposed Atlantic Coastal Highway. At the site the main channel is only about 330 ft. wide, and the swamp is nearly four miles wide. The flow of water is retarded to such an extent by the heavy timber and undergrowth that the extreme high water in the flood of 1908 averaged about 21 ft. deep, across the swamp, although the drainage area is only 15,000 sq.mi. In order to reduce the maintenance charges to a minimum, all structures, except the main spans, will be of reinforced concrete. The bridge will have an 18-ft. roadway, and will be above the highest known water. This width, the minimum used for bridges built by the state highway department, is believed to be ample for this country bridge, although a heavy tourist traffic should develop. As the Santee River is a navigable stream, a 63-ft. draw span is provided. The main channel crossing has one 180-ft., through steel truss swing span and two 120-ft. through steel truss fixed spans on concrete piers.

The approach trestles will have a total length of about 6,000 ft. There are seven trestles, of lengths and positions such as to provide for the most effective discharge of the flood waters. The plans provide for two types of structure, one, the pedestal type, having 36½-ft. concrete beam spans on cast-in-place bents on timber piles, the other having 24½-ft. concrete beam spans on concrete pile bents. These types of structures have been found generally to be the most economical for bridges through the low and wide swamps of the rivers of the coastal plain. The pedestal type of trestle is probably more rigid, but the low bid was based on the concrete-pile type, and this type will be used, as it will also permit of more rapid construction under the difficult swamp conditions. The trestles were designed for a live-load of two 15-ton trucks with 25 per cent allowance for impact.

As the lower part of the bents and concrete piles will be in water for the greater part of the year, particular attention has been given to the protection of the reinforcing steel in the footings and piles. The concrete piles will be pre-cast, and will be 16 in. square for piles 40 ft. long or less, and 18 in. square for piles more than 40 ft. long. Borings at the site show the material in the swamp to be silt or clay to a depth of 8 to 16 ft., underlain with a coarse sand, and rock at 18 to 40 ft. below the ground surface. This material is of sufficient firmness to give the necessary lateral support to the concrete piles and to support the embankments without excessive settlement. To maintain the alignment of the trestles, the outer piles are battered, anchor piers are provided at the center of the long trestles, and abutment piers at each end of each trestle to take up the thrust from the fills.

The embankments will be 23 ft. high, have a total length of 13,200 ft., and require 800,000 cu.yd. of earth. Material is to be taken from borrow pits outside of swamp. As no rapid currents can develop under the swamp conditions, the end slopes will run through abutment piers of the trestles and will be riprapped. Wooden railings are used on the embankments, on account of the risk of settlement causing cracking of concrete railings. On the trestles a simple and pleasing form of concrete railing, widely used in the South, will be applied. As the bridge is on tangent and it is extremely unlikely that a truck could strike a blow normal to the railing, its strength is believed to be adequate to give protection to traffic.

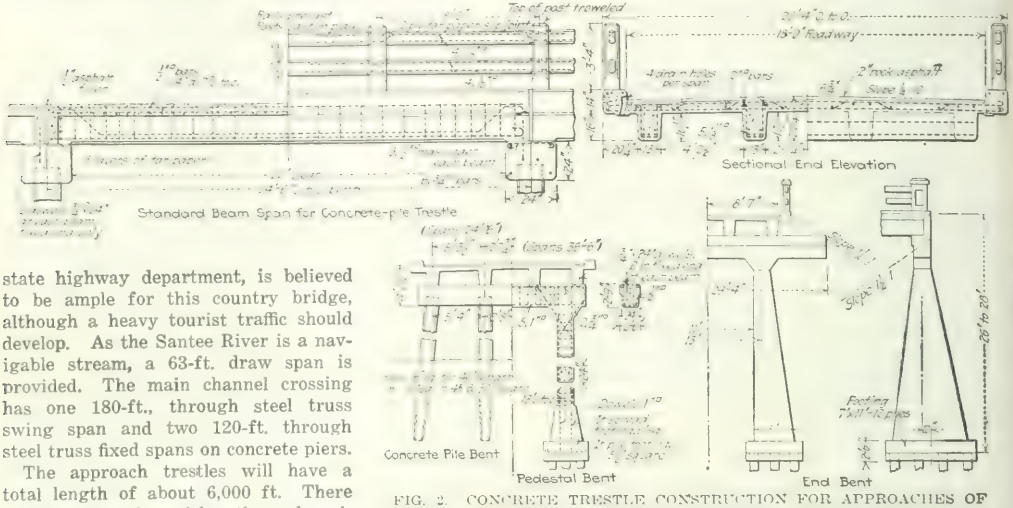



FIG. 2. CONCRETE TRESTLE CONSTRUCTION FOR APPROACHES OF SANTEE RIVER BRIDGE

In order to protect the trestles from the heavy drift carried by the Santee River in flood, a strip of land 225 ft. wide is provided on the upstream side of the right of way on which the timber is to remain standing for so long as protection of the trestles is necessary.

Construction work is now under way. Contracts have been awarded to the Atlantic Bridge Co., Roanoke, Va. for the main spans, to the Simons-Mayrant Co., Charleston, S. C., for the substructure of these spans, and to the Rollin Construction Corp., New York, for the approaches. The total cost of the bridge will be about $850,000. Funds are provided by the Santee Bridge District, composed of the counties of Charleston, Williamsburg and Berkeley, and the federal government. The work is being directed by the State Highway Department, Charles H. Moorefield, chief engineer.

### Local Freight in California Moves by Truck

In a recent opinion handed down by the railroad commission of California, Harley W. Brundige, president of the commission, made the following statement: "About 70 per cent of less-than-carload freight within a radius of 100 miles of San Francisco, Los Angeles and other jobbing centers, is now moved by auto trucks; on a 50-mile basis the percentage is considerably larger."

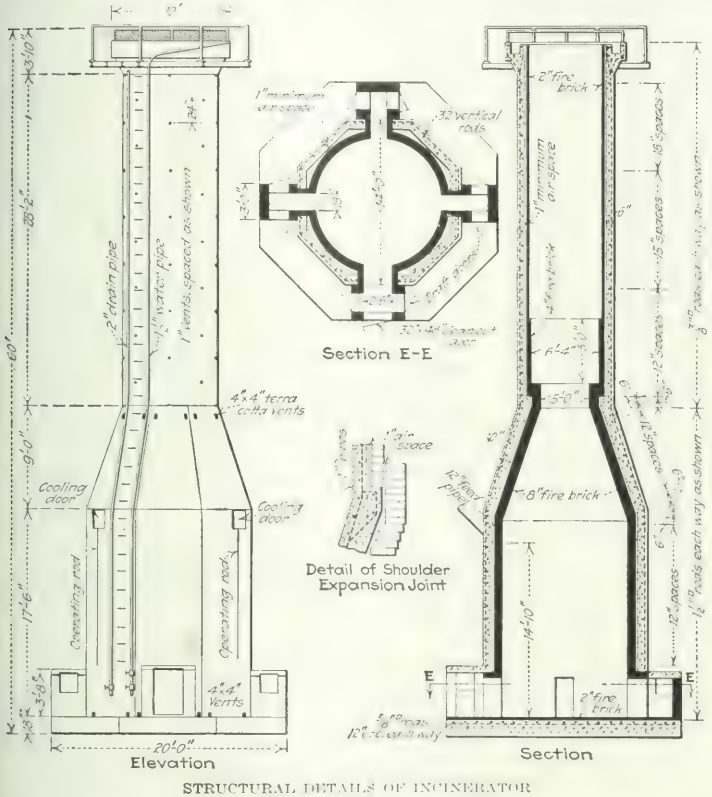
# Incinerator For Mill Refuse Made Of Brick and Concrete

## Air Vents and Expansion Joints Increase Life of Materials Under High Heat—Space Between Shell and Lining

AN INCINERATOR for destroying mill refuse designed for low first cost and long life has been in service at the plant of the Pacific Box Factory in San Francisco 18 months and is reported to be wholly satisfactory. It consists of a concrete shell with fire brick lining, 14 ft. in diameter at the base and 60 ft. high, built at a cost of $6,000. Thus far the capacity has not been reached by the maximum rate at which it has been possible to blow material in through the 18-in. feed pipe. As much as 400 cu.yd. of refuse have been consumed in 9 hours and it is claimed that the greater the rate of feeding the hotter the fire and hence the greater the capacity. Features of the design are the means provided for the expansion of the brick work and the arrangement of vents for cooling concrete thus increasing the life of the structure.

The outer or concrete shell was made in two pours, each pour being made in a day. The first pour carried the structure to height of 28 ft. and left reinforcing projecting for bond. This was the only joint as the second pour completed the structure to full height. Self-supporting forms of the ordinary type were built up on the inside, and outside forms were built up independently supported by scaffolding. The only connection between the two sets of forms were the tie wires run through from side to side to prevent spreading. A 1:2:4 mix was used, delivered by a hoist in the scaffold. All reinforcing was deformed steel bars tied at each intersection with No. 18 soft annealed wire. Dimensions and arrangement of reinforcing are shown in the accompanying illustration. Inside forms were removed in about four days, but outer forms were left in place as long as possible as a protection against wind and weather.

The brick lining put in after the inside forms were removed, was likewise placed in two sections, the upper section resting on a shelf in the concrete and being entirely independent of brick work below. This separation makes it possible to put an expansion joint in the brick work which is said to be the most important feature of the design. The brick of the combustion chamber can expand upward without lifting the weight of the lining above, thus preventing the overloading that tends to crush or buckle the lining and shorten its life.




STRUCTURAL DETAILS OF INCINERATOR

Heat in the combustion chamber ranges from 1,500 to 2,000 deg. F. and is said to cause the brick lining to expand 3 in. in a vertical direction. This movement is taken up in the expansion joint between the two sections of brick work. The clearance between the lining and the outer concrete shell is nowhere less than 1 in. and this is more than the expansion of the brick work circumferentially.

The concrete shell around the combustion chamber is octagonal in plan, thus affording a considerable air space between concrete and brick. Sixteen 4 x 4-in. terra-cotta vents through the concrete, just above ground level, admit cool air into this space. Heated air passes out of this space through corresponding vents near the top of the octagonal section 28 ft. above the base. In the upper circular section the one-inch space between brick and concrete is vented by one-inch galvanized pipe set in the concrete at intervals that place one vent in every 16 sq.ft. of surface.

The firebrick used in the lining are rated as capable of withstanding 3,200 deg. F. and are all laid as headers, i.e. "end on" to the combustion chamber. The bricks are 8 in. long and 2½ in. thick with a width, in a horizontal plane, that varies from 3½ in. on the fire box face to 4½ in. at the outer end, thus giving a joint slightly narrower at the rear than at the front end. In the upper part of the combustion chamber, or fire box,

the concave curve or corbeling-in of the brick work toward a smaller-diameter throat is said to improve the draft at the same time that it reflects the heat in such way that high temperature and excellent combustion is secured. A very small quantity of ash accumulates as the draft and high temperature are such as to reduce the residue to a minimum and to carry away a part of it as very fine particles that escape in the draft. No grate bars are used, the concrete foundation at ground level being covered only with a layer of fire brick on the flat.

A means of controlling the rate of burning and, to a certain extent, the temperature of the brick lining is provided by four 20 x 20-in. iron doors at a height of 19 ft. above ground extending through both the concrete and brick. These doors, controlled by rods running down to a convenient height are opened after the fire is well started and by admitting cold air near the top of the combustion chamber prevent excessive heating of the brick work. The inlets covered by these doors incline sharply upward.

Draft for suitable combustion conditions is secured by means of short tunnels at ground level, each of which has an indirect air entry by way of a pair of iron doors. These doors are held open as desired by ratchet latches and are set according to the direction of wind. At the outer end of these tunnels a wall with fire brick facing takes the direct heat from the combustion chamber, except in the case of one tunnel provided with a large end-door for clean-out purposes and for convenience in passing in refuse too large to be blown in through the 18-in. pipe.

The top of the incinerator is covered with screen of ½-in. mesh to catch sparks and a gutter is built in the concrete around the top which can be flooded when desired. A 1½-in. galvanized water pipe runs up to this gutter and a 2-in. drain pipe leads down from its lowest point.

In applying a design of this sort where hot air is needed for some auxiliary use, such as in a dry kiln, the concrete shell could be made octagonal in cross-section all the way up to increase air volume between shell and lining. Vents to the outer air would be omitted and a blower at the base would draw the heated air into a pipe for delivery as desired.

The incinerator was designed by Captain W. W. Breite, structural engineer of San Francisco and built by Herman Ludwig who has been granted a patent under the name of the Ludwig incinerator and hot air dry kiln.

### Uncompahgre River Flood

During June floods in Uncompahgre River, Colo., exceeded any previous floods of record. On June 11 a stage of 3,900 sec.-ft. was reached and continued until June 14, when a heavy storm over the whole watershed raised the flow to between 4,300 and 4,500 sec.ft. at the upper end of the valley. Reporting on the flood in the October *Reclamation Record*, L. J. Foster, project manager, states that former seasonal flood discharges as far back as 1898, range only from 1,500 to 2,450 sec.-ft. Much damage was done to works of the U. S. Reclamation Service, private ranches and the Denver & Rio Grande tracks. At one point it required three days time with a dragline to turn the river back into its old channel by closing a 315-ft. gap in the river bank. Bundles of trees were anchored with rock baskets.

# A Study of Topeka Mixed Bituminous Pavement Specifications

## Practice in 46 Cities and States Analyzed—Wide Variations Noted—Desirable Mixture Suggested

By Roy M. Green
President, Western Laboratories, Lincoln, Neb.

IN ORDER to study the methods of specifying the laying of mixed asphaltic (Topeka) roads in common use in the United States requests were sent to every state highway department and the city engineers of the two principal cities in each state, asking for copies of their specifications. As a result of these requests 46 specifications were received. The wide variation in many of their features forms the subject of the following discussion:

*Large Aggregate*—Fifty-four per cent of the specifications described the large aggregate as "a hard, tough and durable stone," or as a material "satisfactory to the engineer"; 72 per cent contained a clause requiring the material to be clean; 20 per cent called for a certain toughness; 39 per cent demanded a certain minimum French coefficient of wear; 19 per cent required a certain grading on only two screens; and 9 per cent a grading more than two screens.

A cleanliness clause for this material is desirable and, since there are accurate methods for determining the suitability of stone, limits for toughness and resistance to abrasion should be given, so that the instructions may be more specific. It must be borne in mind, however, that the limiting requirements for the various types of mixtures should be different, as in the case where the Topeka specifications are modified by the introduction of more stone in the mixture than is permissible under the Topeka decree. The properties of the local materials should also be kept in mind so that the best local materials may be used and at the same time make it possible to obtain materials economically that will meet all requirements specified.

The exact grading of the large aggregate need not be given if limits of composition are specified for the finished mixture.

### Sand Grading Requirements

*Sand*—Of the specifications examined 80 per cent contained a cleanliness clause for sand; 38 per cent a grading requirement on only two sieves; 24 per cent a grading on more than two sieves; 38 per cent gave no specific grading requirements; and 59 per cent limited the maximum amount of material passing the 200-mesh sieve. This limiting amount passing the 200-mesh sieve varied from 4 to 10 per cent.

Since it is possible for a fine sand to be too dirty for this type of construction a cleanliness clause is desirable. As the fine sand passing the 200-mesh sieve is not usually useful as a filler, and may be a detriment, a clause limiting its amount to not more than 10 per cent is desirable. In some cases, depending upon the nature of the sand, this limit should be reduced to 6 per cent.

It is not necessary to give the grading limits for this material, other than that passing the 200-mesh sieve, if the formula for the mixture is closely drawn so as to control the finished mixture.

*Filler*—Eighty-five per cent of the specfications allowed the use of either portland cement, limestone

or dolomite dust to be used as a filler; 7 per cent did not mention the filler in any way; and 57 per cent placed a minimum amount passing the 200-mesh sieve for this material.

Since portland cement, limestone and dolomite dust have been successfully used as a filler it is desirable to allow the use of any one of them. A minimum amount of material passing the 200-mesh sieve is desirable, so that a certain definite proportion will be sufficiently fine to be classified as filler. A limit on the maximum size of the filler should also be specified.

*Asphalt Cement*—Of the specifications examined 55 per cent were of the blanket type, that is, they described the oil asphalts and natural asphalt cements by one and the same group of test limits; 36 per cent were of the alternate types, that is, for purposes of description the natural asphalt cements were separated from the oil asphalt cements; 9 per cent were closed to all except oil asphalts. Forty-five per cent were modeled after the asphalt cement requirements of the 1914 sheet asphalt specifications of the American Society of Municipal Improvements; 33 per cent were modeled after the specifications suggested by the U. S. Bureau of Public Roads; and 7 per cent allowed the use of a tar as well as an asphalt cement.

Since equally good results may be obtained by the use of any asphalt cement of recognized standard no engineer is justified in drawing his specifications in such a way that he will eliminate any one of them or give one material the advantage over the other. The fact that the natural asphalts are separated from the oil asphalts, for purposes of description, in some of the specifications is no indication that separate bids are received on pavements constructed with the two types of materials. In case this kind of a specification is used, bids should be received upon an equal basis for, if properly handled, one material is in no way superior to the other.

### Variations in Temperature Clauses

*Temperatures at Paving Plant*—Forty-six per cent of the specifications limited the temperature of the asphalt cement, aggregate and finished mixture; 50 per cent limited the temperature of the aggregate and asphalt cement only; 2 per cent limited the temperature of the aggregate only; and 2 per cent limited the temperature of the asphalt cement and mixture only. The temperature range of the aggregate in 30 per cent of the specifications was from 225 to 325 deg. F.; for the asphalt cement 35 per cent called for a limit of from 275 to 350 deg. F.; and for the finished mixture 26 per cent called for the limiting temperatures of from 225 to 325 deg. F.

The temperature limits for the aggregate and asphalt cement should be sufficiently high to allow the two to mix thoroughly and at the same time must be low enough so as not to injure the asphalt cement. The temperature limits for the aggregate should be high enough to compensate for the fact that the cold filler is added to the aggregate before the asphalt cement, but it must be remembered that the larger particles of aggregate will remain at practically the same temperature after the addition of the filler, as they do not readily drop in temperature because of their greater volume.

Reasonable temperatures for the mineral aggregate for this type of construction would be from 250 to 375 deg. F.; for the asphalt cement, from 250 to 350 deg. F.; and if the temperature of the finished mixture is to be specified it should be from 250 to 350 deg. F. It must be remembered that the various asphalt cements are not affected to the same extent by high temperatures and the proper working temperatures are therefore different.

*Time of Mixing*—In the specifications examined 96 per cent contained a clause that the material should be mixed "until uniform in color and appearance" or a similar clause; 11 per cent required a mixing of at least 1 min.; 4 per cent for at least 1½ min.; 4 per cent for at least 45 sec.; while 2 per cent did not mention how long the mixing should be continued.

The time of mixing is important, as it is essential that the mixture be made uniform and that every batch be the same, otherwise the pavement is certain to "bunch up" under traffic. This is a matter that must be handled by the inspector at the paving plant but it is well to specify a minimum limit on the mixing time. This time limit should be made as short as possible, consistent with good work, and it should be remembered that mixtures containing a high percentage of the larger particles mix much more readily than those made up entirely of the finer material. For modified Topeka mixtures containing a high percentage of material retained on the 10-mesh sieve the minimum time should be 45 sec. The mixing can be more thoroughly and completely done if the man placing the asphalt cement in the mixer is very careful to have it evenly distributed along its entire length, or at least to be sure that it is not placed near one end.

### Composition of Mixture

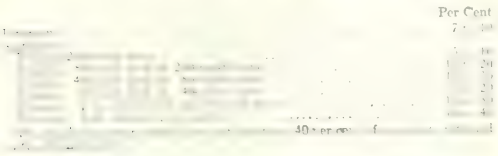
*Type of Mixture*—Seventeen per cent of the specifications called for the Topeka mixture just as it is described in the decree; 74 per cent were of the modified Topeka type; and 9 per cent did not call for any particular formula.

It has been pointed out many times that it is impossible to expect good results from a pavement mixture which follows the Topeka decree formula without modifications. For this reason that form of specification should be discontinued. If the Topeka decree is to be modified simply by making the sand grading more satisfactory and not by increasing the amount of aggregate retained on the 10-mesh sieve it would be well to make use of the formula which was used by 28 per cent of the cities and states whose specifications were examined. This formula follows:

| | Per Cent |
|---|---|
| Bitumen | 7 to 11 |
| Aggregate: | |
| Passing 200-mesh sieve | 5 to 11 |
| Passing 80-mesh and on 200-mesh sieve | 10 to 25 |
| Passing 40-mesh and on 80-mesh sieve | 11 to 36 |
| Passing 10-mesh and on 40-mesh sieve | 7 to 25 |
| Passing ¼-in. screen and on 10-mesh sieve | 11 to 25 |
| Passing ½-in. and on ¼-in. screen | 5 to 10 |

If it is desirable to obtain some stability of the pavement mixture through the interlocking effect of the aggregate retained on the 10-mesh sieve it is necessary to increase the amount of material of that size to much more than that allowable under the foregoing formula. Such a mixture has practically never been specified in the past because of the Bitulithic patents even though a great many pavements of this type have been laid under other specifications. Since the basic Bitulithic patent has now expired, it is possible to specify such a

mixture as the following, which is much more desirable than the foregoing under most traffic conditions:




Such mixtures must be controlled within the limits given in the specifications if satisfactory results are to be obtained. A clause stating that the engineer shall have the right to vary the proportions within the limits given should also be included.

*Temperature of Mixture on Street*—Thirty-three per cent of the specifications called for a temperature higher than 200 deg. F. for the mixture just before it is spread; 15 per cent required a temperature higher than 250 deg. F.; and 17 per cent did not mention any temperature.

The temperature at which the material shall arrive at the street should be placed high enough so that it will insure proper spreading and rolling. A temperature of 250 deg. F. is reasonable for the lower limit. No upper limit need be specified, because the matter of excessively high temperatures is taken care of at the plant.

### Roller Should Weigh 7 Tons

*Rolling*—As in all other types of bituminous pavements the wearing surface must be thoroughly compacted. Such compaction is always obtained by rolling. Eighty-nine per cent of the specifications required that the surface "shall be rolled until no further compression is obtained" or "until all roller marks disappear"; 44 per cent required that two rollers be used; 24 per cent required that the roller or rollers shall weigh from 7 to 8 tons; 20 per cent did not specify any particular roller weight; 28 per cent required that the weight be from 200 to 300 lb. per inch width of tread of the roller; 28 per cent did not specify any particular unit weight per inch width of tread; and 20 per cent limited the area to be rolled to 2,000 sq.yd. per 10-hr. day.

For this type of construction it is not desirable to use a roller weighing less than 7 tons, nor to roll the surface first with a light roller before using the heavy one. A light roller used in advance of the heavy one chills the top surface without forcing the larger pieces of aggregate down into the mortar mixture. After becoming chilled it is then impossible for the heavy roller to compress the surface enough to allow these particles to become properly surrounded with the bituminous mortar. The weight of the roller should also be defined in weight per inch width of tread and the limits should be between 200 and 300 lb. per inch width.

It is always convenient to have two rollers on the job, but if the roller is good, the operator an experienced man, and the output of the plant not more than 200 sq.yd. per hour, one roller will suffice, unless the surface finish is to be put on by the flush coat method. It is well to specify two rollers but that, with the permission of the engineer, one may be used.

*Surface Finish*—Of the specifications examined 37 per cent required the use of the portland cement or stone dust finish for the surface; 24 per cent called for the flush coat method of sealing; 33 per cent did not require any finishing other than the final rolling; and 4 per cent called for the mixed method bituminous seal coat.

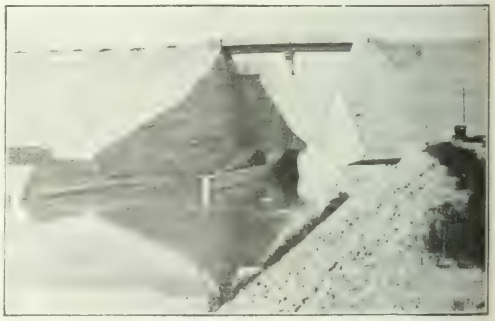
The stone dust or portland cement finish is satisfactory for the finer mixtures, where the amount of material retained on the 10-mesh sieve does not exceed that given in the Topeka decree. For mixtures containing much higher proportions of the larger size the flush coat method of sealing should be used.

*Weather Limitations*—Forty per cent of the specifications did not place any weather or seasonal limitations upon the work of laying the wearing surface; 22 per cent allowed no work between Dec. 1 and April 1, or when the temperature is below 50 deg. F. unless special permission is obtained from the engineer; and 13 per cent required that the work be discontinued when the weather conditions are not satisfactory "in the opinion of the engineer."

The seasonal limitations given above—work to be discontinued from Dec. 1 to April 1—is entirely too strict in most localities in the United States. Good work can be done when the temperature is below 50 deg. F. if other weather conditions are satisfactory. The temperatures at which work can be properly performed depend upon humidity and wind. For these reasons it is difficult to fix a minimum temperature at which work should be discontinued. It is better to leave this matter to the judgment of the engineer, even though it is always undesirable to have such points so indefinitely stated in the specifications.

## Lockington Dam Completed

WITH the completion of the Lockington dam of the Miami Conservancy District, just announced, two of the five detention dams for flood protection of the Miami Valley, in southwestern Ohio, are in service in their final condition. The view herewith shows the main portion of this structure, which in its entirety is 6,500 ft. long and at its maximum 78 ft. high from river bed to crest. It is the longest of the five dams.

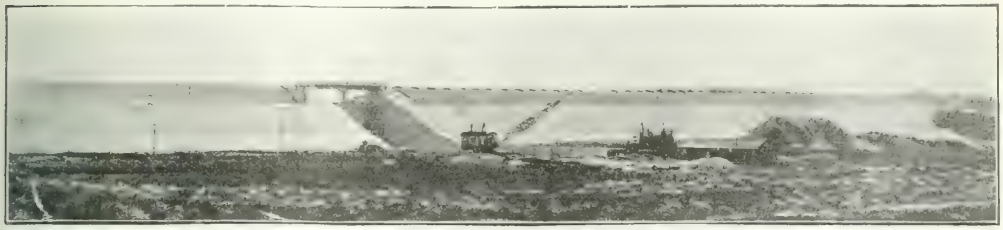


LOWER END OF DISCHARGE CONDUITS AT LOCKINGTON

The Lockington dam controls the flood waters of Loramie Creek, a stream which enters the Miami River just north of Piqua. The two outlet conduits of the dam, each about 8 ft. wide by 10 ft. high, which pass through the base of the concrete spillway weir seen in the view, would discharge about 10,000 second feet under maximum conditions. In a flood like that of 1913

when the dam would impound water to 60-ft. depth and the basin storage would total 63,000 acre-feet, the conduits would discharge 8,600 sec.-ft. The 72-ft. spillway, 16 ft. below the top of the dam, constitutes a safety provision under maximum flood conditions. The bridge seen crossing the spillway opening carries a 25-ft. roadway across the valley.

About 1,100,000 cu.yd. of material were required to make the dam. Most of this was handled and deposited by the hydraulic method. Enough rock was found in the material to provide for paving the dam slopes below the upper berm with cobble-stones, which provided a very cheap surface protection for the dam slopes. Construction of the dam was in charge of B. M. Jones, Division Engineer; C. H. Shea, Assistant Division Engineer, and G. E. Warburton, Superintendent.



UPSTREAM SIDE OF LOCKINGTON DAM, WITH COMBINATION OUTLET-CONDUIT AND SPILLWAY STRUCTURE

## Fire Protection for Railway Timbered Tunnels

OF 151 tunnels aggregating 28.6 miles on the Pacific system of the Southern Pacific Ry., all but 1.6 miles in solid rock were built with timber lining, according to a paper read at the recent annual meeting of the Railway Fire Protection Association, at Chicago, by Harry Pollard, general fire inspector of the Southern Pacific Ry. In the past few years the timbering has been reduced to 20.6 miles by the construction of concrete lining at different places. The following is an abstract of the paper:

Numerous fires have occurred and the difficulties of fighting them are increased by the limited space, the necessity of attack from one or both ends, the lack of light and ventilation, the mass of timber packing in cavities outside of the lining, and the air drafts which come from the portals and through seams in the rock. Three examples of tunnel fires may be noted.

1. A brush fire sweeping over a mountainous district was drawn into a tunnel by the draft. In a few hours the workmen succeeded in closing the ends and steam was turned in from locomotives. After about 48 hours one end was opened, but fire was discovered and when the tunnel was again closed carbon dioxide was forced in for about 36 hours. It was then decided to open both ends and if the fire was still alive to let it burn itself out. In a short time the tunnel was again burning furiously.

2. A torch was left in a tunnel by a repair gang when going out to let a train pass. The lining was burned and the tunnel caved in, a temporary track being laid around it until the tunnel could be restored.

3. A fire from an outside wreck spread to the tunnel lining and into the timber packing. In a few hours the ground caved in and it was hoped the fire would be smothered. Expert firemen from San Francisco were employed to explore the tunnel, using gas and smoke masks, but though they reported the fire was out it soon developed again. A pump and water plug proved of little use, as the fire behind the lining could not be reached. It was then decided to wreck the tunnel and four sets of timbers were blasted out so that the ground caved. In this way the fire was blocked off and sealed on all sides, but the enclosed timber burned as in a kiln, due to the air admitted through cracks in the rock. The water pipe was used repeatedly to cool the rock and to put out fires discovered during excavation of the debris. Only the checking of the fire by the early caving made it possible to get into the tunnel from the opposite end and keep the fire in check.

Sprinkler systems and perforated pipes are of little value in tunnels, owing to the conditions of steam and heat from the engines, damp, corrosion and the possibilities of destructive effect by wrecks. Such protecton is out of the question in view of its cost, the difficulty of maintenance and the lack of reliability in time of need. It is doubtful if expensive fire protection in tunnels is worth its cost. Fireproof paint on the timbers is not satisfactory, as it will not adhere to green timber, it is liable to scale off and no such paint will resist the heat developed in a tunnel fire.

Strangely enough there is no record of fire being started by a locomotive, even in the coal burning days, and the oil burning engines now used are less hazardous. The causes to be guarded against are outside sources, train wrecks and human carelessness. For the first, it is well to clear the ground of brush, trees, grass and weeds for 100 ft. beyond the entrance, and to whitewash the timbering annually for 50 ft. from the portal.

Fire protection equipment needs to be something that is simple and can be used not only by employees but by others, as such outside help has sometimes saved property. Two water barrels and buckets may be placed near each end, or a 5-gal. extinguisher of the type that will not freeze and does not have to be recharged except after being used. At 500-ft. intervals there should be a fire extinguisher and a water barrel with bucket. Where water is available it should be stored in a reservoir or tank with as much head as possible and piped into the tunnel, where hose would be stored. Valves should be about 250 ft. apart, to reduce length of hose, and should be protected by underground boxes.

Electric light should be provided where possible. Open lights, whether oil or carbide, should not be left unattended and should be extinguished while trains are passing. Inflammable material not required for maintenance should be kept outside, and such waste as shavings, small wood blocks and chips from adzing ties and timber should be taken out daily.

Fire prevention can be secured only by fireproof construction, which means solid rock or a lining of brick or reinforced concrete. Brick is not favored, owing to the possibility of knocking out a section and wrecking the tunnel. Concrete will stand more punishment. In the past few years the Southern Pacific Ry. has placed concrete lining in about 6.3 miles of tunnel, leaving 20.6 miles yet to be lined. This work was begun by selecting the most hazardous tunnels and placing concrete for 50 ft. at each end. In bad ground a section of concrete lining was put in, which acts as a fire break.

# Foundation Problems in Erecting Standard Oil Building

## Adjoining Heavy Buildings Underpinned Down Through Quicksand—Novel Method of Cofferdam Construction

By Ralph H. Chambers
Jarrett-Chambers Co., Inc., Consulting and Constructing Engineers, New York City

THE necessity to maintain existing usable space, until new quarters could be made ready for occupancy, led the designers and constructors of the new Standard Oil building, New York City, to erect the building in sections. This method of construction added to the usual problems of shoring and underpinning the buildings adjoining the site, the further problem of the maintenance of the heavy buildings which still occupied the remainder of the site.

The new Standard Oil building will be thirty stories high and will occupy the site bounded by Broadway, Beaver and New Streets, adjoining the present Standard Oil building. The soil underlying this site is water-bearing clay and quicksand to a depth of 27 to 30 ft. below curb level. Below the quicksand is a stratum of hardpan 13 to 28 ft. thick, lying upon the rock and as the upper layer of the rock was found to be decomposed to a depth of several feet, the sound rock lies at a depth of 41 to 73 ft. below curb level.

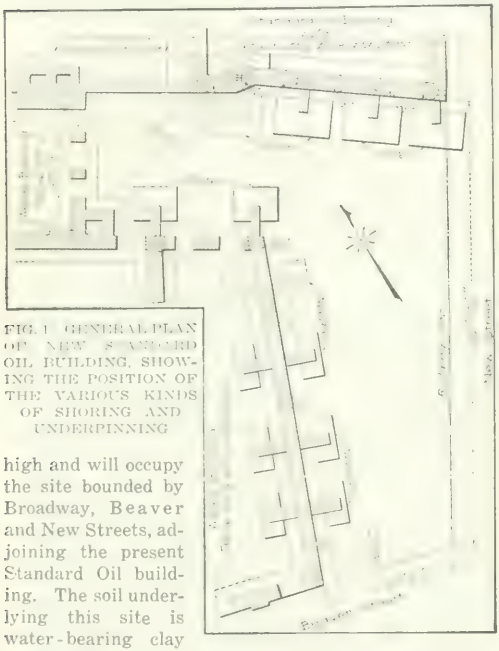


FIG. 1. GENERAL PLAN OF NEW STANDARD OIL BUILDING, SHOWING THE POSITION OF THE VARIOUS KINDS OF SHORING AND UNDERPINNING

The first section of the building will occupy the portion of the site adjoining the Welles building on the west, and the present Standard Oil building on the north, and fronting on New and Beaver Streets. The second section will extend the first section to the west and will occupy the site of the Beaver Street wing of the Welles building.

The plans for the building provide for a deep subbasement under sections one and two, the floor of which will be 37 ft. below the curb level. This requires a cofferdam wall, sunk to rock and entirely surrounding sections one and two. The north side of the cofferdam wall is coincident with the south face of the wall of the old Standard Oil building and this cofferdam wall was sunk 40 to 48 ft. below the bottom of the foundations of the old Standard Oil building.

The foundations for some of the interior columns of the new building were located immediately under the east wall of the Welles building. Furthermore, to advance the date of completion of the new building it was determined to sink foundations for the new building, under the Beaver St. wing of the Welles building, without disturbing the tenants of this building.

### Shoring and Underpinning

Confronted with these conditions, it was evident that the south wall of the old Standard Oil building and the east wall of the Welles building would have to be underpinned, and the underpinning would have to be carried down to rock, before the caisson foundations for the new building could be sunk. The theory set up as governing the work to be done to safeguard and maintain the old building was as follows:

First, the foundations of the old buildings being very heavily loaded, would not allow any underpinning work which might disturb them to be begun until adequate shoring had been installed; second, the type of underpinning to be adopted and the method of installation used should disturb to the least possible extent existing foundations; and third, the underpinning installed should sustain the old buildings without dependence upon portions of the old foundation left in place when the work was completed.

Two forms of shoring were used and installed. Needles were placed under the greater part of the east wall of the Welles building and spur shores were used to support the balance of the Welles building wall and the old Standard Oil building. The needle form of shoring was not feasible under the wall of the Standard Oil building without seriously interfering with the operation of the mechanical equipment in the basement. Each set of needles had a capacity of about 300 tons. Each shore under the Welles building had a capacity about equal to that of the needle shores, although the mat was of smaller area. The shores used on the Standard Oil building were of about 500 tons capacity each. By actual test of the screw jacks, the lifting capacity of the shores was determined and the shoring was maintained at its full capacity until the adjacent underpinning was completed. The two types of shoring are illustrated in accompanying photographs.

The needle shores, used in this work, were made up of two sets of steel beams, each set consisting of three 24-in. beams, the upper set supported by the lower. The jack blocks and mats were timber in the usual form and adjustment of the shoring was provided by eight steel screw jacks each 3½ in. in diameter.

The spur shoring consisted of heavy timber mats each carrying as many as twelve steel screw jacks, which controlled the 24-in. square spur shores engaging with the wall to be sustained. It is believed that this

is the first instance of the use of screw jacks with spur shores of this capacity. Experience in this work with this form of shoring, as compared with needle shoring, was very favorable to the spur shores.

It was found that the cost of the spur shoring as compared with the needle shore was somewhat less for equal capacity. Furthermore, the spur shores had the decided advantage in that they could be used without having to gain access to the interior of the building to be shored.

When the underpinning work under the east wall of the Beaver Street wing of the Welles building had been completed, 64 per cent of the foundation of this wall had actually been removed and the portion of the foundation left in place had been subjected to the disturbance caused by the sinking of the foundation caissons under this wall, as well as the underpinning cylinders. Also, 50 per cent of the foundations of the wall of the Standard Oil building had been removed. This work was, however, accomplished successfully and without any settlement or cracking of the walls being noted.

One of the interesting phenomena observed in the action of the shores, was the slow yielding of the soil under the pressure of the shores. When the shores were first installed, after the lapse of some hours the jacks were found to be comparatively loose. The jacks were then tightened and again the yielding of the soil was observed. This action continued for a week or more, depending upon the character of the soil, before the jacks remained tight during a considerable period of time. It would appear from this, that the element of time must be taken into account in foundation work and the determination of the bearing capacity of a pile or footing cannot be made by a single test, but that it must be obtained by a series of tests extending over a considerable period of time.

To conform to the second and third conditions of the theory adopted, it was determined to construct concrete underpinning piers under the walls of the old buildings and to sink these piers by the compressed air method to the rock. In doing this the following method was employed.

The piers were installed by sinking cylindrical steel shells down to a level 2 ft. below the surface of the hard pan and continuing the excavation in the hard pan, without a shell, to the rock. Each steel shell was in three or four lengths and was fitted with air-tight heads and doors so that there was an air lock chamber in the second length of each shell. The excavation to rock completed, concrete was filled in up to the level of the bottom of the wall footing. Air pressure was maintained during the whole operation until the concrete had reached a level above the bottom of the steel shell and had set for 24 hours. After the concrete in the cylinder was set the notch cut in the wall footing was filled with concrete except that a space about 4 in. high was left at the top. This space was finally filled with dry concrete rammed into place. Each of the underpinning piers has a capacity of approximately 700 tons

Another underpinning difficulty was met in underpinning a steel column which supports a large portion of the weight of the upper six stories of the old Standard Oil building and runs down from the ninth

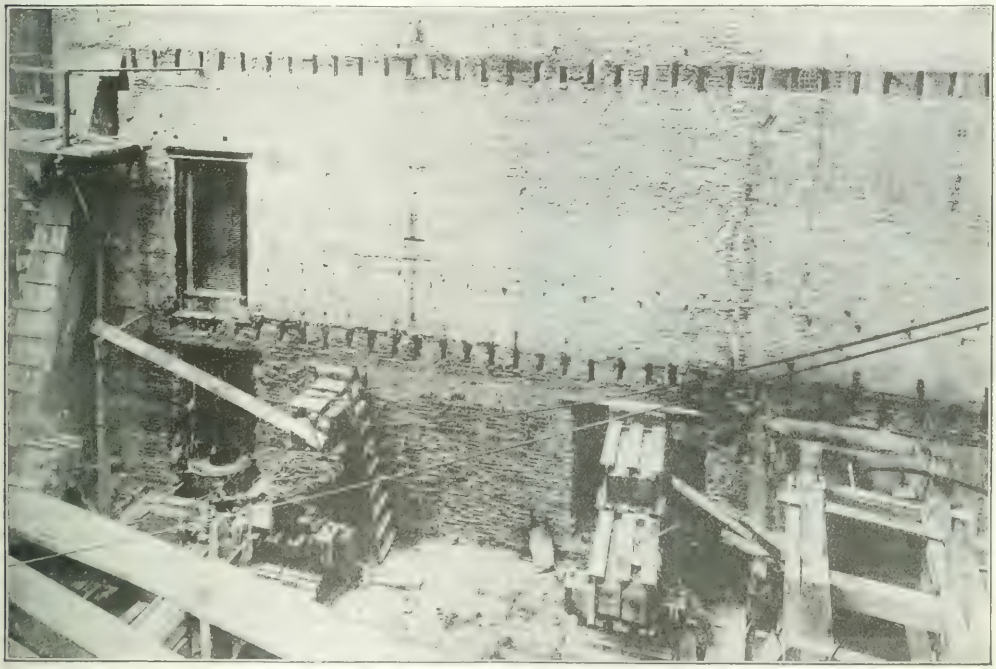


FIG. 2. SYSTEM OF UNDERPINNING BY NEEDLES AND SHORES

floor to the foundations of this building. Originally, the present Standard Oil building was ten stories high and later six additional stories were added. These additional stories are supported by a system of distributing and cantilever trusses, resting, in general, on the walls at the ninth floor level. Owing to an offset in the south wall of the building, one of the main cantilever trusses overhangs the wall and the load on this truss is supported by a single steel column which was inserted into the wall and which carries the load from the ninth floor to the foundation at the basement floor. The loading on this column was about 400 tons and the column was apparently well bricked into the original wall, but some doubt was felt as to whether the shoring of the wall would take care of the column

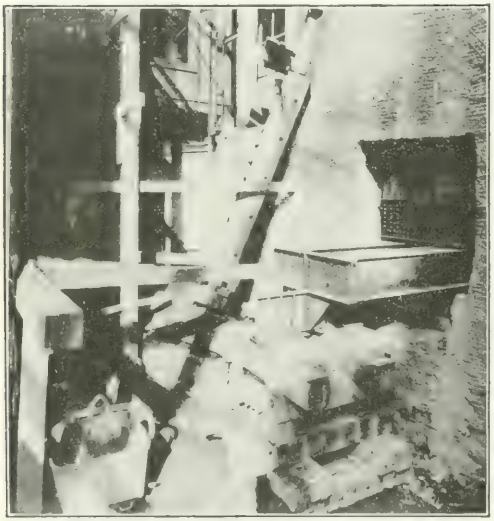


FIG. 3. LONG COLUMN INSIDE BUILDING WAS SUPPORTED ON GRILLAGE SHOWN IN FOREGROUND

also. It later developed that this doubt was well founded as it was found possible to lift the column slightly without lifting the wall.

The shoring of this column was planned upon the assumption that no appreciable settlement of the column could be allowed. Any settlement would redistribute the stresses and reactions in the cantilever girder above. Also it was decided that the footing originally provided for the column would be entirely adequate, even if slightly disturbed by the underpinning operation, if the load were properly distributed on the footing.

Support of the column was therefore provided by a short steel girders connected with each of the two sides of the column by cutting out the rivets near the bottom of the column, reaming out the holes and riveting the girder to the column. To avoid cutting out too many rivets at a time, the girders, placed on each side of the column, were each made up of two similar girders, one above the other, only one of these girders being connected at a time. Between the girders four diaphragms on each side of the column were riveted. These diaphragms were intended to carry the column load to the shoring needles below and in order to distribute

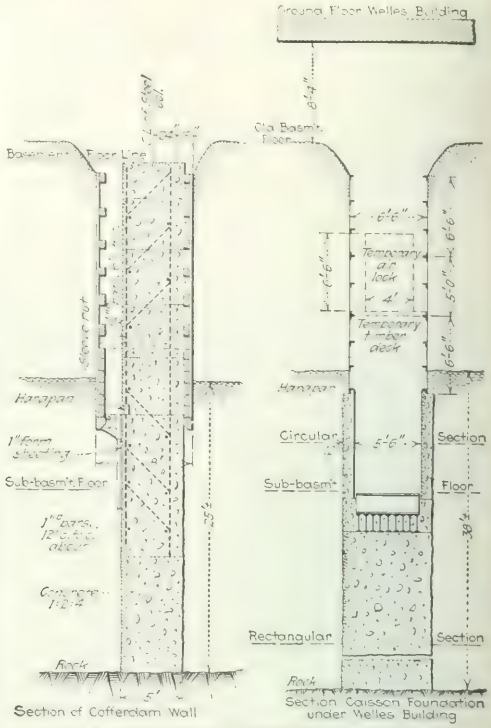



FIG. 4. SECTION OF COFFERDAM WALL AND FOUNDATION CAISSON

the reaction equally to the two girders, the bearing surface of the diaphragms was confined to the middle part of the ends of the diaphragms. The ends of the shoring needles inside the building rested on steel beams, which in turn were supported by the grillage beams of the original footing. No settlement of this footing was looked for, although means for jacking up the ends of the needles were provided should the emergency arise.

The outer ends of the needles were riveted to a distributing beam which was supported only at one point in the middle of this beam. The support under the distributing beam rested upon four screw jacks which in turn rested upon a timber mat on the soil. Thus the column which sustained the floors of the six upper stories of the building transmitted its load to the girders riveted to it and through the diaphragms between the girders the load was carried to the shoring needles and then to the mat on the soil outside the building, and to the footing originally provided for this column inside the building. Thus the column was supported, at its base, by three points of support.

This balanced system of support was deemed necessary as a precaution against unequal loading of the ends of the girders riveted to the column, as any but a uniform loading of these girders would have produced a torsion and would have increased the shearing stresses in the rivets connecting the girders to the column, as well as a bending of the column itself.

After the shoring was completely installed, the jacks were screwed up and it was found that the column

could actually be lifted. This shoring accomplished, the masonry under the column was cut away and an underpinning pier was sunk under the column. The shoring was then removed. The work was accomplished without any settlement of the column.

An unusual condition was met in installing the foundation for the first section and in putting in the sub-basement walls. Only two sides of the cofferdam to include the sub-basement could be constructed until after the building, which occupied the site of the second section, had been demolished and the foundations for the columns of the first section of the building which were within the area enclosed by the cofferdam had to be sunk from the surface.

In the construction of the cofferdam wall, to take advantage of the comparative shallow depth of quicksand and to limit the thickness of the wall to a minimum, timber caissons were sunk but these were carried only a short distance into the hardpan. From the bottom of the timber caissons the excavation through the hardpan down to the rock was limited in width to the required thickness of the finished wall. When the excavation had been completed the concrete was carried up to a level just above the bottom of the timber caisson and having been allowed to set, the air pressure was taken off, the deck of the caisson removed and the wall was finished in the open cofferdam. The timber bracing was removed as the wall was carried up.

It will be evident that the method adopted makes it possible to limit the thickness of the wall to any desired minimum. This cannot be accomplished in the ordinary method because the thickness of the working chamber walls govern the minimum width of the cofferdam wall. Also the method used in this work makes it possible to build a cofferdam wall which is continuous from the rock to the top without any cause for apprehension as to possible voids left unfilled under the roof of the working chamber.

In putting the caissons under the Welles building a cylindrical steel shaft was sunk under air pressure, into the surface of the hardpan. A temporary wooden deck was used to form a working chamber in the shaft and a small lock was bolted to this deck. The excavation was carried down through the hardpan below the bottom of the steel shaft to the rock and was extended laterally to a rectangular section of the dimensions desired for the column footing. The concrete was then carried up to the bottom of the steel grillage and the grillage was set under air pressure.

This work was done under the direction of Theodore Pratt, of the Standard Oil Company. The architects are Carrere & Hastings, Shreve, Lamb & Blake Associated. Charles T. Wills, Inc., is the builder. The plans for the foundation work were made by the Jarrett-Chambers Co. and the work was done by that firm.

### Refuse Pulverization in English Towns

The Borough of Oswestry, England, has adopted a system by which its refuse will be pulverized for utilization on land. We are informed by G. William Lacey, borough surveyor and water engineer of Oswestry that, before pulverization of the mixed refuse, tins, metal, rags, and bottles will be sorted out for sale. Mr. Lacey also states that the same general system is now in operation at the Borough of Southwark, London, and at Bury, Durham, Gateshead, and elsewhere.

## St. Paul City Planning Projects Form Broad Scheme

### Arcade Sidewalks—Improved Street System—Bridges and Viaducts—Civic Center—Use of Vacant Land—Railroad Work

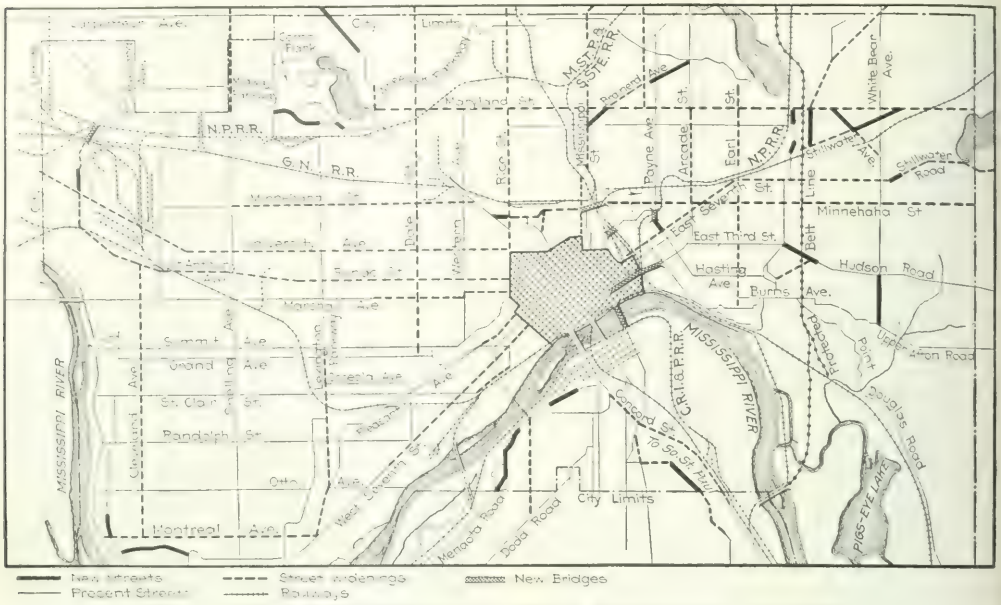
A COMPREHENSIVE scheme of municipal improvements proposed by the City Planning Board of St. Paul, Minn., in order to give better routing of traffic around and across the city and to relieve the serious congestion of traffic in business districts, includes sidewalk arcades, street widenings, linking up streets into continuous main thoroughfares, a civic center, railway grade crossing elimination, and bridges at some street intersections to provide for grade reduction of streets. Parks and parkways and some work to improve the appearance of the city are auxiliaries of the main scheme. Some of the projects have been adopted already by the municipal authorities. The following review of the situation is prepared from information furnished by George H. Herrold, city planning engineer for St. Paul, and from a report to the City Planning Board by Edward H. Bennett and William E. Parsons, consultant city planners, Chicago. A general plan of the improvement scheme is given in Fig. 1 and a more detailed plan of the difficult and costly works in the central portion of the city is given in Fig. 2.

#### Improvements in Street Layout

A rectilinear street system applied to a site of irregular topography has led to unfavorable traffic conditions in St. Paul by lack of continuity of several major streets. There is still opportunity to correct this defect, however, by opening new connections and by connecting dead ends of streets at topographic breaks by viaducts in order to establish major arteries both through and around the business district and afford direct communication with the east, west and southwest districts. The heavier grades on existing streets range from 4½ to 11 per cent, but the improvements provide for a maximum of 3 per cent on all main traffic routes. Incidentally, it is stated that the rectilinear street system has cost the city more than $6,000,000 for grading.

A conspicuous example of the inadequacy of the present street layout is that between 7th and Maryland Sts., a distance of nearly two miles, there is no other east and west street to serve as a crosstown line. This defect will be remedied by the proposed plan. Districts north and northeast of the business district are reached now by zigzags only causing inconvenience, increased costs of transportation and hindering the development of the districts in which they occur. Diagonal cut-offs are proposed to remedy this condition.

Where major streets having street car lines are paralleled closely by other streets suitable for light vehicles, it is planned to develop traffic on the dual arteries rather than to incur the expense of widening the major street. In most cases, however, the only way of increasing the traffic capacity is to widen the street. Much of the heavy traffic to and from the freight terminals, local yards, warehouses and wholesale houses now passes through the central business district. To widen many of these streets would involve prohibitive expense, but by providing a circuit of wide streets around this district the through traffic may be diverted with advantage to both through and local traffic. This circuit includes 3rd, Wacoutah, 12th and Main Sts.


City Limits
M.St.P.&S.S.M.R.R.
N.P.R.R.
G.N. R.R.
Maryland St.
Payne Ave.
Arcade St.
Earl St.
White Bear Ave.
Stillwater Road
Minnehaha St.
East Third St.
Hastings Ave.
Burns Ave.
Hudson Road
Upper 41st Road
Summit Ave.
Grand Ave.
St. Clair St.
Randolph St.
Portland Ave.
Mississippi River
C.R.I.&P.R.R.
Concord St.
Douglas Road
Pigs-Eye Lake
West Seventh St.
Robert St.
Wabasha St.
Cedar St.
Jackson St.
Broadway
Wacoutah St.
Sibley St.
Minnesota St.
Fort Road
Lexington Parkway
Dale St.
Western Ave.
Mackubin St.
Rice St.
Lafayette Freeway
Kellogg Blvd.
Sixth St.
Seventh St.
Eighth St.
Ninth St.
Tenth St.
Eleventh St.
Twelfth St.
Thirteenth St.
Fourteenth St.
Fifteenth St.
Sixteenth St.
Seventeenth St.
Eighteenth St.
Nineteenth St.
Twentieth St.
Twenty-first St.
Twenty-second St.
Twenty-third St.
Twenty-fourth St.
Twenty-fifth St.
Twenty-sixth St.
Twenty-seventh St.
Twenty-eighth St.
Twenty-ninth St.
Thirtieth St.
Thirty-first St.
Thirty-second St.
Thirty-third St.
Thirty-fourth St.
Thirty-fifth St.
Thirty-sixth St.
Thirty-seventh St.
Thirty-eighth St.
Thirty-ninth St.
Fortieth St.
Forty-first St.
Forty-second St.
Forty-third St.
Forty-fourth St.
Forty-fifth St.
Forty-sixth St.
Forty-seventh St.
Forty-eighth St.
Forty-ninth St.
Fiftieth St.
Fifty-first St.
Fifty-second St.
Fifty-third St.
Fifty-fourth St.
Fifty-fifth St.
Fifty-sixth St.
Fifty-seventh St.
Fifty-eighth St.
Fifty-ninth St.
Sixtieth St.
Sixty-first St.
Sixty-second St.
Sixty-third St.
Sixty-fourth St.
Sixty-fifth St.
Sixty-sixth St.
Sixty-seventh St.
Sixty-eighth St.
Sixty-ninth St.
Seventieth St.
Seventy-first St.
Seventy-second St.
Seventy-third St.
Seventy-fourth St.
Seventy-fifth St.
Seventy-sixth St.
Seventy-seventh St.
Seventy-eighth St.
Seventy-ninth St.
Eightieth St.
Eighty-first St.
Eighty-second St.
Eighty-third St.
Eighty-fourth St.
Eighty-fifth St.
Eighty-sixth St.
Eighty-seventh St.
Eighty-eighth St.
Eighty-ninth St.
Ninetieth St.
Ninety-first St.
Ninety-second St.
Ninety-third St.
Ninety-fourth St.
Ninety-fifth St.
Ninety-sixth St.
Ninety-seventh St.
Ninety-eighth St.
Ninety-ninth St.
One Hundredth St.
One Hundred First St.
One Hundred Second St.
One Hundred Third St.
One Hundred Fourth St.
One Hundred Fifth St.
One Hundred Sixth St.
One Hundred Seventh St.
One Hundred Eighth St.
One Hundred Ninth St.
One Hundred Tenth St.
One Hundred Eleventh St.
One Hundred Twelfth St.
One Hundred Thirteenth St.
One Hundred Fourteenth St.
One Hundred Fifteenth St.
One Hundred Sixteenth St.
One Hundred Seventeenth St.
One Hundred Eighteenth St.
One Hundred Nineteenth St.
One Hundred Twentieth St.
One Hundred Twenty-first St.
One Hundred Twenty-second St.
One Hundred Twenty-third St.
One Hundred Twenty-fourth St.
One Hundred Twenty-fifth St.
One Hundred Twenty-sixth St.
One Hundred Twenty-seventh St.
One Hundred Twenty-eighth St.
One Hundred Twenty-ninth St.
One Hundred Thirtieth St.
One Hundred Thirty-first St.
One Hundred Thirty-second St.
One Hundred Thirty-third St.
One Hundred Thirty-fourth St.
One Hundred Thirty-fifth St.
One Hundred Thirty-sixth St.
One Hundred Thirty-seventh St.
One Hundred Thirty-eighth St.
One Hundred Thirty-ninth St.
One Hundred Fortieth St.
One Hundred Forty-first St.
One Hundred Forty-second St.
One Hundred Forty-third St.
One Hundred Forty-fourth St.
One Hundred Forty-fifth St.
One Hundred Forty-sixth St.
One Hundred Forty-seventh St.
One Hundred Forty-eighth St.
One Hundred Forty-ninth St.
One Hundred Fiftieth St.
One Hundred Fifty-first St.
One Hundred Fifty-second St.
One Hundred Fifty-third St.
One Hundred Fifty-fourth St.
One Hundred Fifty-fifth St.
One Hundred Fifty-sixth St.
One Hundred Fifty-seventh St.
One Hundred Fifty-eighth St.
One Hundred Fifty-ninth St.
One Hundred Sixtieth St.
One Hundred Sixty-first St.
One Hundred Sixty-second St.
One Hundred Sixty-third St.
One Hundred Sixty-fourth St.
One Hundred Sixty-fifth St.
One Hundred Sixty-sixth St.
One Hundred Sixty-seventh St.
One Hundred Sixty-eighth St.
One Hundred Sixty-ninth St.
One Hundred Seventieth St.
One Hundred Seventy-first St.
One Hundred Seventy-second St.
One Hundred Seventy-third St.
One Hundred Seventy-fourth St.
One Hundred Seventy-fifth St.
One Hundred Seventy-sixth St.
One Hundred Seventy-seventh St.
One Hundred Seventy-eighth St.
One Hundred Seventy-ninth St.
One Hundred Eightieth St.
One Hundred Eighty-first St.
One Hundred Eighty-second St.
One Hundred Eighty-third St.
One Hundred Eighty-fourth St.
One Hundred Eighty-fifth St.
One Hundred Eighty-sixth St.
One Hundred Eighty-seventh St.
One Hundred Eighty-eighth St.
One Hundred Eighty-ninth St.
One Hundred Ninetieth St.
One Hundred Ninety-first St.
One Hundred Ninety-second St.
One Hundred Ninety-third St.
One Hundred Ninety-fourth St.
One Hundred Ninety-fifth St.
One Hundred Ninety-sixth St.
One Hundred Ninety-seventh St.
One Hundred Ninety-eighth St.
One Hundred Ninety-ninth St.
One Hundred Two Hundredth St.
One Hundred Two Hundred First St.
One Hundred Two Hundred Second St.
One Hundred Two Hundred Third St.
One Hundred Two Hundred Fourth St.
One Hundred Two Hundred Fifth St.
One Hundred Two Hundred Sixth St.
One Hundred Two Hundred Seventh St.
One Hundred Two Hundred Eighth St.
One Hundred Two Hundred Ninth St.
One Hundred Two Hundred Tenth St.
One Hundred Two Hundred Eleventh St.
One Hundred Two Hundred Twelfth St.
One Hundred Two Hundred Thirteenth St.
One Hundred Two Hundred Fourteenth St.
One Hundred Two Hundred Fifteenth St.
One Hundred Two Hundred Sixteenth St.
One Hundred Two Hundred Seventeenth St.
One Hundred Two Hundred Eighteenth St.
One Hundred Two Hundred Nineteenth St.
One Hundred Two Hundred Twentieth St.
One Hundred Two Hundred Twenty-first St.
One Hundred Two Hundred Twenty-second St.
One Hundred Two Hundred Twenty-third St.
One Hundred Two Hundred Twenty-fourth St.
One Hundred Two Hundred Twenty-fifth St.
One Hundred Two Hundred Twenty-sixth St.
One Hundred Two Hundred Twenty-seventh St.
One Hundred Two Hundred Twenty-eighth St.
One Hundred Two Hundred Twenty-ninth St.
One Hundred Two Hundred Thirtieth St.
One Hundred Two Hundred Thirty-first St.
One Hundred Two Hundred Thirty-second St.
One Hundred Two Hundred Thirty-third St.
One Hundred Two Hundred Thirty-fourth St.
One Hundred Two Hundred Thirty-fifth St.
One Hundred Two Hundred Thirty-sixth St.
One Hundred Two Hundred Thirty-seventh St.
One Hundred Two Hundred Thirty-eighth St.
One Hundred Two Hundred Thirty-ninth St.
One Hundred Two Hundred Fortieth St.
One Hundred Two Hundred Forty-first St.
One Hundred Two Hundred Forty-second St.
One Hundred Two Hundred Forty-third St.
One Hundred Two Hundred Forty-fourth St.
One Hundred Two Hundred Forty-fifth St.
One Hundred Two Hundred Forty-sixth St.
One Hundred Two Hundred Forty-seventh St.
One Hundred Two Hundred Forty-eighth St.
One Hundred Two Hundred Forty-ninth St.
One Hundred Two Hundred Fiftieth St.
One Hundred Two Hundred Fifty-first St.
One Hundred Two Hundred Fifty-second St.
One Hundred Two Hundred Fifty-third St.
One Hundred Two Hundred Fifty-fourth St.
One Hundred Two Hundred Fifty-fifth St.
One Hundred Two Hundred Fifty-sixth St.
One Hundred Two Hundred Fifty-seventh St.
One Hundred Two Hundred Fifty-eighth St.
One Hundred Two Hundred Fifty-ninth St.
One Hundred Two Hundred Sixtieth St.
One Hundred Two Hundred Sixty-first St.
One Hundred Two Hundred Sixty-second St.
One Hundred Two Hundred Sixty-third St.
One Hundred Two Hundred Sixty-fourth St.
One Hundred Two Hundred Sixty-fifth St.
One Hundred Two Hundred Sixty-sixth St.
One Hundred Two Hundred Sixty-seventh St.
One Hundred Two Hundred Sixty-eighth St.
One Hundred Two Hundred Sixty-ninth St.
One Hundred Two Hundred Seventieth St.
One Hundred Two Hundred Seventy-first St.
One Hundred Two Hundred Seventy-second St.
One Hundred Two Hundred Seventy-third St.
One Hundred Two Hundred Seventy-fourth St.
One Hundred Two Hundred Seventy-fifth St.
One Hundred Two Hundred Seventy-sixth St.
One Hundred Two Hundred Seventy-seventh St.
One Hundred Two Hundred Seventy-eighth St.
One Hundred Two Hundred Seventy-ninth St.
One Hundred Two Hundred Eightieth St.
One Hundred Two Hundred Eighty-first St.
One Hundred Two Hundred Eighty-second St.
One Hundred Two Hundred Eighty-third St.
One Hundred Two Hundred Eighty-fourth St.
One Hundred Two Hundred Eighty-fifth St.
One Hundred Two Hundred Eighty-sixth St.
One Hundred Two Hundred Eighty-seventh St.
One Hundred Two Hundred Eighty-eighth St.
One Hundred Two Hundred Eighty-ninth St.
One Hundred Two Hundred Ninetieth St.
One Hundred Two Hundred Ninety-first St.
One Hundred Two Hundred Ninety-second St.
One Hundred Two Hundred Ninety-third St.
One Hundred Two Hundred Ninety-fourth St.
One Hundred Two Hundred Ninety-fifth St.
One Hundred Two Hundred Ninety-sixth St.
One Hundred Two Hundred Ninety-seventh St.
One Hundred Two Hundred Ninety-eighth St.
One Hundred Two Hundred Ninety-ninth St.
One Hundred Two Hundred Three Hundredth St.
One Hundred Two Hundred Three Hundred First St.
One Hundred Two Hundred Three Hundred Second St.
One Hundred Two Hundred Three Hundred Third St.
One Hundred Two Hundred Three Hundred Fourth St.
One Hundred Two Hundred Three Hundred Fifth St.
One Hundred Two Hundred Three Hundred Sixth St.
One Hundred Two Hundred Three Hundred Seventh St.
One Hundred Two Hundred Three Hundred Eighth St.
One Hundred Two Hundred Three Hundred Ninth St.
One Hundred Two Hundred Three Hundred Tenth St.
One Hundred Two Hundred Three Hundred Eleventh St.
One Hundred Two Hundred Three Hundred Twelfth St.
One Hundred Two Hundred Three Hundred Thirteenth St.
One Hundred Two Hundred Three Hundred Fourteenth St.
One Hundred Two Hundred Three Hundred Fifteenth St.
One Hundred Two Hundred Three Hundred Sixteenth St.
One Hundred Two Hundred Three Hundred Seventeenth St.
One Hundred Two Hundred Three Hundred Eighteenth St.
One Hundred Two Hundred Three Hundred Nineteenth St.
One Hundred Two Hundred Three Hundred Twentieth St.
One Hundred Two Hundred Three Hundred Twenty-first St.
One Hundred Two Hundred Three Hundred Twenty-second St.
One Hundred Two Hundred Three Hundred Twenty-third St.
One Hundred Two Hundred Three Hundred Twenty-fourth St.
One Hundred Two Hundred Three Hundred Twenty-fifth St.
One Hundred Two Hundred Three Hundred Twenty-sixth St.
One Hundred Two Hundred Three Hundred Twenty-seventh St.
One Hundred Two Hundred Three Hundred Twenty-eighth St.
One Hundred Two Hundred Three Hundred Twenty-ninth St.
One Hundred Two Hundred Three Hundred Thirtieth St.
One Hundred Two Hundred Three Hundred Thirty-first St.
One Hundred Two Hundred Three Hundred Thirty-second St.
One Hundred Two Hundred Three Hundred Thirty-third St.
One Hundred Two Hundred Three Hundred Thirty-fourth St.
One Hundred Two Hundred Three Hundred Thirty-fifth St.
One Hundred Two Hundred Three Hundred Thirty-sixth St.
One Hundred Two Hundred Three Hundred Thirty-seventh St.
One Hundred Two Hundred Three Hundred Thirty-eighth St.
One Hundred Two Hundred Three Hundred Thirty-ninth St.
One Hundred Two Hundred Three Hundred Fortieth St.
One Hundred Two Hundred Three Hundred Forty-first St.
One Hundred Two Hundred Three Hundred Forty-second St.
One Hundred Two Hundred Three Hundred Forty-third St.
One Hundred Two Hundred Three Hundred Forty-fourth St.
One Hundred Two Hundred Three Hundred Forty-fifth St.
One Hundred Two Hundred Three Hundred Forty-sixth St.
One Hundred Two Hundred Three Hundred Forty-seventh St.
One Hundred Two Hundred Three Hundred Forty-eighth St.
One Hundred Two Hundred Three Hundred Forty-ninth St.
One Hundred Two Hundred Three Hundred Fiftieth St.
One Hundred Two Hundred Three Hundred Fifty-first St.
One Hundred Two Hundred Three Hundred Fifty-second St.
One Hundred Two Hundred Three Hundred Fifty-third St.
One Hundred Two Hundred Three Hundred Fifty-fourth St.
One Hundred Two Hundred Three Hundred Fifty-fifth St.
One Hundred Two Hundred Three Hundred Fifty-sixth St.
One Hundred Two Hundred Three Hundred Fifty-seventh St.
One Hundred Two Hundred Three Hundred Fifty-eighth St.
One Hundred Two Hundred Three Hundred Fifty-ninth St.
One Hundred Two Hundred Three Hundred Sixtieth St.
One Hundred Two Hundred Three Hundred Sixty-first St.
One Hundred Two Hundred Three Hundred Sixty-second St.
One Hundred Two Hundred Three Hundred Sixty-third St.
One Hundred Two Hundred Three Hundred Sixty-fourth St.
One Hundred Two Hundred Three Hundred Sixty-fifth St.
One Hundred Two Hundred Three Hundred Sixty-sixth St.
One Hundred Two Hundred Three Hundred Sixty-seventh St.
One Hundred Two Hundred Three Hundred Sixty-eighth St.
One Hundred Two Hundred Three Hundred Sixty-ninth St.
One Hundred Two Hundred Three Hundred Seventieth St.
One Hundred Two Hundred Three Hundred Seventy-first St.
One Hundred Two Hundred Three Hundred Seventy-second St.
One Hundred Two Hundred Three Hundred Seventy-third St.
One Hundred Two Hundred Three Hundred Seventy-fourth St.
One Hundred Two Hundred Three Hundred Seventy-fifth St.
One Hundred Two Hundred Three Hundred Seventy-sixth St.
One Hundred Two Hundred Three Hundred Seventy-seventh St.
One Hundred Two Hundred Three Hundred Seventy-eighth St.
One Hundred Two Hundred Three Hundred Seventy-ninth St.
One Hundred Two Hundred Three Hundred Eightieth St.
One Hundred Two Hundred Three Hundred Eighty-first St.
One Hundred Two Hundred Three Hundred Eighty-second St.
One Hundred Two Hundred Three Hundred Eighty-third St.
One Hundred Two Hundred Three Hundred Eighty-fourth St.
One Hundred Two Hundred Three Hundred Eighty-fifth St.
One Hundred Two Hundred Three Hundred Eighty-sixth St.
One Hundred Two Hundred Three Hundred Eighty-seventh St.
One Hundred Two Hundred Three Hundred Eighty-eighth St.
One Hundred Two Hundred Three Hundred Eighty-ninth St.
One Hundred Two Hundred Three Hundred Ninetieth St.
One Hundred Two Hundred Three Hundred Ninety-first St.
One Hundred Two Hundred Three Hundred Ninety-second St.
One Hundred Two Hundred Three Hundred Ninety-third St.
One Hundred Two Hundred Three Hundred Ninety-fourth St.
One Hundred Two Hundred Three Hundred Ninety-fifth St.
One Hundred Two Hundred Three Hundred Ninety-sixth St.
One Hundred Two Hundred Three Hundred Ninety-seventh St.
One Hundred Two Hundred Three Hundred Ninety-eighth St.
One Hundred Two Hundred Three Hundred Ninety-ninth St.
One Hundred Two Hundred Four Hundredth St.
One Hundred Two Hundred Four Hundred First St.
One Hundred Two Hundred Four Hundred Second St.
One Hundred Two Hundred Four Hundred Third St.
One Hundred Two Hundred Four Hundred Fourth St.
One Hundred Two Hundred Four Hundred Fifth St.
One Hundred Two Hundred Four Hundred Sixth St.
One Hundred Two Hundred Four Hundred Seventh St.
One Hundred Two Hundred Four Hundred Eighth St.
One Hundred Two Hundred Four Hundred Ninth St.
One Hundred Two Hundred Four Hundred Tenth St.
One Hundred Two Hundred Four Hundred Eleventh St.
One Hundred Two Hundred Four Hundred Twelfth St.
One Hundred Two Hundred Four Hundred Thirteenth St.
One Hundred Two Hundred Four Hundred Fourteenth St.
One Hundred Two Hundred Four Hundred Fifteenth St.
One Hundred Two Hundred Four Hundred Sixteenth St.
One Hundred Two Hundred Four Hundred Seventeenth St.
One Hundred Two Hundred Four Hundred Eighteenth St.
One Hundred Two Hundred Four Hundred Nineteenth St.
One Hundred Two Hundred Four Hundred Twentieth St.
One Hundred Two Hundred Four Hundred Twenty-first St.
One Hundred Two Hundred Four Hundred Twenty-second St.
One Hundred Two Hundred Four Hundred Twenty-third St.
One Hundred Two Hundred Four Hundred Twenty-fourth St.
One Hundred Two Hundred Four Hundred Twenty-fifth St.
One Hundred Two Hundred Four Hundred Twenty-sixth St.
One Hundred Two Hundred Four Hundred Twenty-seventh St.
One Hundred Two Hundred Four Hundred Twenty-eighth St.
One Hundred Two Hundred Four Hundred Twenty-ninth St.
One Hundred Two Hundred Four Hundred Thirtieth St.
One Hundred Two Hundred Four Hundred Thirty-first St.
One Hundred Two Hundred Four Hundred Thirty-second St.
One Hundred Two Hundred Four Hundred Thirty-third St.
One Hundred Two Hundred Four Hundred Thirty-fourth St.
One Hundred Two Hundred Four Hundred Thirty-fifth St.
One Hundred Two Hundred Four Hundred Thirty-sixth St.
One Hundred Two Hundred Four Hundred Thirty-seventh St.
One Hundred Two Hundred Four Hundred Thirty-eighth St.
One Hundred Two Hundred Four Hundred Thirty-ninth St.
One Hundred Two Hundred Four Hundred Fortieth St.
One Hundred Two Hundred Four Hundred Forty-first St.
One Hundred Two Hundred Four Hundred Forty-second St.
One Hundred Two Hundred Four Hundred Forty-third St.
One Hundred Two Hundred Four Hundred Forty-fourth St.
One Hundred Two Hundred Four Hundred Forty-fifth St.
One Hundred Two Hundred Four Hundred Forty-sixth St.
One Hundred Two Hundred Four Hundred Forty-seventh St.
One Hundred Two Hundred Four Hundred Forty-eighth St.
One Hundred Two Hundred Four Hundred Forty-ninth St.
One Hundred Two Hundred Four Hundred Fiftieth St.
One Hundred Two Hundred Four Hundred Fifty-first St.
One Hundred Two Hundred Four Hundred Fifty-second St.
One Hundred Two Hundred Four Hundred Fifty-third St.
One Hundred Two Hundred Four Hundred Fifty-fourth St.
One Hundred Two Hundred Four Hundred Fifty-fifth St.
One Hundred Two Hundred Four Hundred Fifty-sixth St.
One Hundred Two Hundred Four Hundred Fifty-seventh St.
One Hundred Two Hundred Four Hundred Fifty-eighth St.
One Hundred Two Hundred Four Hundred Fifty-ninth St.
One Hundred Two Hundred Four Hundred Sixtieth St.
One Hundred Two Hundred Four Hundred Sixty-first St.
One Hundred Two Hundred Four Hundred Sixty-second St.
One Hundred Two Hundred Four Hundred Sixty-third St.
One Hundred Two Hundred Four Hundred Sixty-fourth St.
One Hundred Two Hundred Four Hundred Sixty-fifth St.
One Hundred Two Hundred Four Hundred Sixty-sixth St.
One Hundred Two Hundred Four Hundred Sixty-seventh St.
One Hundred Two Hundred Four Hundred Sixty-eighth St.
One Hundred Two Hundred Four Hundred Sixty-ninth St.
One Hundred Two Hundred Four Hundred Seventieth St.
One Hundred Two Hundred Four Hundred Seventy-first St.
One Hundred Two Hundred Four Hundred Seventy-second St.
One Hundred Two Hundred Four Hundred Seventy-third St.
One Hundred Two Hundred Four Hundred Seventy-fourth St.
One Hundred Two Hundred Four Hundred Seventy-fifth St.
One Hundred Two Hundred Four Hundred Seventy-sixth St.
One Hundred Two Hundred Four Hundred Seventy-seventh St.
One Hundred Two Hundred Four Hundred Seventy-eighth St.
One Hundred Two Hundred Four Hundred Seventy-ninth St.
One Hundred Two Hundred Four Hundred Eightieth St.
One Hundred Two Hundred Four Hundred Eighty-first St.
One Hundred Two Hundred Four Hundred Eighty-second St.
One Hundred Two Hundred Four Hundred Eighty-third St.
One Hundred Two Hundred Four Hundred Eighty-fourth St.
One Hundred Two Hundred Four Hundred Eighty-fifth St.
One Hundred Two Hundred Four Hundred Eighty-sixth St.
One Hundred Two Hundred Four Hundred Eighty-seventh St.
One Hundred Two Hundred Four Hundred Eighty-eighth St.
One Hundred Two Hundred Four Hundred Eighty-ninth St.
One Hundred Two Hundred Four Hundred Ninetieth St.
One Hundred Two Hundred Four Hundred Ninety-first St.
One Hundred Two Hundred Four Hundred Ninety-second St.
One Hundred Two Hundred Four Hundred Ninety-third St.
One Hundred Two Hundred Four Hundred Ninety-fourth St.
One Hundred Two Hundred Four Hundred Ninety-fifth St.
One Hundred Two Hundred Four Hundred Ninety-sixth St.
One Hundred Two Hundred Four Hundred Ninety-seventh St.
One Hundred Two Hundred Four Hundred Ninety-eighth St.
One Hundred Two Hundred Four Hundred Ninety-ninth St.
One Hundred Two Hundred Five Hundredth St.
One Hundred Two Hundred Five Hundred First St.
One Hundred Two Hundred Five Hundred Second St.
One Hundred Two Hundred Five Hundred Third St.
One Hundred Two Hundred Five Hundred Fourth St.
One Hundred Two Hundred Five Hundred Fifth St.
One Hundred Two Hundred Five Hundred Sixth St.
One Hundred Two Hundred Five Hundred Seventh St.
One Hundred Two Hundred Five Hundred Eighth St.
One Hundred Two Hundred Five Hundred Ninth St.
One Hundred Two Hundred Five Hundred Tenth St.
One Hundred Two Hundred Five Hundred Eleventh St.
One Hundred Two Hundred Five Hundred Twelfth St.
One Hundred Two Hundred Five Hundred Thirteenth St.
One Hundred Two Hundred Five Hundred Fourteenth St.
One Hundred Two Hundred Five Hundred Fifteenth St.
One Hundred Two Hundred Five Hundred Sixteenth St.
One Hundred Two Hundred Five Hundred Seventeenth St.
One Hundred Two Hundred Five Hundred Eighteenth St.
One Hundred Two Hundred Five Hundred Nineteenth St.
One Hundred Two Hundred Five Hundred Twentieth St.
One Hundred Two Hundred Five Hundred Twenty-first St.
One Hundred Two Hundred Five Hundred Twenty-second St.
One Hundred Two Hundred Five Hundred Twenty-third St.
One Hundred Two Hundred Five Hundred Twenty-fourth St.
One Hundred Two Hundred Five Hundred Twenty-fifth St.
One Hundred Two Hundred Five Hundred Twenty-sixth St.
One Hundred Two Hundred Five Hundred Twenty-seventh St.
One Hundred Two Hundred Five Hundred Twenty-eighth St.
One Hundred Two Hundred Five Hundred Twenty-ninth St.
One Hundred Two Hundred Five Hundred Thirtieth St.
One Hundred Two Hundred Five Hundred Thirty-first St.
One Hundred Two Hundred Five Hundred Thirty-second St.
One Hundred Two Hundred Five Hundred Thirty-third St.
One Hundred Two Hundred Five Hundred Thirty-fourth St.
One Hundred Two Hundred Five Hundred Thirty-fifth St.
One Hundred Two Hundred Five Hundred Thirty-sixth St.
One Hundred Two Hundred Five Hundred Thirty-seventh St.
One Hundred Two Hundred Five Hundred Thirty-eighth St.
One Hundred Two Hundred Five Hundred Thirty-ninth St.
One Hundred Two Hundred Five Hundred Fortieth St.
One Hundred Two Hundred Five Hundred Forty-first St.
One Hundred Two Hundred Five Hundred Forty-second St.
One Hundred Two Hundred Five Hundred Forty-third St.
One Hundred Two Hundred Five Hundred Forty-fourth St.
One Hundred Two Hundred Five Hundred Forty-fifth St.
One Hundred Two Hundred Five Hundred Forty-sixth St.
One Hundred Two Hundred Five Hundred Forty-seventh St.
One Hundred Two Hundred Five Hundred Forty-eighth St.
One Hundred Two Hundred Five Hundred Forty-ninth St.
One Hundred Two Hundred Five Hundred Fiftieth St.
One Hundred Two Hundred Five Hundred Fifty-first St.
One Hundred Two Hundred Five Hundred Fifty-second St.
One Hundred Two Hundred Five Hundred Fifty-third St.
One Hundred Two Hundred Five Hundred Fifty-fourth St.
One Hundred Two Hundred Five Hundred Fifty-fifth St.
One Hundred Two Hundred Five Hundred Fifty-sixth St.
One Hundred Two Hundred Five Hundred Fifty-seventh St.
One Hundred Two Hundred Five Hundred Fifty-eighth St.
One Hundred Two Hundred Five Hundred Fifty-ninth St.
One Hundred Two Hundred Five Hundred Sixtieth St.
One Hundred Two Hundred Five Hundred Sixty-first St.
One Hundred Two Hundred Five Hundred Sixty-second St.
One Hundred Two Hundred Five Hundred Sixty-third St.
One Hundred Two Hundred Five Hundred Sixty-fourth St.
One Hundred Two Hundred Five Hundred Sixty-fifth St.
One Hundred Two Hundred Five Hundred Sixty-sixth St.
One Hundred Two Hundred Five Hundred Sixty-seventh St.
One Hundred Two Hundred Five Hundred Sixty-eighth St.
One Hundred Two Hundred Five Hundred Sixty-ninth St.
One Hundred Two Hundred Five Hundred Seventieth St.
One Hundred Two Hundred Five Hundred Seventy-first St.
One Hundred Two Hundred Five Hundred Seventy-second St.
One Hundred Two Hundred Five Hundred Seventy-third St.
One Hundred Two Hundred Five Hundred Seventy-fourth St.
One Hundred Two Hundred Five Hundred Seventy-fifth St.
One Hundred Two Hundred Five Hundred Seventy-sixth St.
One Hundred Two Hundred Five Hundred Seventy-seventh St.
One Hundred Two Hundred Five Hundred Seventy-eighth St.
One Hundred Two Hundred Five Hundred Seventy-ninth St.
One Hundred Two Hundred Five Hundred Eightieth St.
One Hundred Two Hundred Five Hundred Eighty-first St.
One Hundred Two Hundred Five Hundred Eighty-second St.
One Hundred Two Hundred Five Hundred Eighty-third St.
One Hundred Two Hundred Five Hundred Eighty-fourth St.
One Hundred Two Hundred Five Hundred Eighty-fifth St.
One Hundred Two Hundred Five Hundred Eighty-sixth St.
One Hundred Two Hundred Five Hundred Eighty-seventh St.
One Hundred Two Hundred Five Hundred Eighty-eighth St.
One Hundred Two Hundred Five Hundred Eighty-ninth St.
One Hundred Two Hundred Five Hundred Ninetieth St.
One Hundred Two Hundred Five Hundred Ninety-first St.
One Hundred Two Hundred Five Hundred Ninety-second St.
One Hundred Two Hundred Five Hundred Ninety-third St.
One Hundred Two Hundred Five Hundred Ninety-fourth St.
One Hundred Two Hundred Five Hundred Ninety-fifth St.
One Hundred Two Hundred Five Hundred Ninety-sixth St.
One Hundred Two Hundred Five Hundred Ninety-seventh St.
One Hundred Two Hundred Five Hundred Ninety-eighth St.
One Hundred Two Hundred Five Hundred Ninety-ninth St.
One Hundred Two Hundred Six Hundredth St.
One Hundred Two Hundred Six Hundred First St.
One Hundred Two Hundred Six Hundred Second St.
One Hundred Two Hundred Six Hundred Third St.
One Hundred Two Hundred Six Hundred Fourth St.
One Hundred Two Hundred Six Hundred Fifth St.
One Hundred Two Hundred Six Hundred Sixth St.
One Hundred Two Hundred Six Hundred Seventh St.
One Hundred Two Hundred Six Hundred Eighth St.
One Hundred Two Hundred Six Hundred Ninth St.
One Hundred Two Hundred Six Hundred Tenth St.
One Hundred Two Hundred Six Hundred Eleventh St.
One Hundred Two Hundred Six Hundred Twelfth St.
One Hundred Two Hundred Six Hundred Thirteenth St.
One Hundred Two Hundred Six Hundred Fourteenth St.
One Hundred Two Hundred Six Hundred Fifteenth St.
One Hundred Two Hundred Six Hundred Sixteenth St.
One Hundred Two Hundred Six Hundred Seventeenth St.
One Hundred Two Hundred Six Hundred Eighteenth St.
One Hundred Two Hundred Six Hundred Nineteenth St.
One Hundred Two Hundred Six Hundred Twentieth St.
One Hundred Two Hundred Six Hundred Twenty-first St.
One Hundred Two Hundred Six Hundred Twenty-second St.
One Hundred Two Hundred Six Hundred Twenty-third St.
One Hundred Two Hundred Six Hundred Twenty-fourth St.
One Hundred Two Hundred Six Hundred Twenty-fifth St.
One Hundred Two Hundred Six Hundred Twenty-sixth St.
One Hundred Two Hundred Six Hundred Twenty-seventh St.
One Hundred Two Hundred Six Hundred Twenty-eighth St.
One Hundred Two Hundred Six Hundred Twenty-ninth St.
One Hundred Two Hundred Six Hundred Thirtieth St.
One Hundred Two Hundred Six Hundred Thirty-first St.
One Hundred Two Hundred Six Hundred Thirty-second St.
One Hundred Two Hundred Six Hundred Thirty-third St.
One Hundred Two Hundred Six Hundred Thirty-fourth St.
One Hundred Two Hundred Six Hundred Thirty-fifth St.
One Hundred Two Hundred Six Hundred Thirty-sixth St.
One Hundred Two Hundred Six Hundred Thirty-seventh St.
One Hundred Two Hundred Six Hundred Thirty-eighth St.
One Hundred Two Hundred Six Hundred Thirty-ninth St.
One Hundred Two Hundred Six Hundred Fortieth St.
One Hundred Two Hundred Six Hundred Forty-first St.
One Hundred Two Hundred Six Hundred Forty-second St.
One Hundred Two Hundred Six Hundred Forty-third St.
One Hundred Two Hundred Six Hundred Forty-fourth St.
One Hundred Two Hundred Six Hundred Forty-fifth St.
One Hundred Two Hundred Six Hundred Forty-sixth St.
One Hundred Two Hundred Six Hundred Forty-seventh St.
One Hundred Two Hundred Six Hundred Forty-eighth St.
One Hundred Two Hundred Six Hundred Forty-ninth St.
One Hundred Two Hundred Six Hundred Fiftieth St.
One Hundred Two Hundred Six Hundred Fifty-first St.
One Hundred Two Hundred Six Hundred Fifty-second St.
One Hundred Two Hundred Six Hundred Fifty-third St.
One Hundred Two Hundred Six Hundred Fifty-fourth St.
One Hundred Two Hundred Six Hundred Fifty-fifth St.
One Hundred Two Hundred Six Hundred Fifty-sixth St.
One Hundred Two Hundred Six Hundred Fifty-seventh St.
One Hundred Two Hundred Six Hundred Fifty-eighth St.
One Hundred Two Hundred Six Hundred Fifty-ninth St.
One Hundred Two Hundred Six Hundred Sixtieth St.
One Hundred Two Hundred Six Hundred Sixty-first St.
One Hundred Two Hundred Six Hundred Sixty-second St.
One Hundred Two Hundred Six Hundred Sixty-third St.
One Hundred Two Hundred Six Hundred Sixty-fourth St.
One Hundred Two Hundred Six Hundred Sixty-fifth St.
One Hundred Two Hundred Six Hundred Sixty-sixth St.
One Hundred Two Hundred Six Hundred Sixty-seventh St.
One Hundred Two Hundred Six Hundred Sixty-eighth St.
One Hundred Two Hundred Six Hundred Sixty-ninth St.
One Hundred Two Hundred Six Hundred Seventieth St.
One Hundred Two Hundred Six Hundred Seventy-first St.
One Hundred Two Hundred Six Hundred Seventy-second St.
One Hundred Two Hundred Six Hundred Seventy-third St.
One Hundred Two Hundred Six Hundred Seventy-fourth St.
One Hundred Two Hundred Six Hundred Seventy-fifth St.
One Hundred Two Hundred Six Hundred Seventy-sixth St.
One Hundred Two Hundred Six Hundred Seventy-seventh St.
One Hundred Two Hundred Six Hundred Seventy-eighth St.
One Hundred Two Hundred Six Hundred Seventy-ninth St.
One Hundred Two Hundred Six Hundred Eightieth St.
One Hundred Two Hundred Six Hundred Eighty-first St.
One Hundred Two Hundred Six Hundred Eighty-second St.
One Hundred Two Hundred Six Hundred Eighty-third St.
One Hundred Two Hundred Six Hundred Eighty-fourth St.
One Hundred Two Hundred Six Hundred Eighty-fifth St.
One Hundred Two Hundred Six Hundred Eighty-sixth St.
One Hundred Two Hundred Six Hundred Eighty-seventh St.
One Hundred Two Hundred Six Hundred Eighty-eighth St.
One Hundred Two Hundred Six Hundred Eighty-ninth St.
One Hundred Two Hundred Six Hundred Ninetieth St.
One Hundred Two Hundred Six Hundred Ninety-first St.
One Hundred Two Hundred Six Hundred Ninety-second St.
One Hundred Two Hundred Six Hundred Ninety-third St.
One Hundred Two Hundred Six Hundred Ninety-fourth St.
One Hundred Two Hundred Six Hundred Ninety-fifth St.
One Hundred Two Hundred Six Hundred Ninety-sixth St.
One Hundred Two Hundred Six Hundred Ninety-seventh St.
One Hundred Two Hundred Six Hundred Ninety-eighth St.
One Hundred Two Hundred Six Hundred Ninety-ninth St.
One Hundred Two Hundred Seven Hundredth St.
One Hundred Two Hundred Seven Hundred First St.
One Hundred Two Hundred Seven Hundred Second St.
One Hundred Two Hundred Seven Hundred Third St.
One Hundred Two Hundred Seven Hundred Fourth St.
One Hundred Two Hundred Seven Hundred Fifth St.
One Hundred Two Hundred Seven Hundred Sixth St.
One Hundred Two Hundred Seven Hundred Seventh St.
One Hundred Two Hundred Seven Hundred Eighth St.
One Hundred Two Hundred Seven Hundred Ninth St.
One Hundred Two Hundred Seven Hundred Tenth St.
One Hundred Two Hundred Seven Hundred Eleventh St.
One Hundred Two Hundred Seven Hundred Twelfth St.
One Hundred Two Hundred Seven Hundred Thirteenth St.
One Hundred Two Hundred Seven Hundred Fourteenth St.
One Hundred Two Hundred Seven Hundred Fifteenth St.
One Hundred Two Hundred Seven Hundred Sixteenth St.
One Hundred Two Hundred Seven Hundred Seventeenth St.
One Hundred Two Hundred Seven Hundred Eighteenth St.
One Hundred Two Hundred Seven Hundred Nineteenth St.
One Hundred Two Hundred Seven Hundred Twentieth St.
One

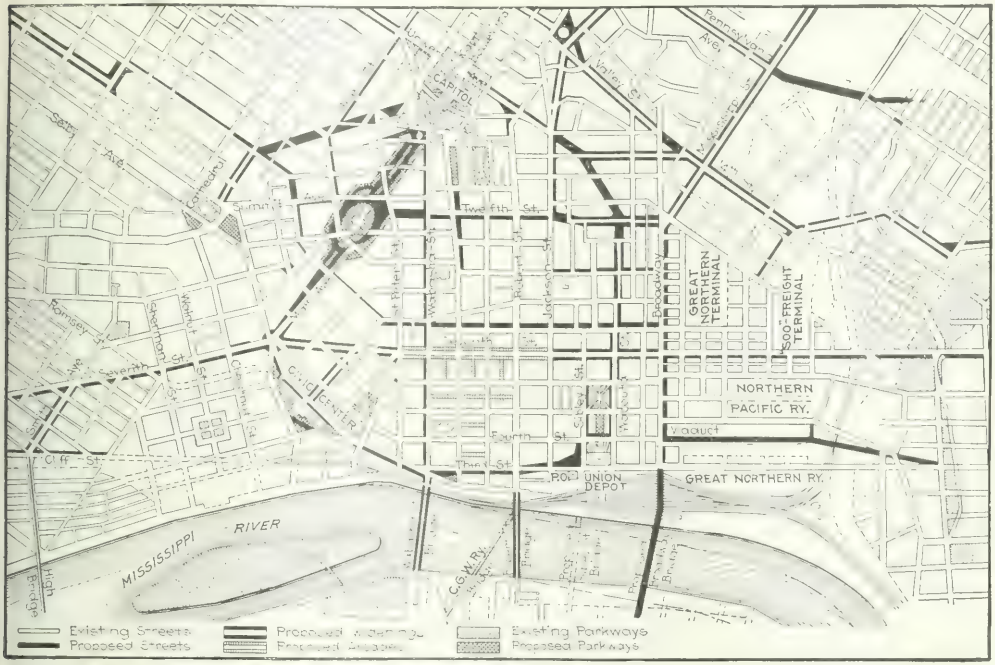



FIG. 2. PROPOSED "CITY PLAN" DEVELOPMENTS IN CENTRAL SECTION OF ST. PAUL, MINN.

drawspans. They are level with the streets on the north side of the river and have 3½ per cent grades in the south approaches from the district known as Riverview.

For an additional bridge to serve the business district there are two rival plans for Sibley St. and Broadway respectively, as shown in Fig. 2. The former would be a low-level bridge with draw and has been authorized by Congress, but there is considerable opposition to it on the following grounds: (1) That being so near Robert St. it will depreciate property which has paid heavily for street widening; (2) that it will interfere with the car routing scheme and the development of river traffic; (3) that its approaches will interfere with heavy traffic on cross streets and with that of the new U. S. Post Office at Sibley and 3rd streets; (4) that it will increase rather than relieve congestion, as Sibley St. is not a continuous thoroughfare or artery and has recently been narrowed between 3rd St. and the levee to give 30-ft. additional length to the headhouse and stub tracks of the new Union Station; (5) that being a low-level bridge, the opening of its drawspan will back up traffic in the entrance of the C., M. & St. P. Ry. freight station and completely block any movement of traffic here while the span is open.

The Broadway bridge location is strongly recommended by the City Planning Board as an essential element in the growth of the city. The proposed plan provides for widening Broadway, which is not only a main artery but would be connected by the bridge with State St., an arterial thoroughfare in West St. Paul. It is considered that a bridge on this location would relieve the traffic congestion of the business district, and being at a high level it would require no drawspan.

To open additional communication across railway property it is proposed to build a viaduct connecting Minnehaha St. with Pennsylvania Ave., and to replace the old 3rd St. viaduct with one on the line of 4th St., giving a better approach to the Union Station. This latter project has been taken up with the railway companies, which are committed to the rebuilding of the 3rd St. viaduct.

*Railways*—A thorough investigation of the railway situation in its relation to the city's interests is under way, but it is pointed out already that there is opportunity for improvement in three directions: (1) Separation of grades at street crossings; (2) electrification of certain lines to reduce smoke and noise; (3) detouring through freight to avoid congestion of the city terminals. In this last part of the program would be included the proposed Twin City Belt Line described in *Engineering News-Record*, Oct. 25, 1917, p. 784, the construction of which was stopped by the war.

*Capitol Boulevard*—A conspicuous feature in the City Plan, Fig. 2, is the proposed boulevard approach from Seven Corners to the State Capitol, which is slightly modified from plans approved by the Capitol Approach Commission. Although this is included as a logical part of the general scheme it will be paid for by the State as part of the capitol developments, but as financial conditions are unfavorable the plans have not yet been presented to the state legislature.

*Civic Center*—The present city and county building, now 40 years old, is so inadequate that several departments are located in rented offices. It occupies a highly valuable site in the center of the business district. In selecting the new site shown on the plan, the controlling conditions were: (1) It is easily accessible but out-

side the line of future business development; (2) although convenient to street car lines it is far enough away to avoid the excessive noise of the present location; (3) it is in logical relation to the State Capitol, Union Station and other public buildings, all on high ground in full view from the river.

*Zoning and Vacant Property*—Only a tentative zoning plan has been prepared so far, but the investigation as shown the striking fact that nearly half of the area within the city limits is vacant, due to large outlying areas having been taken into the city during a real estate boom in 1887. In the accompanying table are shown the present uses of the area and the uses under the proposed plan. The area includes the adjacent streets. With the new distribution the population could be doubled without increasing its density. But before such a growth could be reached there would be expansion beyond the city limits, so that major streets should be planned to meet future suburban traffic conditions.

### Examples of "City Plan" Projects Adopted

Two specific improvements which have been approved by the City Council and for which condemnation pro-

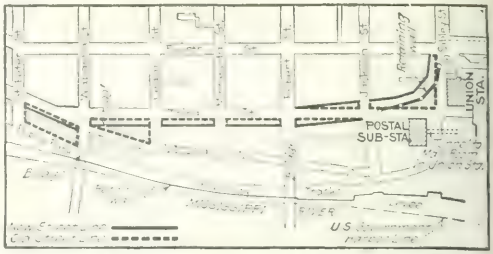



FIG. 4. WIDENING AND NEW CONNECTION ON THIRD ST.

ceedings have been started are the widening and grade reduction of University Ave. and the widening of Third St. These are described below as being illustrative of the various improvements included in the proposed plans.

*University Ave. Improvement*—This main artery to the State University and the adjacent city of Minneapolis is 120 ft. wide from the city limits to Dale St., 80 ft. for about a mile to Rice St. and then from 60 to 72 ft. wide as far as Jackson St. It is proposed to make it 120 ft. wide to Rice St. and then 84 ft. to Jackson St., beyond which a new 84-ft. street will extend it to Wacoutah St. (see Fig. 3). There is a descending grade of 10½ per cent from Cedar St. to Robert St. and 6 per cent thence to Jackson St. It is proposed to lower University Ave. about 24 ft. at Cedar St., in order to reduce the grade to 6 per cent, the latter street being carried across the avenue by a handsome concrete bridge.

Further, the alignment of Robert St. is to be changed so as to run into University Ave. on a curve of 192-ft. radius. In 1913, Robert St. was widened from the river to Central Ave. by taking 20 ft. of property on the west side. This widening will be continued to Aurora Ave., but in order to avoid the Mechanic Arts High School, the center line will be shifted slightly and land taken on both sides, as shown, the 75-ft. width increasing on the curve to fit the 84-ft. width of the avenue.

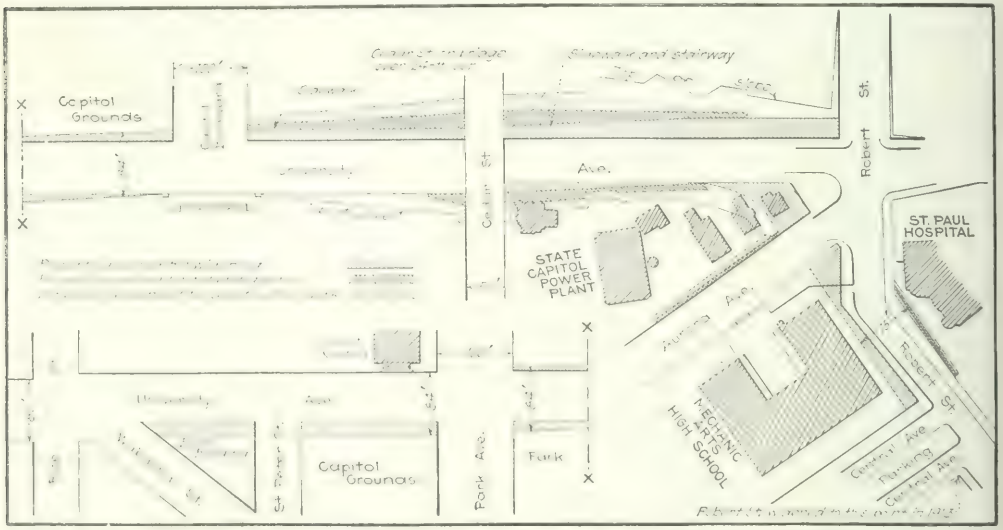



FIG. 3. GRADE REDUCTION AND WIDENING ON UNIVERSITY AVE. AND ROBERT ST.

For this new connection, the acquirement of property, change of grade, construction of retaining walls and repaving are estimated to cost $225,000, which will be paid for in assessments against the property along Robert St. In consequence of objections made by property owners who are in the assessment district but not on the street, the Robert St. property owners have agreed to shoulder the entire cost of the improvement if the city will order it carried out. This action affords further evidence of their belief in "city planning" projects as they paid about $1,000,000 for the widening of the street in 1913.

*Third St. Improvement*—A more expensive project is the widening of 3rd St. in the retail district along

PROPERTY USE OF LAND IN ST. PAUL, MINN.

| Use | Present | | Proposed | | Increase per Cent |
|---|---|---|---|---|---|
| | Sq. Mi. | per Cent | Sq. Mi. | per Cent | |
| Residence | 17.06 | 30.75 | 36.60 | 66.00 | 215 |
| Industrial, railway lines and yards | 3.77 | 6.69 | 8.32 | 15.05 | 225 |
| Business | 0.90 | 1.62 | 2.00 | 3.61 | 222 |
| City property and parks | 2.98 | 5.35 | 5.25 | 9.44 | 176 |
| Rivers and lakes | 3.27 | 5.90 | 3.27 | 5.90 | ... |
| Vacant | 27.46 | 49.71 | ... | ... | ... |
| Total within city limits | 55.44 | 100.00 | 55.44 | 100.00 | ... |

the river, as shown in Fig. 4, the cost being estimated at $1,400,000, including new fronts for the buildings. The present width of 53 to 57 ft. will be increased to 90 ft. and the city will acquire the property indicated to form a park at the head of the Wabasha St. bridge, this park being on the edge of the bluff, 80 ft. above the railway tracks along the river bank. From this point 3rd St. and 2nd St. have descending grades eastward.

## Thirteen Projects Submitted for San Francisco Bay Bridge

AT THE hearing on the proposals to bridge San Francisco Bay before Col. Herbert Deakyne, Corps of Engineers, U. S. A. on Oct. 7 (*Engineering News-Record*, Oct. 13, p. 627) thirteen separate projects were put forward. Their main features are outlined in the accompanying table. Some special features may be emphasized in the following notes:

*"Floating Cantilever" Bridge.*—The plan of the Union Construction Co. carries the weight of structure and traffic on a floating support of reinforced concrete pontoons, thus eliminating the foundation problem. The lateral stability of the structure is provided for by 4-post towers, 960 ft. apart, held in place by cables to anchorages in the bay bottom. The structure is made up of sections 320 ft. long connected by pin joints, each section being a rigid unit supported on two pontoons. The pontoons are 40 x 90 ft. in plan and 14 ft. deep, placed transverse to the roadway on 160-ft. centers. In each rigid unit steel trusses span the distance between the pair of pontoons and also carry the roadway for the 60-ft. cantilever projections on each end. The design provides for a live-load of 100 lb. per square foot.

*The "Suspended Tube."*—The plan proposed by Mr. Greene calls for a tube of stream-line cross-section, built in sections of either steel or concrete which would be flanged, gasketed, and bolted together. Messenger cables, used for construction purposes would later be supplemented by cables within the tube. Sections would be made with end faces sloping on a 45-deg. angle. By means of rails along the tops of the sections and down the inclined faces, fitting corresponding parts on the under side and rear face of each section, successive sections would be hauled along on top of the completed portion of the tube and allowed to drop into place. Detachable faces at each end would be removed when the outer shells were secured.

*The Fowler Plan.*—The plans filed with this proposal were the same as were submitted some seven years ago, (*Engineering Record* Oct. 10, 1914, p. 398) with some additional suggestions regarding terminals. By the use of an elevated loop it is now proposed to handle traffic from the top of Telegraph Hill on grades not exceeding 1½ per cent. The main bridge spans would consist of two 650-ft. cantilever arms and a 700-ft. suspended span. Four supports in the stream would each consist of two piers on 250-ft. centers. The total length of crossing on this route would be 20,500 ft.

*Davies and Modjeski Plan.*—The route recommended by these engineers is practically the same as the one proposed by John G. Little and C. H. Snyder, described in *Engineering News-Record* July 7, p. 16. The Davies-Modjeski report was reviewed in *Engineering News-Record* Aug. 18, p. 269.

SAN FRANCISCO BAY BRIDGE PLANS FILED WITH WAR DEPARTMENT

| Proponents | Engineers | Type of Crossing | Provision for Navigation | Western Terminus (S. F. Side) | Eastern Terminus | Width of Roadways No. of Tracks | Estimated Cost Dollars | Remarks |
|---|---|---|---|---|---|---|---|---|
| San Francisco Bay Bridge Committee | Davies and Modjeski | Tunnel and Bridge 300-ft. spans | 2,500 ft. unobstructed | Near Fifth and Townsend Sts. | Western end of Alameda | 40 ft. vehicular, 2 R.R. tracks | 40,000,000 | 40 ft. of water over tunnel |
| C. H. Snyder | Little and Snyder | Tunnel and viaduct | 2,500 ft. unobstructed | About 1 mile S. of Market St. | Western End of Alameda | 28 ft. vehicular, only | 15,000,000 | 50 ft. of water over tunnel |
| Union Construction Co. | W. P. Roop | Concrete pontoons | 440-ft. swing span | Hunter's Point | Point on line with Oakland City Hall | 40 ft. vehicular only | 8,000,000 | ..... |
| E. B. and A. L. Stone | H. F. Droste | Double deck concrete viaduct | 250-ft. double-leaf bascule | S. Side of Hunter's Point | Bay Farm Is. | 35 ft. vehicular 4 R.R. tracks | 13,130,000 to 16,000,000 | ..... |
| L. E. Fowler | Fowler, Wing, Darwin, Hood | High level cantilever bridge, 2,000-ft. spans | 210 ft. clearance under bottom chord | Telegraph Hill | Goat Is. | 40 ft. vehicular 4 R.R. tracks | 75,000,000 (1916 prices) | R.R. yards on N. Side of Goat Is. |
| R. S. Chew | R. S. Chew | High level cantilever bridge, 2,000-ft. spans | 210 ft. clearance under bottom chord | Telegraph Hill | Goat Is. | 70 ft. vehicular 6 R.R. tracks | 50,000,000 (exclusive of approaches) | Three trusses, double deck |
| E. M. Greene | E. M. Greene | Tube suspended on cables | Unobstructed | Market St. | Y to Key Route and S. P. Moles | 4 auto roadways 4 R.R. tracks | ..... | ..... |
| A. J. Rich & Co. | Gustav Lindenthal | Concrete arches 150-ft. spans | Double-leaf bascule, 200-ft. channel | Candlestick Point | S. Side of Alameda | 60 ft. vehicular 6 R.R. tracks | 25,000,000 | Entirely on curve of 4-mi. radius |
| 100 Club | C. A. Pistolesi | Concrete pile viaduct | 200-ft. bascule | [illegible] Knoll, 18 mi. So. of S. Fran. | Near Alameda | 21 ft. vehicular R.R. tracks later | 2,500,000 (including approaches) | ..... |
| M. C. Couchot | M. C. Couchot | Tunnel 25,000 ft. long | Unobstructed | Harrison St. | Between Moles [illegible] W. P. R.R.'s | 26 ft. vehicular 2 R.R. tracks | 30,000,000 | 100 ft. below water level |
| H. C. Holmes | H. C. Holmes | Concrete viaduct | [illegible] Hunter's Point | Mulford Landing | 40 ft. vehicular only | 5,000,000 | Construction period of 18 months |
| [illegible] | C. A. [illegible] | Concrete viaduct | [illegible] | Dumbarton Point, 30 mi. [illegible] | South of S. P. R.R. Bridge | 20 ft. vehicular only | 1,150,000 | ..... |
| O. A. [illegible] | O. A. [illegible] | [illegible] tunnel | [illegible] | Harrison St. | [illegible] | 24 ft. vehicular 2 R.R. tracks | 12,000,000 | 200 ft. below water level |

# What Business Papers Can Do to Speed the Revival of Business

An Address by James H. McGraw, President of the McGraw-Hill Co., Inc., New York, Before the Annual Convention of the Associated Business Papers, Inc., Chicago, Oct. 24, 1921

TO INTERPRET *to American business the bearing of world conditions upon each of our industries and to lead in the advocacy of broad, sound policies in reference to both foreign and domestic economic problems is the duty and the great opportunity of the business press at the present critical moment: such is the view of James H. McGraw, president of the McGraw-Hill Co., Inc., in an address before the convention of the Associated Business Papers at Chicago last week. Mr. McGraw's paper, while not addressed to engineers and contractors, will nevertheless interest them because of his strong grasp of the present situation, his vision and his courage. The opportunity he pictures to the business press lies at the door, though obviously in less degree, of every thinking man.*—EDITOR.

There are two great classes in the world today—those who look on the world in chaos and see no hope for the future and those to whom the world disaster is but an inspiration for greater effort. I am putting the business papers in the latter class.

The leader of today is the man looking straight ahead with new thoughts or with new vision of old thoughts. The business publisher as never before must grapple with the great problems before us, with new thought and new vision and with a full knowledge of world conditions.

Let us picture these world conditions of the moment.

### The European Crisis

Across the Atlantic the financial systems of Central Europe are going down in a horrible crash. The Austrian crown and the German mark sell at 1/300 and 1/50, respectively, of their gold value, and since there is no such thing as isolation in the economic world, we, innocent of the causes, must share the burden with Europe.

Germany is in the throes of another cabinet crisis, with the danger of losing the gains of some eighteen months of political peace.

Russia daily slips deeper into the slough of economic dissolution—though possibly the deeper she goes, the quicker will come the day when her 180,000,000 people will again buy from the outside world—a buying, by the way, essential to a normal world functioning.

Petty wars still rage in Europe, despite the nominal advent of peace three years ago.

### American Conditions

Such, in a word, is the situation in Europe. In America conditions are more hopeful.

We have a tremendously improved banking and credit situation and plentiful evidences that we have passed the low point in the curve.

The oncoming disarmament conference has awakened the hopes of the world in the possibility of turning into productive lines millions of treasure that go into armaments, and of settling the terms on which America and all other nations shall do business with China.

But, while there are bright spots in the business firmament, there are also heavy clouds. Right before us looms a nation-wide railroad strike. When that cloud has dissipated, or after it has been weathered, we shall probably find ourselves hard up against a coal strike, for while the operators are ready to agree to arbitration in settling the wage scales which come up for renewal on March 1, the coal miners are unwilling to give up the strike weapon.

Quite disturbing, too, is the fact that 4,000,000 of our people who want to work, who want to make the goods and build the houses necessary to make up for our war depletion and shortage, are unable to work, and between 10 and 20 per cent of them are either in want now or will be with the advent of cold weather. While this in itself is disturbing, far more important is the evidence it affords of our failure to have developed a sound social system, in which the functioning of industry must necessarily prove an integral part.

Business is stagnant, yet a dallying Congress, imitating Nero, plays the fiddle of back-home politics while business goes to pot. The tax bill languishes on Capitol Hill. The tariff measure, universally condemned, has been shelved, casting just so much added doubt upon the business future. The railroad refunding bill makes no progress. All that could stabilize business and restore confidence is neglected, despite the urgings of an administration that displays a gratifying amount of business sense.

### Interpreting the Situation to Business

Such are some of the features of a world situation unprecedented in complexity, in difficulties and in the number of discouraging features.

Each and every one of the situations referred to has a present-day bearing on American business. What is more, some of them will determine how America is to do business for many years in the future. If American business is to function up to the new position that has come to it during the war, and that necessarily flows from the fact that the center of world finance and of world influence has shifted to our shores, these governing conditions must be interpreted in terms of their influence on every industry. We may become, if we have but the knowledge, the foresight, and the energy, what England has long been—the market center of the world. But we can take this position only if we have a race of business men equal to the occasion—a race worthy of a world-wide commercial dynasty.

How shall American business men get this conception, how shall they rise to this opportunity unless the business press carries the message to them in each issue, strong with knowledge of the situation and its bearing on American business, convincing in the wisdom of the remedies it suggests, invincible in the enthusiasm and courage it displays?

It is no job for weaklings, but for the broadest-gaged men that the country commands. It will not be accomplished by editors chained to their desks, nor by mere reporters nor by publishers who are bearish on America's future. It can only be accomplished by men of broad vision, sound judgment and unfliching courage.

As to European and other world factors which bear on American business, there must be a wise policy carried home constantly by the business press. We must help mobilize American opinion on the stabilization of European currencies. When Russia comes back, when the other weakened powers are in a position again to buy in normal quantities the business press must picture the opportunity and be the apostle of whatever credit structure is necessary to bring these nations again into the world economic family.

Likewise, as to every other factor in the European and the world situation, business papers must rise to the occasion and help American business to adopt a wise and courageous policy.

### Interpreting Our Own Situation

This task of interpreting world conditions to American business is not an easy one, yet it is only part of the great job which American business paper editors and publishers must do. We must necessarily be concerned with the affairs of the world, but naturally our first responsibility is for our own country, for our own industrial, economic and social conditions. Studying the problems that are closer to home, we find many avenues along which business papers can work in speeding the revival of business.

War breeds extravagance. In spite of the noble ideals which inspired this nation to take up the great conflict across the seas, the inevitable result was the accumulation

of innumerable wastes and habits of extravagance. We became wasteful of our time, our money, materials and even life itself. We could not help it, but we can and we must overcome the habits and tendencies which were developed throughout our entire social and industrial fabric by that terrible conflict.

As a tangible example of what can be done, Herbert Hoover has focused the attention of industry upon the unnecessary wastes which are sapping the vitality and reducing the productivity of our nation.

We are appalled when our attention is called to criminal wastes of life through accidents and negligence, the prodigal waste of our natural resources through under development or political chicanery, the prodigious waste of materials through mismanagement and inefficiency. But of all the wastes which affect our happiness and prosperity, the waste of time and human effort is the greatest and has the most damaging influence.

Along all these lines the business press must constantly be urging and championing broad, sound policies.

Its greatest single task, though, looking to domestic conditions, is to bring home among thinking men that what this country needs more than anything else is to learn anew the gospel of work—intelligent work, untiring work, work in its most homely sense.

We cannot talk ourselves into prosperity. We cannot argue ourselves into stability, but we can work ourselves out of the valley of depression and up to the heights of plenty. We must do these three things:

First, urge everybody to get busy at his present task, and make the most of it.

Second, demand that everybody consider the "winning of the peace" in the same spirit as characterized the winning of the war.

Third, show that selfishness has now no more place than in war time; that interest in the welfare of all men, individually and as society, lies at the basis of prosperity.

In conclusion let me say, we must consecrate ourselves to giving a full measure of the best service we have within us. As a nation, and as publishers, we must quit our petty quarrels and arguments and devote ourselves to the tasks that lay before us. We had to *fight* and *destroy* to win the war. We will have to *work* and *build* to win the peace. The first nation that gets hold of the idea that the only salvation comes from work, will come out on top and really win the peace.

The business papers have an opportunity such as has never come to them before, to direct the thinking of industry into sane channels. Let us demonstrate by our own untiring efforts to serve and by our diligence in meeting the problems of the day that we have accepted the gospel of intelligent work as the big step in speeding the revival of business.

## Increased Speed On Tie Perforating Machine

The machine developed for perforating railroad ties preliminary to a preservative treatment and which was described in *Engineering News-Record*, April 28, 1921, p. 730, has been moved to San Diego, Cal., and set up with a somewhat different arrangement that has made possible an increased speed of handling the ties. The greased plank formerly used for conveying ties to the perforating rolls and delivering them to cars after passing through the machine, is now replaced by moving chains. To keep the machine running at capacity, ten men are required—4 unloading, 1 watching the chains, 4 loading the perforated ties upon the cars and 1 mechanic. With this arrangement 3,600 ties can be handled in eight hours. As about an hour per day is lost in switching cars to and from the machine, the actual maximum rate of passing through the machine is about 500 per hour. Several hundred thousand ties were treated by this process in the lumber yard of the Charles R. McCormick Co. at San Diego for the Santa Fe Railroad.

## Low Grade Line Saves Pavement From Flood Damage

By C. L. Jenken

Construction Engineer, Maricopa County Highway Commission Phoenix, Ariz.

UNUSUALLY heavy rainfall, coupled with the failure of a dike 10 miles northeast of Phoenix, Ariz., recently caused a flood that swept across about 30 miles of the road system built by the Maricopa County Highway Commission. The currents were so swift that it was expected at least 5 miles of the concrete pavement, which took the brunt of the flood, would be almost a total loss. However, when the waters had subsided an inspection trip showed that $125 in repairs to dirt shoulders would cover all the damage. The success with which the pavement resisted this flood is ascribed in part to the design of the slab but chiefly to the fact that the danger of flooding by irrigation water had been taken into account in the original plans for the system and had resulted in a decision to keep the grade line low.

An exceptionally large runoff from the Cave Creek water shed had caused flood waters to back up water behind the south bank of an irrigation canal just north of and above this part of the road system. When this embankment was overtopped the impounded water was released onto land which has an average fall to the south of about 10 ft. to the mile and to the west of about 8 ft. to the mile, thus creating very strong currents especially where the water reached a depth of 18 to 24 in., as was the case along several of the roads inundated. The danger of damage to the roads was increased by the high ditch banks built in many places along the edge of the right-of-way on the lower side, thus tending to keep the water current running for considerable distance parallel to the edge of the pavement.

### Danger From Irrigation Water

When this road system was being planned, the final location was made so that the grade line was held down to a point where the cuts would equal the fill without utilizing any material borrowed from pits or side ditches. In fact, the drainage ditches already existed in many cases, having been built to care for the waste water from irrigation. In keeping the grade line low the object was not to reduce the danger of floods from the Cave Creek water shed, as this was not anticipated, but was rather to prevent damage from irrigation water that occasionally escaped onto the roads. The latter was a considerable and ever-present danger because burrowing animals occasionally released the water from as much as 160 acres covered to a depth of 4 to 6 in. Another factor believed to have been of material importance in preventing damage is the fact that the 6-in. slab is increased to a thickness of 9 in. at the curb.

The writer believes that the prevailing custom of constructing first-class highways well above the natural surface of the surrounding ground is good practice so long as drainage can unquestionably be handled in side ditches or by other means. Where unknown quantities of water are to be considered or where drainage waters are likely to endanger fills or even a slightly elevated sub-base, it would seem that the low grade line has certain merits that should warrant the most careful consideration.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## What Is An Engineer?

Sir—The following advertisement in the "Help Wanted—Male" columns appeared recently in a paper of this city.

ENGINEER—LICENSED, STEAM, ELECTRICAL, HYDRAULIC POWER, ICE AND REFRIGERATION, MECHANICAL, SOBER, STEADY. GOOD REFERENCES. NO NEGRO OR LAGO DUMP NEED APPLY. ADDRESS B-109 STAR.

How many of us can qualify?

It has been reported with pride in one of the trade papers of a concern which manufactures plumbers' supplies that the term "Sanitary Engineer" is being adopted for the plumbers and that the States of Indiana, Tennessee, Minnesota and Colorado have already officially recognized this dignified title. This paper suggests that, as more fitting, the name of "Domestic Sanitary Engineer" be used, but that "all things require time."

What is there in a name anyway? It is to laugh!

WEBSTER L. BENHAM,
Consulting "Engineer" (We do sanitary work).

Kansas City, Mo., Oct. 22.

## Error in Transition Curve Table

Sir—I would like to call your attention to an error I have just discovered in a paper of mine, "True Transition Curve for Railway Problems," in *Engineering News-Record*, Aug. 26, 1920. In the table for all the values of the function $T(a)$ there should be inserted another 9 between the decimal point and the first figure: e.g.

$T(a)$ for 4°30′ now reads 0.9938
it should read 0.99938

and so on.

GEORGE PAASWELL,
New York City, Oct. 26. Consulting Engineer.

## Another Method for Platting Traverses

Sir—Regarding a letter of Aug. 2 by Emile Low, commenting on a method for platting traverses explained by Herbert N. Bradstreet in *Engineering News-Record*, July 28, 1921, I wish to submit the following as involving fewer operations than either of these methods and at the same time minimizing certain sources of error.

Protractors stamped on transparent parchment are easily obtained. These may be used directly, or blue prints, on very thin paper, may be made from them and the parchment put away for future use.

First lay out a meridian and on this orient and gum or tack down the thin protractor. Now instead of pricking off and numbering the various bearings, which are two unnecessary operations and which involve most of the error in such work, lay the parallel ruler or triangle, as preferred, on the protractor and bring its edge to coincide with the given course, the center of the protractor and the course in the opposite quadrant, then transfer it and plat it in its proper place, without permitting the operation to get cold.

This not only gives a longer base than is used when the pricking off method is applied but is also an excellent guard against laying out the wrong course for if the selection of the direct course is incorrect it becomes conspicuous when the reverse course is sought for in the opposite quadrant.

In this way the working sheet will be kept clean, there will be no temporary penciling such as angle numbers, Meridian lines or deflection angles at or through every point, a feature which is of considerable advantage especially when there is a mass of detail which has to go on the sheet.

I prefer a well-made rolling parallel rule, which, when used in connection with a long light straight edge, will not only take care of any position on the board, but is much faster and probably more accurate than triangles.

This method, though more rapid and involving fewer sources of error than either of the methods referred to above, is consistent only with such field work as is usually done by stadia of rapid chaining and cannot, by any means, take the place of a system of computed co-ordinates, where computed co-ordinates are appropriately used.

New York City, Sept. 7. G. T. WHELTON,

## Possibilities in Fused Cement

Sir—The article by Mr. Eckel on "Quick Hardening Cement Developed by the French," *Engineering News-Record*, Oct. 6, p. 566, calls to the attention of the engineering public of this country a product which is, as he states "certainly worth more attention than has been given to it heretofore." Abroad this material has during the past several years received considerable attention, as evidenced by the paper of Endell, entitled "Cement Rich in Alumina," read before the 1919 meeting of the Portland Cement Association, and an article by Bied dealing with the use of this material in reinforced concrete, published in "Revue de l'Ingenieur," 27-191. I have also called attention to some of the work along this line, which has been done by the Bureau of Standards, in a paper presented before the American Society for Testing Materials, in 1919. It is now being issued by the Bureau as Technologic Paper No. 197, in this form giving complete data obtained in testing a series of cements of this type manufactured by the Bureau. The tests extended over a period of five years and showed the results obtained by using the cement both as a mortar and a concrete, under various conditions of storage.

In every way the tests fulfilled the results which have been obtained abroad, with the sole exception that it was not found satisfactory to use any in concrete which would be subjected continuously to water. As a cement for reinforced concrete they would have much to justify their use over portland cement on account of the very rapid hardening, which as Mr. Eckel states, in twenty-four hours gives results which are rarely obtained with portland cement under twenty-eight days.

The French refer to this cement as fused cement, and call particular attention to its being made in a blast furnace. Our results would lead us to believe that this procedure is not one that has been used because it would give a particularly good cement, but rather one caused by manufacturing conditions. A reference to the work of Rankin, which is the fundamental work in all portland cement investigation, would reveal the fact that a mixture of alumina, lime, and silica of the composition cited by Mr. Eckel, and apparently used by the Lafarge company, will fuse at a temperature of about 1,380 deg. This temperature is about 50 deg. lower than that used in this country in portland cement clinkering. In the Bureau's work but one difficulty was encountered, namely, preventing the material from fusing. A rotary kiln was used in which it was thought desirable to produce a clinker instead of a fused product, on account of the greater ease of reducing a clinker to a ground product. The control required under these latter conditions is far more exacting than would have been required to have fused the mix, especially when compositions approaching that used by the Lafarge company were used.

There is no question about the many remarkable qualities which this cement has. So far as its production in this country is concerned, however, it is largely a matter of source of raw material. If alumina in any form would be available in large quantities near a market where such cement could be used, it would be found possible to produce these cements in an ordinary portland cement plant without any changes whatsoever.

It would be very befitting that this product should be manufactured in this country, as undoubtedly attention was first called to it by the work of Messrs. Spackmann and Lazell.

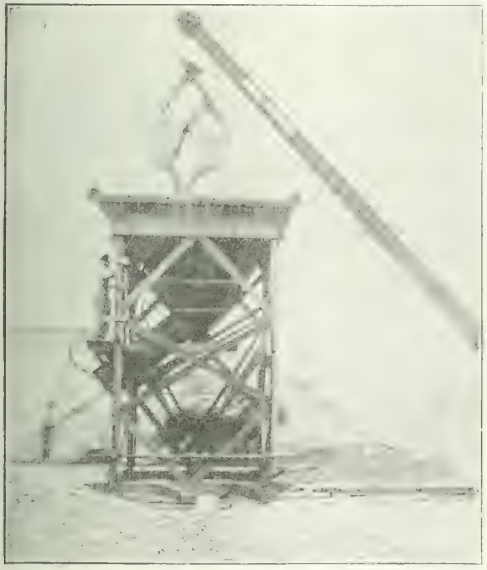
P. H. BATES,
Washington, D. C., Oct. 26. U. S. Bureau of Standards.

# HINTS FOR THE CONTRACTOR

## Simple Loading Hopper Proportions Aggregates from Stock Pile

TWO-COMPARTMENT trucks are loaded with proportioned batches of sand and gravel by means of the elevated hopper illustrated as installed on a 28-mile concrete road job near Garden City, Kan. The hopper has a sand and a gravel compartment and both have gates into the measuring chute. This holds the aggregate for one batch and is filled and discharged twice for a two-compartment truck. After the sand and gravel is chuted into the truck, it is driven to the cement pile where five bags of cement are poured on top of the sand and gravel. When it is windy or stormy the cement is carried in bags to the paver, where it is deposited directly into the charging skip.

From twelve to fifteen 2½-ton, two-compartment trucks take the materials to the pavers. Two cars of



PROPORTIONING HOPPER FOR CHARGING MOTOR TRUCKS

cement a day are used. Because of the fast handling of materials and sufficient water supply it is common to get large daily yardages. On June 24, according to the Chain Belt Co., which has furnished this information, the peak was reached, when 818 lin.-ft. of concrete, 16 ft. wide and 7-8-7 in. thick, were put down in 8 hr. 15 min. This record was made with a 1-min. mixing time and 10 sec. for handling, making a total of 1 min. 10 sec. per batch. Steel forms and a finishing machine were used. The contractors were the Ammerman Contracting Co., Garden City, Kan.

## Steam Shovel Digs for Dragline in Hard, Stiff Material

WHEN a dragline bucket would not dig into the hard yellow and blue clay on a sewer excavation job in Detroit the contractor conceived the idea of using a heavy steam shovel to do the digging. A pit had previously been excavated along the line of the

STEAM SHOVEL AND DRAGLINE IN OPERATION ON DETROIT SEWER JOB

sewer trench and into this pit was placed a 20-ton steam shovel—weighing about 25 tons with continuous tread type of mounting. A large locomotive crane picked up the shovel and placed it in the cut.

The sewer cut is 16 ft. wide and varies in depth from 24 to 27 ft. The shovel, after its installation in the cut, loaded the material on a bench straight ahead, 15 ft. above the bottom of the cut. The dragline then swung its bucket into the bench and removed the loose material as shown in the accompanying view. Working in this way an average output of 350 cu.yd. per day was maintained with about 400 cu.yd. as the best day's work. The speed of the dragline governed the amount that could be dug.

The contractor who did the work is the Gass-Thurston Co. of Detroit. The foregoing information is supplied by the Ball Engine Co., whose type B Erie steam shovel was used in the pit to break up the clay for the dragline.

# NEWS OF THE WEEK

New York, November 3, 1921

## Hydraulic-Dam Core Exposed by Slope Washout

**Summit Pool Overflow Cuts 15-ft. Trench in Face of Miami Conservancy Structure**

Overflow of the summit pool of the nearly completed Englewood dam of the Miami Conservancy District, 10 miles northwest of Dayton, Ohio, during the night of Oct. 25 to 26, cut a narrow trench 15 ft. deep into the upstream slope of the dam and exposed the upper part of the clay core. The core material was washed out for 40 to 50 ft. along the axis of the dam and 15 ft. deep, but the exposed ends of the core remained as nearly vertical banks, with only slight sagging of the top surface for a few feet back from the edge. About 7,000 cu.yd. were washed out; of this amount not more than 800 cu.yd. were core.

As seen by a representative of *Engineering News-Record*, just after the accident, the dam, which will be 125 ft. high and is now within 15 ft. of crest elevation, has a present top width of only about 60 ft., and affords scant room for the retaining dikes required along the edges to confine the discharge of the hydraulic pumps. The entire embankment is being built by hydraulic filling, the discharge from the pipe lines along the edges of the top forming gravel and sand beaches sloping down to the central pool in which the fine materials deposit and build up the core.

### Core Nearly Completed

According to H. S. R. McCurdy, division engineer at Englewood, the core was to be carried only a few feet higher, after which a central discharge pipe was to be used for bringing in the topping-out material, permitting substantial dikes to be built. At the time of the accident the dikes, formed of beach material cast up by a small dragline, were small sharpcrested levees about 5 ft. wide by 2 ft. high. The pool, about 2 ft. deep by 4,000 ft. long, contained some 150,000 cu.ft. of water. Seepage through the dike, unnoticed in the night, is believed to have caused the dike to slump and thus allowed the pool to overflow down the slope, in spite of regular inspection of the dikes by a watchman. The flow of nearly a million gallons of water down the bank trenched it in a V-shaped gully, running out about 50 ft. below the top.

Filling of the trench will require two or three weeks, but the summit work will continue at the same time over the rest of the dam, and it is expected that the final topping out of the dam, about Dec. 15, will not be delayed. Charles H. Paul, chief engineer of the district, states that the accident revealed a gratifying rapid consolidation of the core material. It had been thought that directly below the pool water a layer of several feet of the clay was semi-fluid, but this appears not to be the case, for even the immediate bottom of the pool showed no disturbance by the outflowing water. A fuller technical report of the incident is soon to be made public.

## Engineering Employment Improving

The outlook for engineering services was slightly better for September, according to records of the American Association of Engineers. Not as many men registered for employment as in August while nearly as many vacancies were received and more men were placed during the month. The accompanying table shows the trend:

| | Sept. 1921 | Aug. 1921 | Sept. 1920 |
|---|---|---|---|
| Applicants for employment.. | 1749 | 2320 | 1372 |
| Positions received..... | 348 | 360 | 770 |
| Men referred.. | 1861 | 2250 | 3697 |
| Men placed.... | 213 | 204 | 309 |

Fifty-five per cent of the men who registered for employment stated that they could report "at once," indicating unemployment or present employment terminating. Forty per cent of the registrations were civil engineers. The average monthly salary of positions filled in September was $184 ($3 more than last month), while for the same month last year it was $206. The greatest demand for engineers was in highway engineering, architectural, appraisal and public utility work.

## Engineering Dispute in Britain

*(London Correspondence)*

Hard on the heels of the coal stoppage in Britain comes a dispute in the engineering trades, which, should the threatened strike materialize, will prove just as ruinous. In the absence of any agreement being made the engineering and shipbuilding employers have given notice to their men of the withdrawal from Oct. 12 of the 12½ per cent bonus on total earnings for time workers and the 7½ per cent on piece rates. The general effect of such a reduction will be to reduce wages of 3,000,000 skilled and unskilled men from 10s. to 9s. a week, which follows a somewhat recent cut of 6s. per week. So far the employees have refused arbitration and the unions are urging the Minister of Labor to institute an inquiry. The employers will not order a lock-out unless the unions withdraw the labor, but they are resolved that these cuts shall take place since neither industry can pay the present high wages.

## General Goethals Completes Lake Dallas Survey

Gen. George W. Goethals who went to Dallas, Texas, in the capacity of a consulting engineer to consider the proposal of damming the Trinity River has finished his survey and returned to New York City. The work upon which Gen. Goethals has been engaged is known as the Lake Dallas project.

## Hiram F. Mills Made Notable Public Bequests

**$200,000 to Harvard for Cancer Study—Gifts to Schools and Societies—Residue to City Charities**

Among the numerous bequests in the will of the late Hiram F. Mills, hydraulic engineer and sanitarian (see obituary in these columns, Oct. 13) is one of $200,000 to Harvard University, the income from which is to be used in "the investigation of the origin and cure of cancer," the gift to be a memorial to Mrs. Mills. Gifts to other colleges and to technical and professional societies are: Rensselaer Polytechnic Institute and Massachusetts Institute of Technology, $10,000 each; American Society of Civil Engineers, $2,000; New England Water Works Association and Boston Society of Civil Engineers, $1,000 each; American Academy of Arts and Sciences, $5,000. Other bequests bring the total of specific gifts to nearly $450,000.

### Mill Workers Aided

The residue of the estate is left in trust as the "Hiram Francis Mills Fund," the net income from which is to be used for charitable purposes in Lawrence and Lowell, with special regard "to the needs and welfare of mill workers and their families." In explanation of this gift the will mentions the fact that more than fifty years of Mr. Mills' life were "largely devoted to the maintenance and improvement of the water power of the Merrimac River."

The will also provides that since for many years Mr. Mills had been engineer of the Essex Company in Lawrence and of the Proprietors of the Locks and Canals on the Merrimac River in Lowell, the allotment by the trustees of the income from this fund for use in each city shall be subject to approval of the companies' directors.

It appears that Mr. Mills' fortune was amassed by himself, except for a small inheritance from his father, and that it was due to his business capacity, savings, and the increases in value of judicious investments, all through an exceptionally long life. When he became engineer of the Essex Co., nearly a half century ago, he conditioned acceptance of the position on the transfer to him of a stated number of shares of stock. His long connection with the company named and the similar company at Lowell, and the many friends he made not only in those organizations but also among the manufacturers and business men in the Merrimac valley enabled him to invest successfully in various mill stocks, some of which paid handsome returns. An intimate acquaintance of long standing informs *Engineering News-Record* that Mr. Mills "had a very strong faith in the manufacturing interests of the Merrimac valley and a belief that money invested there would always come back four-fold."

## Court Restrains Formation of Drainage District

By a recent decision in the Washington State supreme court, King County Commissioners are permanently restrained from proceeding with the formation of a drainage district which would involve the construction of nine miles of ditch along a country road and which, when it is constructed, would be an additional burden to the abutting property. The supreme court decision affirmed the decision of the King County court. The 1921 legislature passed a law giving counties the right, so far as they have power, to construct longitudinal ditches along highways. The ditch in this case, however, was found to be one which would carve a 10-ft. zone out of the highway to drain private property, and which would seriously hamper ingress and egress to the property of the plaintiffs.

## Princeton Association Meets

The Princeton Engineering Association, the organization of the engineering alumni of the institution, held a smoker at Princeton, Oct. 21, in order to extend a welcome to Dr. Arthur M. Greene, Jr., who is to become dean of the engineering department of Princeton next fall. It was the first opportunity of the engineering graduates to meet the new dean.

The occasion was honored by the presence of Dr. John G. Hibben, president of the University, who explained to the assembled graduates that Dr. Greene had been selected after a most extensive survey, resulting in the conclusion that he was the man best fitted for the work.

## Engineers on Connecticut Stream Pollution Commission

Appointments by the Governor of Connecticut to the new commission for the investigation of stream pollution in that state include: Caleb M. Saville, chief engineer and manager, Hartford Water Department, chairman; Robert A. Cairns, city engineer of Waterbury; Shepard B. Palmer, an engineer of Norwich; Charles E. Wheeler of Stafford, representing the oyster industry of the state; and George Kimball of New Britain and John Goss of Waterbury, representing manufacturing interests. Frank E. Healy, attorney-general, is an ex-officio member. Mr. Kimball has been made secretary of the commission.

The bill providing for the present commission abolished the Industrial Wastes Commission created a year or two ago. That commission, which was given an appropriation of $75,000, and worked in conjunction with the State Department of Health, has completed a report which is now in the hands of the printer. The new commission has no appropriation. The State Department of Health has been ordered to turn over to the new commission all of the records of stream pollution.

The work of the Industrial Wastes Commission and proposals for a substitute were the subjects of much contention in the last session of the Connecticut legislature. A proposal to give the new commission $50,000 for its work was voted down The new commission is to report to the legislature of 1922.

# Problems of City Engineer Feature A.S.M.I. Convention at Baltimore

### Twenty-Seventh Annual Meeting Considers Paving Practice and Wide Range of Municipal Subjects—E. S. Rankin New President

In contrast to its sessions of several years ago the 27th annual convention of the American Society for Municipal Improvements, held at Baltimore, Oct. 25-28, developed hardly a ripple of discord in the consideration of changes in paving specifications. As a matter of fact, no radical revisions were proposed, the chief differences of opinion relating to the committee's recommendation, for bituminous concrete, of only one mineral aggregate grading, approximating that of the expired Warren bitulithic patent, instead of alternate forms including practically a run of-crusher product. In the brick paving specifications the committee's proposal to limit the blocks to the lug type was met with opposition from the manufacturers, who urged that provision be made also for a straight-faced brick; a decision in this matter will be held over until next year.

With only one or two exceptions, the papers and committee reports developed practically no discussion, a condition explainable, in part, by the overloading of the technical program with more papers than could be disposed of effectively and failure to set any time limit on the speakers. One paper followed another in steady succession, unrelieved by discussion from the floor. The lax control of the technical program was in sharp contrast to the efficient handling of the entertainment features of the convention. Attendance was representative and on the final day the registration figures showed 162 active members, 78 associate members, and 279 guests, or a total of 519.

*Membership and Finances* — Reports by the officers of the society showed an active membership of 648, as of Oct. 1, 1921, as against 611 at the beginning of the year, a gain of 6 per cent. Receipts for the year totaled $5,702 and expenditures $5,518; last year's deficit of $1,600 has been reduced $500.

In his presidential address, R. Keith Compton, chairman, Baltimore Paving Commission, urged an extension of the scope of the organization by inaugurating as an annual convention feature a conference of mayors. He also recommended that the organization take steps to stimulate construction as a means of relieving unemployment, a policy which is being followed by Mayor Broening of Baltimore, who delivered the opening address.

#### Technical Sessions

Following the business meeting there were 6 general sessions in which the papers and reports were grouped, in so far as practicable, to cover broad subjects, such as street lighting; water supply, sewerage and sanitation; city planning and zoning; street paving methods and materials; specifications for pavements; and transportation and traffic.

*Street Lighting*—A committee report by C. W. Koiner, city manager, Pasadena, Cal., and papers by E. A. Anderson, National Lamp Works, Cleveland, C. A. B. Halvarson, General Electric Co., West Lynn, Mass.; and L. A. S. Wood, Westinghouse Electric & Manufacturing Co., South Bend, Ind., brought out as the most important development during the year the tendency to supersede the use of arc lights by gas-filled incandescent electric lamps of high intensity, these units running up to 1,000 cp. In fact, Mr. Anderson exhibited a 2,500-cp. unit, not yet commercially introduced. A trend, also, away from plain glassware globes to lantern type heads was noted. Mr. Halvarson described a new type of highway lighting unit, in which, by means of concentric reflectors, light beams were confined to the roadway area.

*Water works* — The report of the committee on water-works presented by Nicholas S. Hill, Jr., consulting engineer, New York City, emphasized the need for employing trained men and

## Reconstruction of South St. Bridge To Be Readvertised

Bids on the removal of the old South St. bridge over the Schuylkill River in Philadelphia and construction of foundations for a new bridge, as noted in these pages June 30, p. 1138, proved to be too high to be acceptable, and the city is now planning to ask bids for the entire work of reconstruction. The work to be done is the replacement of the present old wrought-iron pin connected hand operated draw-bridge (built in 1878 and reinforced in 1895) by a plate-girder structure of five spans, of which the central span will be a double leaf electrically operated bascule draw, giving a 100-ft. clear channel. The length of the work is 576 ft. Foundation work is to be carried as far as possible before closing down the old bridge. Charles Frommer, acting chief engineer of the Bureau of Surveys, Department of Public Works, Philadelphia, is in charge.

## Engineering Building Planned for San Francisco

Plans are under way for interesting a large number of engineers of San Francisco in an enterprise for constructing and operating a 20- to 25-story office building which would serve as a center of engineering activity. The movement is fostered by the San Francisco Electrical Development League which estimates the cost of the project at about $2,000,000. Several schemes for financing have been considered, the preferred means being to accept the offer of a capitalist who has agreed to advance $1,700,000 toward the total amount necessary provided 1,500 San Francisco engineers will buy stock in the enterprise to the extent of $200 each. An alternative plan is to accept an offer of capitalists to meet the entire cost of construction, provided engineering societies, the Engineers' Club, and a representative number of other engineering interests agree to become tenants so the building would be assured of being a center of engineering activity.

paying them adequate salaries, if plants are to be managed efficiently. A scientific basis of rate-making and a uniform system of accounting, in order to make possible comparisons of different plants, were urged. Opportunities for substantial economies are possible, the report stated, in the standardization of water-works fittings, particularly brass goods for service connections. The centrifugal pump was characterized as the most important present pump development in the water-works field. A wider maintenance of rainfall and run-off records was recommended. The report, in predicting that a period of more active construction is rapidly approaching, sounded the following optimistic note:

**"Work on the new Providence supply has been resumed, large purification projects are under way in Baltimore, Milwaukee, Cambridge, Kansas City and Detroit, while in general, the undone work of war time is only awaiting a stabilized labor market for its doing."**

A description of Baltimore's water-works system by J. W. Armstrong and V. B. Siems closed the water-supply session. It was stated that tentative plans for a new filtration plant at Baltimore have been prepared.

### Utilizing Sewage Sludge

*Sewerage and Sanitation* — Disposal of sludge formed the principal subject of the reports of the general committee and sub-committees on sewerage and sanitation, T. Chalkley Hatton, Milwaukee Sewerage Commission, chairman. The desirability of studies of methods for utilizing the fertilizing value of sewage sludge was pointed out, culminating in the passage of a resolution, by the society, calling upon the Bureau of Soils, U. S. Department of Agriculture, to undertake research work along this line. England, according to Mr. Hatton, who has just returned from that country, has made no progress in sludge disposal since 1907. The field for American effort, he said, is wide. In a sub-committee report, Langdon Pearse, Chicago Drainage District, advocated the formation of metropolitan districts, including a number of municipalities, for purposes of water supply, sewerage, lighting, garbage disposal, etc. Operating results of the Rochester (N. Y.) sewage works were presented by N. Adelbert Brown, engineer-in-charge, while John F. Skinner, principal assistant engineer, Rochester, N. Y., presented, as a portion of a sub-committee report, a careful and logically arranged analysis of the factors entering into the design of sewage-works.

*City Planning* — Baltimore is on the eve of drafting a zoning ordinance; the advantages of a topographical map, in this connection, were explained by J. C. Grimball, assistant engineer, City Plan Commission, Baltimore. Among the other papers were committee reports on local subdivisions by Nelson P. Lewis, of New York, and on zoning by Joseph W. Shirley, chief engineer, Topographical Survey Commission, Baltimore.

*Paving Practice*—The general report of the committee on street paving, by W. A. Howell, chief engineer, Bureau of Paving, Newark, N. J., noted a trend toward asphalt or bituminous surfaces for residential streets in cities and advocated an enlargement of municipal paving programs as a means of furnishing employment to labor.

In his report on the experimental wood block paving laid in Minneapolis in 1906, Ellis R. Dutton announced that the results indicated the following order of preference for wood: (1) Long leaf yellow pine and white birch; (2) tamarack; (3) Norway pine; (4) Western larch.

Describing the co-operative investigation which has been undertaken by the U. S. Bureau of Public Roads to correct the shoving of asphalt pavements, Prevost Hubbard, of the Asphalt Association, stated that the formation of transverse waves is most prevalent near the gutters of streets where most of the horse-drawn and slow moving motor traffic travels. "While it is possibly true," the report stated, "that the impact of fast moving traffic will accelerate shoving, once started, or may be directly responsible where irregularities in contour first existed, comparatively slow-moving, heavily loaded vehicles are believed to be the predominating cause." A. W. Dow, consulting engineer, New York, in discussing the foregoing paper, asserted that the presence of moisture coming up through the base to a point of contact with the asphalt surfacing is the most prolific cause of shoving. Another contributory factor, he pointed out, is the crushing of the binder course.

The economical extent of asphalt pavement repairs and maintenance formed the subject of an exhaustive paper by George H. Norton, city engineer, Buffalo, N. Y., which was very favorably received. It was based on the complete records which Buffalo has kept of all repair costs on asphalt pavements for about 40 years, covering about 75,000,000 yard-years of maintenance after guarantee on which the yard rate was kept separately for about 800 different contracts.

A strong endorsement of the practice of inspecting at their source materials which enter into the construction of bituminous surfaces was made by George Cobb, of Baltimore. At the asphalt plant, he said, the inspector should devote most of his time to watching the asphalt buckets, to insure proper proportioning of the materials. Papers on "Oil Asphalt" by H. Spencer, of the Standard Oil Co., and "The Real Value of Highway Literature" by Charles E. Murphy, of The Texas Co., completed the session on paving.

### Specifications

Nothing important developed in the consideration of proposed changes in the society's standard specifications. The present sheet asphalt specifications, according to Herman H. Smith, committee chairman, are too lengthy and are being completely revised. Col. J. W. Howard urged the adoption of standard tests for asphaltic cement to serve as a criterion of their value, irrespective of the source from which the material comes.

As noted in the first paragraph of this report, the committee on bituminous pavement specifications recommended the discontinuance, in the case of bituminous concrete, of the provisions for a grading involving one product of crusher plant and for the Warren Co's. bitulithic pavement, the basic patent for which has expired, and the requirement of a single specification for asphaltic concrete in which the grading of the mineral aggregate is similar to that of the old Warren specifications. Prof. Arthur H. Blanchard objected to the elimination of the grading based on a single product of a stone crushing plant. The specifications as revised to carry only the one grading will go out to letter ballot.

In the committee hearings on brick pavement the manufacturers urged the adoption of a plain-faced brick, although the committee sentiment favored only a lug type. This matter will be held over for another year.

### Traffic and Transportation

The committee on traffic and transportation, Prof. Arthur H. Blanchard, chairman, recommended the use of "dummy cops" at street inter-sections, rotary traffic where practicable, long-radius curb corners, and bypass highways for towns and cities on trunk routes. The committee condemned the "wild cat" jitney service in competition with street railways lines. The committee also recommended that a highway transport division be installed in engineering or highway departments of cities having a population of over 100,000. In the discussion, the trackless trolley in large cities was characterized by Prof. Blanchard as an uneconomic development. He believes that there will be a wide utilization of motor truck lines for freight service installed and operated by the railways.

The principal feature of the final session of the convention was an illustrated paper on "Subways for City Transportation" by Robert Ridgway, chief engineer, New York Transit Commission; an abstract will appear in an early issue.

Dean A. N. Johnson, of the University of Maryland, urged engineers to take a more active part in public affairs and pointed out that the engineering college is under obligation to broaden its courses of instruction the better to prepare young men to enter the public service.

### New Officers

The society elected the following officers:

President, Edward S. Rankin, engineer-in-charge, Bureau of Sewers, Newark, N. J.; first vice-president, W. W. Horner, principal assistant chief engineer, sewers and paving, St. Louis, Mo.; second vice-president, Ellis R. Dutton, assistant city engineer, Minneapolis; third vice-president, H. H. Smith, deputy chief engineer, Board of Estimate and Apportionment, New York City; secretary, Charles Carroll Brown, engineer, Department of Public Works, St. Petersburg, Fla.; treasurer, Linn White, chief engineer, South Park Commission, Chicago.

Cleveland was selected as the city for next year's convention.

The local committee of the society, under the guidance of Ezra B. Whitman, consulting engineer, chairman, and Gustav J. Requardt, assistant chairman, provided an exceptionally well-arranged program of entertainment, including a dance at the Baltimore Country Club, an inspection, by special boat of Baltimore harbor, a Press Club entertainment and an automobile tour covering the city's paving operations and parks.

*Abstracts of some of the convention papers and reports will appear in an early issue.*

## Senator Townsend Makes Statement on Road Bill

**Federal Duty To Assist Interstate Highways Recognized For First Time, He Says**

(*Washington Correspondence*)

The House of Representatives Nov. 1, approved the conference report on the highway bill. The test of strength came on a motion to recommit offered by Representative Hudspeth of Texas. The vote was 253 to 36. The principal opposition came from representatives of Texas and other states that are precluded by their constitutions from issuing bonds for internal improvements. Approval of the conference report by the Senate is assured, although some further delay may be occasioned. At the request of the Washington correspondent of *Engineering News-Record*, Senator Townsend prepared the following statement:

"The proposed federal road act, which is now certain to become a law, is in my judgment the most progressive step ever taken by Congress in aid of good roads.

"Representing a sentiment which favored a change in existing law to the end that a real federal purpose might be served with federal money—I proposed that a system of roads should be laid out of which the principle interstate highways should be the backbone through all of the states—highways connecting at state lines. These roads would serve from 60 to 85 per cent of the highway traffic of the states. Upon this system, and until it was completed, I proposed that all of the federal money should be expended.

### General Principles

"In the bill which has just passed the Congress, I did not obtain all that I had hoped for. I was, perhaps, asking too much, considering the organized forces against a proposition which had so little of selfish interests to serve. The new law, however, contains as its fundamentals the general principles for which I have contended. Before any state can participate in federal aid it must lay out a system of roads approved by the Secretary of Agriculture, consisting of not more than 7 per cent of the road mileage of the state; 3/7 of that 7 per cent shall be inter-state mileage, connecting with similar roads in adjacent States, and 4/7 shall inter-county roads, connecting with the inter-state highways. Sixty per cent of the states share of the federal money will be spent upon inter-state roads until they are completed, and with the consent of the state highway department, all of this money may be spent on these highways. Thus for the first time do we have a recognition by the federal government of the principle that it is the first duty of the government to assist in building its primary, or inter-state roads.

"The law also provides that the states which accept federal aid must accept it on the condition that they shall provide, from whatever source they can, the money to match the federal money. They must also provide the means for maintaining the roads built with federal aid.

"Every provision for safe-guarding the federal appropriation against waste in the construction and maintenance of durable types of road which it was possible to obtain has been incorporated in the new law. A proper administration of the act can be had, for there is ample power conferred to secure approximately the objects which the friends of good roads desire."

## Rock Crusher Repair Parts Shipped by Airplane

At 8:30 one morning a telephone call was received by the Allis-Chalmers Manufacturing Co., Milwaukee, from the Lutz Stone Co., Oshkosh, Wisconsin, stating that its rock-crushing plant was closed down due to the need of repair parts. The parts being in stock, Mr. Lutz said he would call for them within an hour. This was somewhat of a surprise as Oshkosh is more than 3 hours distant by train. According to his request, however, the parts were delivered to the Milwaukee Air Port, 7 miles from the Allis-Chalmers plant, within 45 min. after the call was received. Mr. Lutz called for the parts in his airplane, and upon reaching home was able to have his plant in operation shortly after noon.

## Over 2,000,000 Hp. Approved by Federal Power Commission

Since March 1, 1921, the Federal Power Commission has authorized the issuance of thirty licenses involving 1,269,000 hp. and twenty-four preliminary permits involving 1,280,000 hp., a total of 2,549,000 hp. It has already taken final action upon one-third of the applications filed. Several of the applications approved under the Act involve projects for the construction of which specific congressional authority was sought for many years, but never obtained. Notable among these are projects on the Niagara, on the Connecticut River at Enfield Rapids, and on the Coosa River in Alabama. Notwithstanding the industrial depression and the uncertain financial situation, projects aggregating 1,277,000 hp. and an investment of approximately $100,000,000 are already under construction in New York, Alabama, Wisconsin, Oregon and California.

Up to Oct. 8, 1921, there have been filed with the commission 256 applications involving over 16,000,000 hp. of which about 10,500,000 hp. is primary power and 5,500,000 secondary power. The great majority of these applications contemplate the development and sale of power as public utilities. The reports of the Bureau of the Census for 1917 showed an aggregate water-power development in the United States in that year of about seven million horsepower. The total today is probably between eight and nine million horsepower, or approximately one-half the amount represented by the applications before the commission. In 1917 there were only 259 water-power stations of a capacity in excess of 1,000 hp. engaged in the public utility service, with an aggregate capacity of 4,000,000 hp. The average investment in plant and equipment of these stations was $240 per hp. If the average investment required in the projects before the Commission is only one-half as much, an expenditure of $2,000,000,000 will be involved. The collateral expenditures for distribution systems, for customers' installation, and in accessory industries will be several times greater.

## Build 97-Ft. Concrete Arch in One Month

**Steel Bridge Wrecked By Colliding Autos Replaced By Concrete Structure In 25 Days.**

On Sept. 21 a steel truss bridge in Maryland was wrecked by two colliding automobiles; on Oct. 22 a new 97-ft. reinforced-concrete arch was opened at the site to take the place of the bridge destroyed. At the request of *Engineering News-Record*, John N. Mackall, chairman, State Roads Commission, has sent the following story of the rapid replacement work:

"On the Washington Boulevard, running from Baltimore to Washington, over the Little Patuxent river near Savage, there was a pin connected steel bridge 101-ft. long with a height of about 18 ft. and a driveway of 13 ft. The bridge was posted on each side 'One Way Bridge,' but, despite this, a 5-ton truck loaded with asphalt tried to pass a runabout on the bridge, with the result that the two sideswiped, and the truck was thrown through the side of the bridge, and knocked out a number of the vertical and diagonal members, after which, of course, the bridge settled down in the river. The automobile hung on one of the abutments, and the truck was not badly damaged, because it went down with the bridge and did not have a long fall. This was on Sept. 21.

### Award of Contract

"The State Roads Commission, in session on the 22nd, authorized the chairman to enter into a contract for the rebuilding of a new reinforced-concrete arch at this point. Plans were prepared and three bids received on the 24th. The contract was awarded to the Luten Bridge Co., at York, Pa., at their bid of $19,000, to be completed within 30 working days. The new bridge has a span of 97 ft. and a rise of 18 ft. and is built of reinforced concrete.

"On Monday, Sept. 26, the construction company began work with a force of men excavating for each abutment and another force erecting forms, so that on Oct. 6, the two abutments were poured, and on Oct. 10, the pouring of the arch rings started, and was completed on the 12th. The first spandrel wall was concreted on the 15th, the second was started on the 17th, back filling was started on the 19th, and on Oct. 22 at noon, traffic was turned over the bridge. On Sunday, Oct. 23, the macadam roadway was laid and the road opened for the entire width of 24 ft.

"When it is considered that the bridge was 97 ft. long and 18 ft. high, the contract price of $19,000 was not excessive even for a bridge built under ordinary conditions of approximately six months time from the award of the contract to its completion. Of course, the supporting forms remained under the arch ring, and the spandrel walls remained braced on the outside. The work of constructing the parapets will continue and perhaps the entire bridge will be completed in two more weeks."

**The Engineers' Club of the Lehigh Valley** met at Drown Hall, Lehigh University, Bethlehem, Pa., Oct. 25, to hear E. J. Mehren, editor of *Engineering News-Record*, speak on "Engineering and Economic Conditions in Europe."

## Railroad Strike Called Off

Following a four-hour joint conference the executive committees of the "Big Five" transportation unions on Oct. 27 adopted a resolution canceling the strike call set for Oct. 30. In accordance with the resolution, a code order was sent out from the headquarters in Cleveland withdrawing the strike order. After the leaders of the conductors, engineers, switchmen, trainmen, and firemen had taken their action, officials of the railroad telegraphers organization announced they would follow suit. These constituted the only unions which had authorized a strike.

The belief on the part of the unions that a strike would be in direct contravention to the wishes of the federal government, as expressed through the United States Railroad Labor Board, was responsible for recalling the strike order. The vote not to strike was unconditional.

## Tie Standardization Conference Held in Washington

Rules covering the standardization of grades and sizes, and the inspection of wood, cross and switch ties are to be drawn up as a result of a tie standardization conference held in Washington, Oct. 25. The conference was called by the American Engineering Standards Committee, at the request of the American Railway Engineering Association. Recommendations made at the conference included one that the United States Forest Service and the American Railway Engineering Association be appointed as sponsors to organize a sectional committee. Producers and consumers are to be represented on the committee which is to be directly responsible for the preparation of the standards. The rules thus standardized will be presented to the American Engineering Standards Committee with the recommandation that they be adopted. Organization of a bureau of inspection will be necessary, but it was decided to leave that step to the producers and consumers.

The conference was presided over by A. A. Stevenson, chairman of the American Engineering Standards Committee. Representatives of ten organizations directly interested in tie standardization attended the conference.

## Road Congress Dues Advanced

From Jan. 1, 1922, the annual fee for individual membership in the Permanent International Association of Road Congresses will be increased from 10 to 20 francs. On July 1, 1921, the sum to be paid in order to become a life member was increased from 125 francs to 200 francs. The fee for corporate membership in the association is 100 francs, the corporation having the right to be represented in the association and at congress by as many delegates as it subscribes multiples of 100 francs. However, libraries, schools, etc., which, without paying the minimum subscription which gives the right to a delegate, desire nevertheless to receive copies of the publications of the association, may obtain them by an annual payment of 50 francs.

According to the report of the treasurer on June 10, 1921, total funds in hand amounted to 515,183 francs.

## To Hold Ohio Conference on Water Filter Plant Operation

The State Department of Health of Ohio has called a conference, to be held in Columbus, Nov. 21-22, at the Southern Hotel, at which it is expected that every water purification plant in the state will be represented. An invitation has been extended to mayors, directors of public service, and superintendents of water-works to attend the conference as guests.

# ENGINEERING SOCIETIES

## Calendar

### Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City. Annual Meetings, New York City, Nov. 8-12.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City. Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

**The New York Sections, Am. Soc. C. E., A. S. M. E., A. I. M. M. E. and A. I. E. E.,** will hold a joint meeting, Nov. 14, in the Engineering Societies' Building, New York City. The subject will be "The St. Lawrence Ship Channel and Power Project," and the speakers will be Governor Henry J. Allen of Kansas, W. L. Harding, former Governor of Iowa, Dr. R. S. MacElwee, director of the School of Foreign Service, Georgetown University, Washington, D. C. and H. I. Harriman of Boston.

**The New England Water Works Association** will have as a feature of the opening monthly meeting at Boston, Nov. 9, a paper on "Steam Boilers," by F. W. Dean. Nominations for the ensuing year include, beside a number of present officials: president, Frank A. Barbour, consulting engineer, Boston; vice-presidents, David A. Heffernan, superintendent water works, Milton, Mass.; Frank E. Winsor, chief engineer, Water Supply Board, Providence, R. I.; Theodore L. Bristol, president, Ansonia Water Co., Ansonia, Conn.; treasurer, Frederic I. Winslow, division engineer, Metropolitan District Commission, Framingham, Mass.

**National Municipal League**—The twenty-seventh annual meeting of the League will be held at Chicago, Nov. 16-18. Some of the sessions will be held jointly with the American Civic Association, the City Managers' Association, and the National Association of Civic Secretaries. The morning of Wednesday, Nov. 16, will be devoted to a discussion of "The Financial Plight of Our Cities—What Shall We Tax?" This session will be opened by the report of the Committee on Sources of Revenue, Luther H. Gulick, chairman, who will take up possible new sources of revenue. Municipal tax limits will also be discussed. After a joint luncheon with the City Managers' Association at the City Club of Chicago Wednesday afternoon, Nov. 16, there will be a discussion of "Is City Manager Government Applicable to Our Largest Cities?" Among those scheduled to discuss this subject are Henry M. Waite, formerly city manager of Dayton, Ohio, and Prof. Chas. E. Merriam, of the University of Chicago. Mr. Waite will deliver his address as president of the National Municipal League after an informal banquet at the City Club, Wednesday evening, Nov. 16. Among the other subjects to come before the convention will be "The High Cost of Housing" and "Zoning," each of which will have a session on the afternoon and evening of Nov. 17. The secretary of the League is H. W. Dodds, 261 Broadway, New York City.

**Society of Terminal Engineers**—On Nov. 15 at the Engineering Societies Building, New York City, there will be presented a paper by Nathan C. Johnson, consulting engineer, New York City, entitled "Subaqueous Concrete." Arrangement has been made for an extensive discussion by engineers interested in the subject.

# PERSONAL NOTES

HENRY S. COWELL, recently with the Champion Fibre Co., Canton, N. C., as designing engineer, has opened an office in Charlotte, N. C. to engage in the practice of structural and consulting engineer.

PROF. THEODORE H. TRAMS has joined the engineering faculty of Valparaiso University. He is a graduate in civil engineering of the University of Illinois, 1907, and for two years after graduation, was a member of the faculty of the Missouri School of Mines. In 1913 he became assistant city engineer of Lewiston, Mont. Lately he has engaged in general engineering practice.

R. A. THOMPSON, has resigned as a member of the engineering board, Interstate Commerce Commission, in charge of the Pacific District, Bureau of Valuation, San Francisco, and has been appointed chief engineer in charge of construction of dams and the irrigation system of the Wichita County Water Improvement District, Wichita Falls, Tex.

H. J. KESNER has been appointed associate professor of civil engineering at Armour Institute of Technology, Chicago, Ill.

V. A. ZEHR, consulting engineer, Pekin, Ill., returned from a business trip to Europe, Oct. 17.

JACOB H. BRILLHART, has resigned as chief and consulting engineer for the Mosher Manufacturing Co., Dallas, Tex. to open an office in Dallas as consulting engineer. He will specialize in the design of steel and reinforced concrete bridges, industrial and power plant layouts, and buildings of all types.

R. H. BENNETT, formerly assistant engineer with the United Fruit Co., on railway construction in Honduras, Central America, has accepted a position as resident engineer with the Illinois Division of Highways.

THE TOPEKA ENGINEERING CORP., Topeka, Kan., has been organized to engage in general engineering practice, with Irvin Pribble as president and general manager, Ralph H. Gaw, vice-president and J. C. Marlett, secretary-treasurer.

PROF. H. S. JACOBY, for 31 years a member of the faculty of the engineering college of Cornell University and for the past 21 years professor and head of the department of bridge engineering, will retire from active duty at the close of the present college year, having reached the age specified for retirement.

J. L. HUGHSON has been appointed vice-president of the Robertson Construction & Engineering Co., Ltd., Niagara Falls, Ont.

E. V. DEVERAL has joined the staff of Barber, Wynne-Roberts & Seymour, consulting engineers, Toronto, Ont.

F. P. SHEARWOOD, who has been in the employ of the Dominion Bridge Co., Ltd., since 1887, has been appointed chief engineer of this company.

CLARENCE McN. STEEVES, recently in government employ, has joined the staff of D. C. Burpee & Son, contractors for the sub-structure of the International bridge across the St. John River between Edmunston, N. B. and Madaeaska, Me.

DR. LIVINGSTON FARRAND, for five years president of the University of Colorado, was inaugurated, Oct. 20, as president of Cornell University, Ithaca, N. Y.

JAMES H. McGRAW, president of the McGraw-Hill Co., Inc., was elected president of the Associated Business Papers, Inc., at the annual convention of the association held in Chicago last week.

G. R. ABNEY of Beaumont, Tex., has been appointed highway engineer of Angelina County, Tex.

JACOB L. CRANE, JR., who has completed a trip through England, France, Belgium, Holland, Germany, Austria, Czechoslovakia, Switzerland and Italy, studying city planning and civic affairs, will return to the United States this month.

## OBITUARY

COL. GEORGE D. SNYDER, since 1902 associated with Jacobs & Davies, consulting engineers, New York, died Oct. 21, in Jersey Shore, Pa. He was born in Williamsport, Pa., in 1866. Col. Snyder commenced his professional education with his uncle, Antes Snyder, engineer of right-of-way, Pennsylvania R.R. He served for several years in the engineering departments of the Pennsylvania R. R. and the Union Pacific R. R. In 1894 he was appointed city engineer of Williamsport, Pa., which position he filled for seven years. During his connection with Jacobs & Davies he served as principal assistant engineer on the construction of the Hudson & Manhattan R.R. system. He took part also in the development of the city subway system for the New York Municipal Ry. and made a special study of the subject of city transportation. He received the "George Stevenson" gold medal of the British Institution of Civil Engineers in 1913 for a paper on "City Passenger Transportation in the United States." He served in all ranks from private to captain in the infantry of the Pennsylvania National Guard. In the war with Spain, he took a commission with the 12th Pennsylvania Volunteer Infantry, and during part of that campaign was assistant chief engineer, Second Army Corps. In 1915 he received a commission in the Corps of Engineers, N. G. N. Y., and in 1916 went to the Mexican border with his regiment, the 22nd Engineers, N. G. N. Y. During the World War, he served with the Twenty-Seventh Division. He returned as major of his regiment and was discharged from U. S. Service in 1919, retaining his rank in the reserve. In 1920, became colonel of the 22nd Engineers. In Oct. 1920, at his own request, he was transferred to the reserve list, N. G. N. Y. He also served, after his discharge from the U. S. Army, as Secretary of the Military Affairs Committee, Engineering Council.

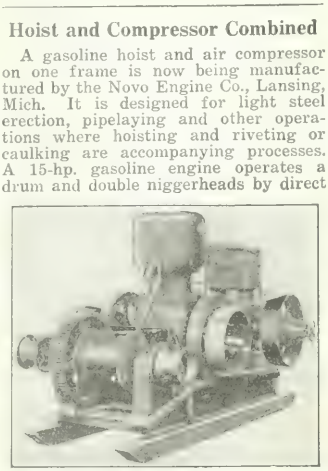
HENRY HARVIE, hydro-electric engineer, was killed Oct. 14 in the plant of the Canadian General Electric Co. at Peterborough, when a large generator burst due to an overspeed test. He was born in England and studied at London University. He came to America in 1900 and in 1901 joined the engineering staff of the Ontario Power Co. at Niagara Falls, Ont., where he spent seven years in the drafting and designing rooms. Thereafter he was employed in designing work by the Algoma Steel Corp., the Ontario Hydro-Electric Power Commission, and the Canadian Ingersoll-Rand Co., at Montreal. Last year he joined the staff of C. H. & P. H. Mitchell, Toronto.

SIR JOHN KENNEDY, consulting engineer of the Montreal Harbor Commissioners since 1907, died Oct. 25, in Montreal, Can. He was born in 1838 in Spencerville, Ont., and was educated at McGill University. From 1872 to 1875 he was chief engineer, Great Western Ry. of Canada. He was chief engineer of the Montreal Harbor Commission from 1875 to 1907 during which time he had charge of the deepening of the St. Lawrence River ship channel between Montreal and Quebec, and the enlargement of the harbor of Montreal. On Mr. Kennedy's advice, the commissioners took over the tracks of the Grand Trunk Ry., which, in 1871, had been permitted to lay a railway track on the wharf in the central part of the harbor and to have exclusive use of it, in order that the harbor should be made both a railway and ocean shipping terminal. The Montreal harbor enlargement work was commenced in 1890 and by the end of Mr. Kennedy's active administration in 1907, the development of the harbor had reached an advanced stage. In 1907, due to defective eyesight, Mr. Kennedy resigned as chief engineer, and was appointed their consulting engineer by the Montreal Harbor Commissioners, in which capacity he served until his death. His Knighthood was conferred in the honors of 1916. He was a member of the American Society of Civil Engineers and of the Institute of Engineers of Great Britain. He was one of the founders of the Canadian Society of Civil Engineers of which he was president in 1892.

## EQUIPMENT AND MATERIALS

### Hoist and Compressor Combined

A gasoline hoist and air compressor on one frame is now being manufactured by the Novo Engine Co., Lansing, Mich. It is designed for light steel erection, pipelaying and other operations where hoisting and riveting or caulking are accompanying processes. A 15-hp. gasoline engine operates a drum and double niggerheads by direct



gears and a 6 x 6-in. single-acting compressor by belt and pulley. The drum holds 700 ft. of ½-in. wire rope and the compressor has a displacement of 60 cu.ft. of air per minute, or enough to operate one riveting hammer. Either hoist or compressor can be operated separately as can the drum and the niggerheads. The compressor has a coolingwater tank, circulating pump, automatic unloader and all the required attachments of a self-contained compressor.

### Out-of-the-Ordinary Trade Publications

The engineer who is interested in the comparative value, as measured in performance, of riveted, cast-iron and hammer-weld pipe may secure it from a recent bulletin issued by the NATIONAL TUBE COMPANY, distributors of the National hammer-weld pipe. The method of manufacturing hammer-weld pipe is described, and pictorial or other descriptions of its various uses are included in the bulletin, as well as certain hydraulic formulas and miscellaneous tables which the water supply engineer may find convenient to clip.

A veritable text book on the properties and utilization in construction of steel sheet piling is provided by the 170-page Bulletin No. 109 just published by the Lackawanna Steel Co. Sizes, properties and shapes of piles are catalogued and described. Of more interest, however, are the discussions of cofferdam design and the many descriptions of actual steel sheet piling installations dating from the period of salvaging the battleship *Maine* to the present time.

Engineers of industrial buildings and architects will find much value in the series of "Chapters" of 20 to 30 pages on the use of structural slate which are being published by the Structural Slate Co., Pen Argyl, Pa. Chapters 6, 7 and 8 on urinal stalls, shower stalls, and tubs and sinks have just been issued.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Reserve Board Finds Residential Building Increasing

In analyzing the building situation, the Federal Reserve Board, in its Nov. 1 report says: "As a whole, building continued to be well sustained during September, but improvement was evident chiefly in residential construction. All districts except No. 1 (Boston) and No. 9 (Minneapolis) showed increases in residential contracts."

District No. 1 (Boston) — Contracts amounted to $15,282,766 as compared with $19,276,295 during August. Of this total approximately $6,548,000 was for residential purposes as compared with $6,703,000 in August.

District No. 2 (New York)—Contracts awarded during September totaled $90,730,134 in comparison with $62,043,905 during August, and residential building totaled $48,789,646 as compared with $36,061,717.

District No. 3 (Philadelphia)—Contracts amounted to $16,197,500 in September and $22,350,500 in August. Residential contracts totalled $5,526,400 in September and $5,331,500 in August.

District No. 4 (Cleveland)—The total amount of contracts awarded was $36,041,601 as compared with $26,665,555 for August. Of these $8,987,610 were for residential purposes as compared with $8,209,645 during August.

District No. 5 (Richmond) — Contracts amounted to $19,597,191 in September, as compared with $17,337,624 in August, while $6,171,436 of the September total represented residential building as compared with $5,938,417 for August.

District No. 7 (Chicago) — Building contracts totaled $41,461,283 during September as compared with $44,680,034 during August.

District 9 (Minneapolis) — Building contracts amounted to $8,162,640 as compared with $9,173,552 during August.

District No. 10 (Kansas City)—Reports from 19 cities show an increase for September over September, 1920, of 71.2 per cent in the number of permits and 106.9 per cent in their valuation.

District No. 11 (Dallas) — In nine cities 2,598 permits valued at $5,680,968 were issued during September as compared with 1,864 permits valued at $3,284,841 issued during September, 1920.

District No. 12 (San Francisco) — "September building returns reached the highest point ever touched." Permits granted in 20 cities of the district number 11,169, with a valuation of $20,134,993 as compared with 9,382, with a valuation of $17,117,294, granted during September, 1920.

## Southern Pine Situation Shows Improvement

Reports from the Southern Pine Association are to the effect that during the month of September the orders received averaged 129 per cent of the actual production and 106 per cent of the normal production. During the same month the shipments were 12 per cent in excess of the actual production and 91 per cent of normal production. The actual production for the month was about 82 per cent of normal production. Stocks on hand totaled 92 per cent of normal production.

For the first nine-months of this year the shipments were 104 per cent of the actual production, while during the corresponding period of 1920 shipments were but 90 per cent of production.

During the week ending Oct. 14 orders received totalled 94,472,000 ft. b. m., or 4 per cent in excess of normal production. The shipments for the same week aggregated 87,000,000 ft. b. m., while actual production amounted to 71,000,000 ft. b.m.

## October Contracts Valued at $104,318,674

### Sums To Be Spent On Road Work And Miscellaneous Building Are 80 Per Cent of Total

Contracts valued at $104,318,674, as reported to *Engineering News-Record*, were let throughout the United States during the month of October. Such contracts cover the construction of water works, sewers, bridges, streets and roads, excavation and dredging, industrial buildings, miscellaneous buildings, (banks, office buildings, churches, schools, theaters etc.), federal government work and miscellaneous installations. No account is taken of housing construction except that for industrial purposes, nor for residential buildings.

Of the nine classifications into which the contracts are divided, the value of contracts let for two classes of construction—street and road work and miscellaneous building—is 80 per cent of the total for the month. Contracts for public work construction and for federal government reported rather a low valuation though industrial work is quickening. Particularly is it noticeable in the number of larger industrial plants which are being constructed as compared with six months ago. The falling off in industrial work may be attributed, partially at least, to the uncertainty as to federal appropriations.

The most remarkable fact to be noted in an analysis of the contracts let for October is that the total value of miscellaneous building put under contract approximated $63,000,000. That is the largest figure recorded for miscellaneous building construction since May, 1920. For the first ten months of 1921 the total amount of money involved in the construction of bank and office buildings, lofts, churches, theatres, schools, etc., amounts to $482,000,000.

More than a quarter of a million

### Engineering News-Record Construction Cost Index Number

| | |
|---|---|
| **November 1921** | **166.32** |
| October 1921 | 182.57 |
| November 1920 | 255.32 |
| Peak, June, 1920 | 273.80 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Cost Index Number is 16.25 points (9 per cent) lower than last month owing to the low price of steel and numerous decreases in labor. Structural shapes in large quantities can be bought for $1.50 per 100 lb. The average labor rate for the country this month is 45c., as against 50c. last month. Lumber and cement bases remain unchanged. Thus, general construction cost is 35 per cent cheaper than one year ago and 39 per cent under the peak; it is only 66 per cent above the 1913 level.**

### Engineering News-Record Construction Volume Index Number

| | |
|---|---|
| Monthly | |
| **October 1921** | **109.00** |
| September 1921 | 114.00 |
| October 1920 | 73.00 |
| 1913 | 100.00 |
| Yearly | |
| 1921 (10 months) | 85.00 |
| 1920 (10 months) | 98.00 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Volume Index Number is 109 for the month of October, and 85 for the whole of 1921 to date, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let this year) is 15 per cent under the volume in the first 10 months of 1913. Our monthly volume number, 109 for October, 1921, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.**

dollars are involved in contracts let for street and road work since the first of the year. The exact amount is in the neighborhood of $278,000,000 and is far in excess of the amount authorized for expenditure during 1920.

CONTRACTS AWARDED IN OCTOBER 1920 AND 1921

| Class | 1920 | 1921 |
|---|---|---|
| Waterworks | $11,168,865 | [illegible] |
| Sewers | 8,051,674 | [illegible] |
| Bridges | 1,573,114 | [illegible] |
| Streets, roads | 12,894,173 | [illegible] |
| Excavation, dredging | 1,086,065 | 372,871 |
| Industrial | 28,044,893 | 9,441,074 |
| Buildings | 26,385,881 | 62,927,041 |
| Fed. Government | 7,487,375 | [illegible] |
| Miscellaneous | 10,749,260 | 6,263,410 |
| Total | 107,441,302 | 104,318,674 |

The total value of contracts let for the past month is within 3 per cent of the total money value of contracts let during the corresponding month of 1920. However, taking into consideration the fact that there has been a decline, within the year, in the cost of construction of between 25 and 30 per cent, the actual money value of October 1921 contracts is from 22 to 27 per cent in excess of the value of contracts let during October 1920. Were the figures of the past month reduced to a basis of construction costs obtaining in October 1920, the October 1921 contracts would amount to about $132,000,000.

### *How's Your Business?*

The Ransome Concrete Machinery Co., Dunellen, N. J., has decided to put an addition to its present plant which will increase manufacturing space 54 per cent. Ground for the building was broken Oct. 6 A. P. Robinson, sales manager, speaking for the Ransome Concrete Machinery Co., recently said:

"We have great faith in the future and our experience in the past year, despite inactivity of industrial building, causes us to feel that at least a 50 per cent increase in factory space is necessary to take care properly of the business that is being offered and which will come with the spring."

### Suit in Equity Filed Against 24 Cement Firms

A suit is equity to enjoin the Midwest Cement Credit and Statistical Bureau from "keeping up an unlawful combination and conspiracy in restraint of interstate trade and commerce in cement" has been filed in the federal court in Chicago. Twenty-four firms are named as defendants. The defendants operate thirty mills in Pennsylvania, Ohio, Michigan, Indiana, Illinois, Iowa, Missouri and Kentucky.

# Labor Rates and Conditions Throughout the Country

Reductions in labor rates are reported in eleven out of the twenty cities listed. Chicago, Dallas, Denver and Seattle report reductions in common labor only. Carpenters in Boston are receiving 75c. as against 90c. and common labor 40c.—as compared with 55c. per hr. formerly.

The wage scale shown for Cincinnati is effective on and after Nov. 8. Although common labor is quoted at 37½c., a minimum of 27c. per hr. is paid for common laborers on street work.

The Landis decision placed common labor at 72½c. in Chicago, but men are obtainable at 35@40c. per hour.

Denver and Dallas both quote common labor at 35c. as an average rate, with 40c. as a maximum in Denver and 45c. per hr. the maximum in Dallas.

The Associated Building Contractors of Detroit report no change in the regular scale, but individual contractors are hiring men on miscellaneous jobs for less than the regular rates. Hoisting engineers in Kansas City are receiving $1 as against $1.07½ per hour.

Los Angeles reports conditions good and very few men idle in all classes of construction work, excepting pile drivers and unskilled laborers. There is not much call for pile drivers and the rate now paid is 87½c. per hr. Not less than 30,000 men, mostly unskilled, are unemployed in Los Angeles, many having drifted in from the colder parts of the country.

The established wage scale in Minneapolis as agreed to by the unions and the employers is being cut considerably, the amounts varying on different jobs, especially as affecting carpenters, hod carriers and common laborers.

Montreal reports further adjustments in wage rates. Bricklayers are now receiving 80c. as against 85c.; hod carriers, 30@35c. as compared with 35@40c..; structural iron workers, 55c. instead of 60c. per hr. Common labor is procurable at 25@30c. per hour.

Common labor is quoted in St. Louis at 62½c., as against 67½c. formerly, and in Seattle at 50c., as against 50@60c.

San Francisco reports a reduction to $1.03 from $1.12½ per hr. for carpenters, hoisting engineers and pile drivers. Bricklayers receive $1.16, as against $1.25; hod carriers, 92c., as against $1; and common labor, 75c., as compared with 81¼c. per hour. We print the union scale for San Francisco, but unskilled, non-union labor is actually receiving 50@55c.

Labor plentiful, all c[illegible] Higher rates indicated by +, decreases by—

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | $0.80 | $0.70 | $1.00 | $0.30 | ..... | $1.00 | $0.20 |
| Baltimore | 1.25 | .80 | .87½ | .31 | $0.74 | 1.00 | .30 |
| Birmingham | 1.00 | .75 | [illegible] | .25 | [illegible] | 1.00 | 15@.25 |
| Boston | .90 | —.75 | .90 | .60 | .90 | .90 | —.40 |
| Cincinnati | —1.12½ | —.87½ | .87½ | —.72½ | —.77½ | —.77½ | —.37½ |
| Chicago | 1.10 | 1.00 | 1.10 | [illegible] | [illegible] | 1.05 | —.35@.40 |
| Cleveland | 1.04 | 1.04 | 1.04 | .60 | .91 | 1.04 | [illegible] |
| Dallas | 1.00 | 1.00 | 1.00 | .60 | 1.00 | 1.00 | —.35@.45 |
| Denver | 1.87½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | —.35@.40 |
| Detroit | 1.00 | .80 | .80@.90 | .50@.60 | 1.00 | .60@.80 | .50 |
| Kansas City | 1.00 | 1.00 | —1.00 | .80 | 1.07½ | 1.07½ | .70 |
| Los Angeles | 1.25 | 1.00 | 1.00 | 1.12½ | —.87½ | 1.00 | — 50 |
| Minneapolis | 1.00 | .80 | .80 | .65 | ..... | .80 | .50 |
| Montreal | —.80 | .60 | .50 | —.30@.35 | .50 | —.55 | —.25@.30 |
| New Orleans | 1.00 | .88 | .90 | .40 | .80 | 1.00 | .30 |
| New York | 1.25 | 1.12½ | 1.25 | .87½ | 1.00 | 1.12½ | .75 |
| Pittsburgh | 1.12½ | 1.00 | 1.00 | .80 | ..... | 1.00 | Open |
| St. Louis | 1.25 | 1.25 | 1.37½ | .87½ | 1.25 | 1.25 | —.62½ |
| San Francisco | 1.16 | —1.03 | —1.03 | —.92½ | —1.03 | 1.16 | —.50@.55 |
| Seattle | 1.00 | .80 | .90 | .70 | 1.00 | .80@.90 | —.50 |

## Increased Demand for Brick Tends to Equalize Prices

During September the upward tendency in the construction industry which had been reflected in previous reports has had its effect upon the price of brick according to the recent digest issued by the Common Brick Manufacturers Association of America. Predictions appearing in the digest several months ago that a stiffening of demand would show itself in equalization of prices has been realized inasmuch as the variation between the highest price and the lowest price quoted by manufacturers to the association is much less than it was a month ago. In some sections where open competition had driven the price below the cost of manufacture there are found advances in the price due to the better demand. In other sections where the price is based upon fractional production there is a lowering of the quotation due to a larger production of the plants. Altogether the digest finds that "price quotations in this issue are on a much more business-like and wholesome basis."

The railroad freight situation is found to be still the principal factor in keeping up the cost of manufacture, inasmuch as producers have to pay a large transportation cost on coal which is passed on to the consumer. In addition, the consumer pays for the high rate of delivery.

According to the digest if the general pick-up in industrial conditions continues brick men will find themselves pressed to take care of the demand when the spring season opens. The chance that fuel may become less costly, and that other elements of manufacture will be reduced, have tended to keep manufacturers who otherwise might operate during the winter from piling up stocks against the spring demand.

### Trend of Business

**Stock Market**—Principal activity in oil stocks, as was the case the previous week. As oils are speculative, the real trend may be determined only by examining the investment groups, such as industrials and railroads. The chief feature is the professional character of the market.

**Bond Market** — Continued heavy demand for state and municipal issues, last week's total nearing $30,000,000, with purchases plentiful, despite rising prices. United States Government bonds closed the week strong, in sympathy with the high price commanded by municipals, with Liberty bonds from one-half to one point higher than at the close of the previous week. Railroad bonds strong, due largely to the good September showing of several railroads. Interest in public utilities seems to be increasing, as indicated by the quick sale of the Philadelphia Company's 6s. Interest in foreign government issues centers on the impending loan to China by the Consortium, which may reach $20,000,000.

**Money market**—Call money was 5 to 6 per cent throughout the week. Time money same as last three weeks, at 5½ per cent. Money easier throughout the country, and Government recognition of this is shown by the lowing of the interest rate on the Treasury's offering of six months' certificates at 4½ per cent, as against 5¼ per cent at the end of the summer.

**Foreign Exchange**—Erratic, with only small changes. Sterling firm. Little change in the market; no rise expected while note circulation increases.

About 75 per cent of the manufacturers report an outlook of "fair to good." This optimism is about equally distributed among the ten districts into which the membership of the association is divided for the purpose of the report. Every section seems to have felt something of the business revival, says the report.

On Oct. 1 the number of burnt brick on hand reported by 104 manufacturers was 205,602,000 and the orders on the books amounted to 137,644,000 brick.

## Railroad Rates and Wages

According to a recent bulletin issued by the Association of Railway Executives, New York City, since 1915 there have been four general increases in freight rates which average as follows: 3.7 per cent on June 27, 1917; 2 per cent on March 15, 1918; 22 per cent on June 25, 1918; and 34 per cent on Sept. 1, 1920. This makes a total of 78 per cent. The average annual compensation of all classes of railroad employees has been increased as follows, says the bulletin: 1916, 7 per cent over 1915; 1917, 13 per cent over 1916; 1918, 41 per cent over 1917; 1919, 5 per cent over 1918; and 1920, 22 per cent over 1919. The bulletin contains this statement:

While freight rates increased the percentage stated (78 per cent) and wages were increased 119 per cent, the freight rate increase percentage is a theoretical one, while the wage increase percentage is actual. Between 1915 and 1920 the average annual compensation per employee increased from $830 to $1,820. On the other hand, with rates theortically 78 per cent higher in 1920 than in 1915, the average receipts of the railroads per ton-mile increased only from 0.722c. in 1915 to 1.052c. in 1920 or only 46 per cent.

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Iron and Steel.**—Structural shapes, plates and bars are quoted at the Pittsburgh mills at $1.50@$1.65 per 100 lb. Mill shipments, New York, of shapes and plates are $1.88@$2.03; bars at $1.80@$1.88 per 100 lb. Minneapolis quotes mill shipments of steel shapes at $2.51 via all rail; $2.45 per 100 lb. by lake and rail. Demand for structural material is small, due to the tendency of the buyer to anticipate a reduction in freight rates. Weaker mill prices have not as yet been reflected in the warehouse quotations. Pig-iron prices remain firm with small demand.

**Railway Supplies**—Heavy open-hearth steel rails have dropped $4.65 per ton; light rails 15c. per 100 lb. at Birmingham mills. Steel rails quoted in Canada at $53 per gross ton at the mill. Pittsburgh reports decrease of 70c. on standard spikes and 75c. per 100 lb. on track bolts.

**Rivets and Nails**—Drop of 25c. per 100 lb. on structural rivets and 15c. per keg on wire nails at Pittsburgh mill. Decrease of 10c. per keg on wire nails at San Francisco warehouses.

**Pipe**—Wrought-iron pipe discounts on the Pittsburgh basing card of Sept. 16 show an even increase of 5 per cent on all sizes. Cast-iron pipe advanced $2 in New York and Birmingham and $1 per net ton in Chicago. Sharp rises in sewer pipe prices again reported in St. Louis.

**Road and Paving Materials**—Cincinnati quotes rise of $1.61 in asphalt in packages, and $2.31 per ton in bulk. Montreal quotes drop of $5 per M. in granite paving block. Wood paving block has dropped 10c.@15c. in New Orleans and has risen 25c. per sq.yd. in Cincinnati.

**Sand, Gravel and Crushed Stone**—Gravel down 5c.@50c. in Chicago, St. Louis, Minneapolis, Cincinnati, San Francisco, Dallas and Atlanta; up 50c. per cu.yd. in Denver and 25c. per ton in Montreal. Sand down 10c.@50c. in Chicago, Minneapolis, Birmingham, Dallas and Denver. Crushed stone down 10c.@30c. per cu.yd. in Chicago, Cincinnati, San Francisco and St. Louis; slight advances in Kansas City and Dallas.

**Lime and Cement**—Hydrated finishing lime down $3.40 in San Francisco and $5 per ton in Montreal. Seattle quotes drop of 25c. in lump finishing lime and 50c. per bbl. in common lump lime. Average decline of 27c. per bbl. in cement prices in eight principal cities. Minneapolis quotes cement at $2.26 f.o.b.; $2.45 per bbl. delivered.

**Brick and Hollow Tile**—Common brick down 50c. in Cincinnati and up $1 per 1,000 in Atlanta. New York quotes brick at $15 wholesale as against $15@$15.50 per 1,000. Slight declines in hollow tile in Kansas City, Montreal.

**Lumber**—Long leaf yellow pine up $1@$4 in Cincinnati and Atlanta and down $1@$9 per M ft. in Minneapolis, Birmingham and Kansas City. Douglas fir up $1@$8 in Denver, Los Angeles and Seattle and down $1@$5 per M. ft. in Minneapolis and Kansas City. Hemlock has advanced $4 in Los Angeles and declined $1 per M. ft. in Minneapolis.

**Manila Rope**—Advance of 1c. reported in Los Angeles, 1¼c. in Kansas City and 2c. per lb. in Cincinnati and St. Louis.

**Explosives**—Advance of 2c. on 40% and 60% gelatin dynamite in Kansas City and Los Angeles; decrease of 2c.@2¾c. per lb. in Birmingham and St. Louis.

Price advances since last month are indicated by **heavy type**; declines by *italics*

**PIG IRON**—Per Gross Ton—Quotations compiled by The Matthew Addy Co:

| | Current | One Year Ago |
|---|---|---|
| **CINCINNATI** | | |
| No 2 Southern (silicon 2.25 @ 2.75) | $24 50† | $45 60 |
| Northern Basic | 22 [illegible]† | 51 30 |
| Southern Ohio No 2 (silicon 1.75 @ 2.25) | 23 [illegible]† | 48 50 |
| **NEW YORK, tidewater delivery** | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | 30 26† | 52 10 |
| **BIRMINGHAM** | | |
| No 2 Foundry (silicon 2.25 @ 2.75) | 20.00† | 42.00@45 00 |
| **PHILADELPHIA** | | |
| Eastern Pa., No. 2X, (2.25@2.75 sil.) | 22 76† | 51 25* |
| Virginia No. 2 (silicon 2.25 @ 2.75) | 28 74† | 50 00† |
| Basic | 20 75† | 51 00* |
| Grey Forge | 21 75† | 49 00 |
| **CHICAGO** | | |
| No 2 Foundry Local (silicon 1.75 @ 2.25) | 22 70† | 46 00 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | 26 66† | 50.00 |
| **PITTSBURGH, including freight charge from the Valley** | | |
| No 2 Foundry Valley (silicon 1.75 @ 2.25) | 22 96† | 49 56 |
| Basic | 21 96† | 48 96 |
| Bessemer | 21 96† | 51 96 |

*F.o.b. furnace † Delivered

## RAILWAY SUPPLIES

**STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

| | Pittsburgh | | Birmingham | Chicago |
|---|---|---|---|---|
| | Current | One Year Ago | | |
| **Standard bessemer rails** | $45 00 | $55 00 | | $[illegible] |
| **Standard openhearth rails** | 47 00 | 57 00 | $40 00 | 40 00 |
| **Light rails, 8 to 10 lb** | 1 65@1 75* | 2 88@4 00* | 1 60* | 1.65@1.80* |
| **Light rails, 12 to 14 lb** | 1 65@1 75* | 2 88@3 84* | 1.60* | 1.65@1.80* |
| **Light rails, 25 to 45 lb** | 1 65@1 75* | 2 75@3 75* | 1.60* | 1.65@1.80* |

*Per 100 lb

**RAILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8 Ft. | 7 In. x 9 In. by 8 Ft. 6 In. |
|---|---|---|
| Chicago, White Oak | $1 35 | $1 50 |
| Chicago, Hardwood and Red Oak | 1 20 | 1 30 |
| Chicago, Empty Cell Creosoting (add'l) | 45 | [illegible] |
| San Francisco, Green Douglas Fir | [illegible] | [illegible] |
| San Francisco, Empty Cell Creosoted Douglas Fir | [illegible] | [illegible] |

For ties on standard "railroad administration" specifications f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pressed Sap Cypress |
|---|---|---|---|
| Grade 3 | $1 15 | $1 05 | $0 75 |
| Grade 2 | 1 05 | 95 | 85 |
| Grade 1 | 95 | 80 | 75 |

**TRACK SUPPLIES**—The following prices are f.o.b. per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh | | Chicago | St. Louis | Birmingham |
|---|---|---|---|---|---|
| | Current | One Year Ago | | | |
| Standard spikes, 5-in. and larger | $[illegible] | $4 00 | $[illegible] | $[illegible] | 4 00 |
| Track bolt | [illegible] | [illegible] | [illegible] | [illegible] | 4 15 |
| Standard section angle bar | 2 75 | 3 00@4 00 | [illegible] | [illegible] | 3 25 |

BUTT WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 1 to 1½ | 68½ | 55 | 1 to 1½ | 44½ | 30½ |
| 2 to 3 | 67½ | 56 | | | |

LAP WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 2 | 59½ | 48 | 2 | 40½ | 27½ |
| 2½ to 4 | 63½ | 52 | 2½ to 4 | 43½ | 29½ |
| 4½ to 6 | 62½ | 51 | 4½ to 6 | 42½ | 28½ |
| 7 to 8 | 58½ | 45 | 7 to 8 | 37½ | 22½ |
| 9 to 12 | 52½ | 39 | 9 to 12 | 30½ | 18½ |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | 60% | 60% | 56½% |
| 3½ to 6 in. lap welded | 51% | 57½% | 53½% |

| | Galvanized | | |
|---|---|---|---|
| | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | 46% | 46% | 42½% |
| 3½ to 6 in. lap welded | 37% | 43% | 39½% |

Malleable fittings, Class B and C, from New York stock sell at list less 5%. Cast iron, standard sizes, 32½% off.

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York | | | | | | San Francisco |
|---|---|---|---|---|---|---|---|
| | Current | One Year Ago | Birmingham | Chicago | St. Louis | | |
| 4 in. | $52 30@53 30 | $87 22 | $40 00 | $48 10@50 10 | $46 20 | $53 00 | |
| 6 in. and over | 47 30@48 30 | 77 22 | 36@38 | 45 10@47 10 | 43 20 | 50.00 | |

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin. ft.:

| Size, In. | New York Current | New York One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 3 | $40 00 | $62 00 | $35 00 | $50 00 | | $55 00 |
| 4 | 50 00 | 77 00 | 85 00 | 60 00 | $90 00 | 65 00 |
| 5 | 80 00 | 110 00 | 140 00 | 80.00 | 115 00 | 84 00 |
| 6 | 105 00 | 140 00 | 140 00 | 100 00 | 150 00 | 110 00 |
| 8 | 175 00 | 228 00 | 200 00 | 150 00 | 250 00 | 181 00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots:

| Size, In. | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | $0 14 | 087 | | 1175 | 30 12 | $0 12 | |
| 4 | 14 | 087 | $0 09 | **1575** | 12 | .15 | $0 18 |
| 5 | .21 | .1305 | | 1645 | 18 | .18 | .165 |
| 6 | .21 | .1305 | 135 | **225** | 18 | .21 | .25 |
| 8 | .35 | .203 | 225 | **315** | 28 | .30 | .33 |
| 10 | .52 | .3045 | | 329 | 42 | 45 | |
| 12 | .67 | .3915 | .3825 | **441** | 54 | .54 | 80 |
| 15 | 1 15 | .522 | .5625 | 73 | 90 | .90 | .. |
| 18 | 1 55 | .725 | .765 | 1 029 | 1 20 | 1 20 | |
| 20 | 1 98 | .87 | 1 125 | 1 372 | 1 50 | | |
| 22 | 2 64 | 1 16 | | 1 60 | | | |
| 24 | 2 97 | 1 305 | 1 4625 | **1 95** | 1 80 | 2 10 | 2 40 |
| 27 | 4 50 | 1 885 | | 2 75 | 3 75 | 3 00 | |
| 30 | 5 00 | 2 088 | | 3 40 | 4 75 | 3 60 | |
| 33 | 6 55 | 2 61 | | 4 05 | 5 50 | | |
| 36 | 7 50 | 2 9725 | | **4 70** | 6 00 | | |

| | 3 | 5 | 8 | 12 | 24 | 36 |
|---|---|---|---|---|---|---|
| Bo-ton | $0 [illegible] | $0 [illegible] | $[illegible] | $0 [illegible] | $1 [illegible] | $4 92 |
| Minneapolis | | | 40 | 77 | 2 55 | 5 66 |
| Denver | | 15 | 80 | 50 | 1 95 | |
| Seattle | 145 | | 36 | 72 | 2 59 | |
| Los Angeles | 115 | 165 | 275 | **495** | 1 65 | |
| New Orleans | | 108 | 27 | 459 | 1 755 | |
| Cincinnati | [illegible] | [illegible] | | 45 | 1 50 | [illegible] |
| Atlanta | 098 | 147 | 243 | 4165 | 1 5925 | |
| Montreal, *delivered* | 80 | 45 | 85 | 1 35 | 4 50 | 6 50 |
| Detroit | 105 | 1575 | 243 | 4725 | 2 115 | 5 4500 |
| Buffalo | [illegible] | [illegible] | [illegible] | 6885 | [illegible] | [illegible] |
| Kansas City, Mo | 15 | 21 | 189 | 60 | 2 41 | 4 74 |

*4-in., 6-in., 9-in. [illegible]

## PIPE

**WROUGHT PIPE**—The following discount sheets, subject to carload or other Pittsburgh basing card of Sept. 16, 1921:

BUTT WELD

| Inches | Steel Black | Steel Galv. | Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| 1 to 3 | 68½ | 56 | ¼ to 1½ | 44½ | 30½ |

LAP WELD

| | | | | | |
|---|---|---|---|---|---|
| 2 | 61½ | 49 | 2 | 39½ | 25½ |
| 2½ to 4 | 65½ | 53 | 2½ to 4 | 42½ | 28½ |
| 7 to 8 | 62½ | 49 | 7 to 12 | 40½ | 25½ |
| 9 to 12 | 59½ | 49 | | | |

## ROAD AND PAVING MATERIALS

**ROAD OILS**—The following are prices per gallon in tank cars, 8,000 gal. minimum, f.o.b. point named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45% asphalt (at terminal) | $0 05 | $0 13 |
| New York, 65% asphalt (at terminal) | 05 | 12 |
| New York, binder (at terminal) | 08 | 13 |
| New York, flux (at terminal) | 06 | 13 |
| New York, liquid asphalt (at terminal) | 06 | [illegible] |
| St. Louis, 50-60% asphalt (*f.o.b.*) *Tulsa, Okla.* | 03* | 12 |
| Chicago, 40-50% asphalt | 05 | .08½ |
| Chicago, 70-75% asphalt | .05½ | .08½ |
| Dallas, 40-50% asphalt | 10 | 10 |
| Dallas, 60-70% asphalt | 13 | 13 |
| Dallas, 75-90% asphalt | 15 | 15 |
| San Francisco, binder, per ton | 15 00 | 13 00 |

*Tank cars $21.75 per ton to Whiting, Ind.
†F.o.b. refinery, Gulf. Freight to San Francisco, 80c. per ton.

**ASPHALT**—Prices per ton in packages, 350-lb. barrels, 425-lb. barrels and in bulk in carload lots:

| | Package | Bulk |
|---|---|---|
| New York (Bayonne, N. J.) | $26 00 | $17 00 |
| Boston | [illegible] | [illegible] |
| Chicago | 25 85 | 19 50 |
| San Francisco. *f.o.b. refinery.* Oleum, Cal. | 21 50* | 15 00* |
| Dallas | 35 00 | 27 00 |
| Seattle | [illegible] | [illegible] |
| Denver | 45 00 | 65 00 |
| Minneapolis | [illegible] | 20 50 |
| St. Louis | 28 00 | 22 00 |
| Baltimore | 28 00 | [illegible] |
| Los Angeles | [illegible] | 15 00 |
| Montreal | [illegible] | [illegible] |
| Atlanta | [illegible] | [illegible] |
| Detroit (petroleum asphalt) | 24 50 | 20 00 |
| Cincinnati | 26 10 | 21.80 |
| Woodbridge, N. J. asphalt cement | [illegible] | [illegible] |
| Maurer, N. J. asphalt cement | 29 36 | 25 31 |

*Freight to San Francisco, 80c per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

**PAVING STONE**—

| | | |
|---|---|---|
| New York | 5-in. granite [illegible] | $[illegible] M |
| Chicago | About 4x8x4 dressed | 3 35 sq.yd. |
| | About 4x8x4 [illegible] | 3 00 sq.yd. |
| San Francisco | Basalt block 4x7x8 | 65.00 per M |
| Boston | 5-in. granite | 125.00 per M |
| Atlanta | Granite | 2.00 sq.yd. |
| Detroit | Granite, 2½ blocks per sq.yd. | 107.00 per M |
| Baltimore | Granite | 2.15 sq.yd. |
| Montreal | Granite | [illegible] per M |
| New Orleans | Granite, 4 x 8 x 4 | 3.25 sq.yd. |
| Cincinnati | Granite | 4.30 sq.yd. |
| St. Louis | 4x8x4 dressed | 3.25 sq.yd. |
| | 4x8x4 [illegible] | 3 00 sq.yd. |
| Kansas City | No. 1 Granite | [illegible] sq.yd. |

**FLAGGING**—

| | | | |
|---|---|---|---|
| New York | Bronx | $0 25 | sq.ft. |
| | Manhattan, 4 ft. | .26 | sq.ft. |
| | Queens, 5 ft. | .26 | sq.ft. |
| | 6x20-in. cross-walk | 1.00 | lin.ft. |
| Chicago | 18 in. wide | .99 | lin.ft. |

**CURBING**—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in.; 88c. for 5x18 in.; in cargo lots.

**WOOD BLOCK PAVING**—

| | Size of Block | Treatment | Per S. Yd. |
|---|---|---|---|
| New York | 3 | 16 | $2 09 |
| New York | 3 | 16 | 2 17 |
| New York | 4 | 16 | 2 37 |
| Boston | 3 | 16 | 2 17 |
| Chicago | 4 | 16 | 3 00‡ 3 25 |
| Chicago | 3 | 16 | 2 50‡ 2 75 |
| St. Louis | 3 | 16 | 3 25 |
| St. Louis | 4 | 16 | 3 75 |
| Seattle | 4 | 16 | Off market |
| Minneapolis | 3 | 16 | 2 13 |
| Atlanta | 3 | 16 | 2 30 |
| New Orleans | 3 | 16 | 2 00 |
| New Orleans | 3 | 16 | |
| New Orleans | 4 | 16 | |
| Dallas | 4 | 18 | 3 90 |
| Baltimore | 3 | 16 | [illegible] |
| Montreal, *delivered* | 4 | 16 | 4 50 |
| Detroit | 3 | 16 | 2 84 |
| Detroit | 4 | 16 | 3 00 |
| Cincinnati | 4 | 16 | 2 60 |
| Kansas City | 4 | 16 | [illegible] |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots is as follows, per cu.yd.:

| | Gravel — 1½ In. | | Gravel — ¾ In. | | Sand | |
|---|---|---|---|---|---|---|
| | Current | One Year Ago | Current | One Year Ago | Current | One Year Ago |
| New York | $2 00 | $3 00 | $2 00 | $3 00 | $1 25 | $1 50 |
| Detroit | 2 50 | 2 00 | 2 50 | 1 80 | [illegible] | 1 60 |
| Chicago | [illegible] | 2 75 | [illegible] | 2 75 | [illegible] | 2 75 |
| St. Louis | [illegible] | 1 65 | [illegible] | 1 70 | [illegible] | 1 70 |
| Seattle | 1 50 | 1.25 | 1 50 | 1.25 | 1.50 | 1.25 |
| Dallas (f.o.b.) | [illegible] | 2 50 | [illegible] | 2 50 | [illegible] | 2 50 |
| Minneapolis | [illegible] | 2 00 | 1 50 | [illegible] | [illegible] | 1 25 |
| Cincinnati | [illegible] | [illegible] | [illegible] | 1 50 | [illegible] | 1 45 |
| San Francisco | 2 15 | 1 50 | [illegible] | 1 50 | 1 50 | 1 50 |
| Boston, per ton | 2 65 | 3.50 | 2.65 | 3.00 | 2.00 | 2.75 |
| New Orleans | 2 85 | 3.60 | .... | .... | 1.35 | 1.85 |
| Los Angeles | [illegible] | 1 25 | [illegible] | 1 25 | 1 20‡ | 1 15 |
| Atlanta, per ton | [illegible] | 3 12 | [illegible] | [illegible] | 1 35 | 1 62 |
| Detroit | 2 00 | 1 80 | 2 00 | 1 80 | 2 00 | 1 70 |
| Baltimore, per ton | 1 40 | 1 40‡ | 1 60 | 1.60‡ | 2 40 | .70 |
| Montreal, per ton | [illegible] | 1 50 | 1 50 | [illegible] | 1 25 | 1 25‡ |
| Buffington, Ind., per ton | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.25‡ |

* Fine white sand: Pacific, $4 per ton; Ottawa, $4 50.
† Lump sand for Los Angeles, 75c. per cu.yd., and is included in above price.
‡ Per cu. yd.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1 80 | $1 90 | $2 00 | $1 90 | $2 15 | |
| Chicago | [illegible] | 2 75 | [illegible] | 2 75 | | |
| St. Louis *delivered* | [illegible] | 2 00 | [illegible] | 2.00 | | |
| Dallas, *delivered* | 3 20 | 2 50 | 3 20 | 2.50 | | |
| San Francisco | 2 25 | 1 50 | [illegible] | 1 50 | | |
| Boston, Mass. | 3 00* | 3 00* del. | 3 00* | 3 00* del. | | |
| Minneapolis, *at plant* | 2 00 | 2.25 | 2 25 | 2.50 | | |
| Kansas City | 2 75 | 2 35 | 2 75 | 2 35 | | |
| Denver | 3.50 | .... | 3.50 | .... | | |
| Seattle *delivered* | 3 00 | 3 50 del. | [illegible] | 3 50 del. | | |
| Atlanta | 2 25* | 3 25 | 2 25* | 3.50 | | |
| Cincinnati *delivered* | 2.37½ | .... | 2.08 | 1.65 | | |
| Los Angeles | 1 60* | 1 60* | 1 70* | 1 70* | | |
| Detroit | 1 90* | 2.00 | 1.90* | 2.00* | | |
| Baltimore | 1.75* | 1.80* | 1.65* | 2.20* | | |
| Montreal | 2 00* | 2.30* | 2.10* | 2.55* | | |
| Birmingham *delivered* | 3 20 | | 3 10 | | | |

*Per ton.

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants:

| | 1½-In. | ¾-In. | Roofing | Sand |
|---|---|---|---|---|
| Lebanon or Bethlehem, Pa | $1 00 | $1 00 | $2 50 | $0 90 |
| Easton or Catasauqua, Pa | 1 00 | 1 00 | 2 00 | 90 |
| Buffalo, N. Y. and Erie, Pa | 1 25 | 1 25 | 2 25 | 1 25 |
| Emporium, Pa | 1 25 | 1 25 | | 1 25 |
| East Canaan, Conn | 1 25 | 1 35 | 4 00 | 1 10 |
| Birmingham, Ala | [illegible] | 95 | 2 05 | 80 |
| Toledo, Ohio | 1 50 | 1 50 | 2 35 | |
| Atlanta, Ga | | 2 10 | | |
| Eastern Pennsylvania and New Jersey | 1 20 | 1 20 | 2 50 | 90 |
| Western Pennsylvania and New Jersey | 1 25 | 1 25 | 2 50 | 1 25 |

Birmingham, f.o.b. siding, $1 12 (or $1 45 per cu. yd. on site)

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per 180-Lb. Barrel (net) Finishing | Lump, per 180-Lb. Barrel (net) Common |
|---|---|---|---|---|
| New York | $16 99 | | | $3 69* |
| Chicago | [illegible] | | | 1 40 |
| St. Louis | 0 58 | $0 50 | $2 25 | 0 70† |
| Boston | 23 00 | 20 00 | [illegible] | 3 10 |
| Dallas | 25 00 | | | 2 75 |
| Cincinnati | 0 49 | 0 45 | | |
| San Francisco | [illegible] | [illegible] | | 1 90 |
| Minneapolis | 29 00 | 22 00 (white) | 1 80 | 1 40 |
| Denver | 30 00 | | 95† | 2 95 |
| Detroit | 15 25 | 13 25 | 11 50‡ | 10 50‡ |
| Seattle | 27 50 | | [illegible] | [illegible] |
| Los Angeles | | 30 00 | 3 00 | 3 00* |
| Baltimore | 15 00 | 13 00 | | 12 00‡ |
| Montreal | [illegible] | 21 00 | 15 00‡ | 15 00‡ |
| Atlanta | 19 00 | 16 00 | 2 00 | 1 60 |
| New Orleans | | 17 25 | | 1 75 |

* 280-lb barrels (net). † Per bushel. ‡ Per ton.
Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1 60
Cincinnati and St. Louis quotes hydrated lime per 50-lb. sack.
NOTE—Refund of 10c. per barrel.

**NATURAL CEMENT**—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

| | Current | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2 80 | $3 00 |
| Kansas City (Ft. Scott) | 1 60 | 1 60 |
| New Orleans | 3 16 | 3 36 |
| Atlanta (Magnolia) | 11 00 ton | 1.90 |
| Cincinnati (Utica) | 1 [illegible] | 2 85 |
| Boston (Rosendale) | [illegible] | 2.35 |

**PORTLAND CEMENT**—Current prices are for barrels in carload lots, net at bags, to contractors:

| | Current Without Bags | One Month Ago Without Bags | One Year Ago Without Bags |
|---|---|---|---|
| New York (delivered) | $2 50 | $2 50 | $4 10 |
| New York, alongside dock to dealers | 2 10 | 2 10 | |
| Jersey City | [illegible] | 2 60 | 3 55 |
| Boston | [illegible] | 2 61 | 3 32 |
| Chicago | [illegible] | 1 97 | 2 35 |
| Pittsburgh | 2.22 | 2 02 | 2 42 |
| Cincinnati | 2 38 | 2 28 | 2 73 |
| Detroit | 2 21 | 2 31 | 2 71 |
| Indianapolis | 2 25 | 2 23 | 2 57 |
| Buffalo | 2 31 | 2 31 | 2 71 |
| Milwaukee | 2 19 | 2 19 | 2 51 |
| Duluth | 1.95 | 1 95 | 2 35 |
| Peoria | [illegible] | 2 14 | 2 63 |
| Cedar Rapids | [illegible] | 2 28 | 2 71 |
| Davenport | [illegible] | 2 22 | 2 67 |
| St. Louis | [illegible] | [illegible] | [illegible] |
| San Francisco | 2 84 | 2 84 | 3 09 |
| New Orleans | [illegible] | 3 20 | 4 60 |
| Minneapolis (on cars) | 2 26 | 2 26 | 2 71 |
| Denver | 3 10 | 3 10 | 3 25 |
| Seattle | 3 10 | 3 10 | 3 12 |
| Dallas (f.o.b.) | 2.55 | 2.55 | 3 85 |
| Atlanta | [illegible] | 2 69 | 3 75 |
| Cincinnati | 2 37 | 2.37 | 2 77 |
| Los Angeles | 3 31 | 3.31 | 3 40 |
| Baltimore (del.) | 2 88 | 2 88 (del.) | 4 59 del. |
| Birmingham | [illegible] | 2.85 | [illegible] |
| Kansas City | [illegible] | 2 80 | 2 76 |
| Montreal (delivered) | 3 10 | 3 10 (del.) | 2 95 del. |

Sack Rate: Bags, 10c. each; 40c. per bbl. Montreal, 60c. per bbl.
In Los Angeles, [illegible]

Current mill-prices per barrel in carload lots, without bags; to contractor:

| | |
|---|---|
| Buffington, Ind | $1 70 |
| Pittsburgh, Pa | 1 75 |
| Steelton, Minn | [illegible] |
| Northampton, N. Y. | [illegible] |
| Hudson, N. Y. | [illegible] |
| Valatie, N. Y. | [illegible] |

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots

PLAIN 4-INCH BY 4-INCH MESH

| Style Number | Weight in Pounds | Pittsburgh, Mill | New York (Warehouse) | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|---|
| 032 | 0 022 | $0 74 | 1 13 | $ 82 | $1 15 | $1 24 |
| 049 | 0 028 | 94 | 1 40 | 1 46 | 1 56 | |
| 068 | 0 035 | 1 14 | 1 67 | 1 27 | 1 80 | 1 92 |
| 093 | 0 045 | 1 46 | 2 11 | 1 63 | 2 30 | 2 46 |
| 126 | 0 057 | 1 80 | 2 58 | 2 02 | 2 86 | 3 07 |
| 153 | 0 068 | 2 14 | 3 05 | 2 40 | 3 40 | |
| 180 | 0 078 | 2 46 | 3 48 | 2 76 | 3 93 | |
| 245 | 0 103 | 3 24 | 4 55 | 3 60 | 5 15 | |
| 287 | 0 119 | 3 75 | 5 25 | 4 20 | 5 96 | 6 41 |
| 336 | 0 138 | 4 35 | 6 07 | 4 87 | 7 32 | |
| 395 | 0 160 | 5 04 | 7 01 | 5 65 | 8 | |

PAVING

| | | | | | | |
|---|---|---|---|---|---|---|
| 036P | 0 017 | $0 56 | $0 88 | 0 62 | $0 88 | |
| 053P | 0 024 | 79 | 1 | 0 88 | 1 24 | |
| 072P | 0 031 | | 1 | 1 11 | 1 57 | |
| 097P | 0 040 | 1 26 | 1 87 | 1 43 | 2 02 | |
| 049R | 0 024 | 79 | 1 20 | | 1 24 | |
| 067R | 0 031 | 99 | 1 48 | | 1 57 | |
| 084R | 0 040 | 1 28 | 1 87 | | 2 02 | |

Made in 16- 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% heavier.

**EXPANDED METAL LATH**—Prices in carload lots per 100 sq.yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | $23 25 | $23 39 | $23 30 | $27 62 | $25 50 |
| 26 | 250 | 24 65 | 24 93 | | 29 21 | 27 56 |
| 25 | 300 | 27 30 | 27 45 | 27 45 | | 30 71 |
| 24 | 340 | 29 10 | 29 33 | 29 33 | 35 73 | 33 16 |
| 22 | 433 | 33 80 | 34 06 | | | 35 10 |

* Material shipped from mill, freight allowed on 4 carloads or more. Delivery charge 1c. per sq.yd.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.:

ROLLED FROM BILLETS

| | Warehouse (New York) | | | | | |
|---|---|---|---|---|---|---|
| Inches | Pittsburgh Mill | Birmingham Mill | New York | Chicago | St. Louis | Dallas | San Francisco |
| ½ and larger | $1 65 | *$1 75 | $2 78 | $2 90 | $2 87 | $3 50 | **$3 00** |
| ⅝ and larger | 1 70 | 1 90 | 2 83 | 1 75 | 2 92½ | 3 55 | **3 05** |
| ¾ and larger | 1 75 | 1 90 | 2 88 | 2 00 | 2 97½ | 3 60 | **3 10** |
| ⅞ and larger | 1 90 | 1 90 | 2 93 | 2 15 | 3 12½ | 3 75 | **3 25** |
| 1 and larger | 2 15 | 1 90 | 2 98 | 2 40 | 3 37 | 4 00 | **3 50** |

* Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| ½ and larger | *1 75 | $1 90 | $3 25 | ½ | $ 90 | $2 15 | $3 50 |
| ⅝ in. | 1 80 | 1 95 | 3 30 | ⅝ | 1 90 | 2 40 | 3 75 |
| ¾ | 1 85 | 2 00 | 3 55 | | | | |

**BRICK**—Contractors price per 1,000 in cargo or carload lots as follows:

| | Common | | | Paving Block | |
|---|---|---|---|---|---|
| | Current | One Month Ago | One Year Ago | 3-inch* | 4-inch* |
| New York (del.) | $18 40 | $18.40@19 40 | $22 70 | $47 00 | $42 50 |
| New York (at dock) | 15 00 | 15@15 50 | | | |
| Chicago | 11 00 | 11 00 | 15 00 | 34 00 | 42 50 |
| St. Louis, salmon | 17 00 | 17 00 | 17 00 | | |
| Denver, salmon | 14 00 | 14 00 | 15 00 | | |
| Dallas | 12 72 | 12 72 | 25 00 | 44 00 | |
| San Francisco | 18 00 | 18 00 | 18 00 | | 44 38 |
| Los Angeles | 15 50 | 15 50 | 15 50 | | |
| Boston (del.) | 17 00 | 17 00 | 30 00 | 46 00 | 56 25 |
| Minneapolis (del.) | 17 00 | 17 00 | 24@26 | | 43 00 |
| Kansas City | 14 50 | 14 50 | 22 00 | | |
| Seattle | 14 00 | 14 00 | 19 00 | 48 00 | 53 50 |
| Cincinnati | 15 00 | 15 50 | 24 00 | 41 00 | |
| Montreal (del.) | 16 00 | 16 00 | 20 00 | 100 00 | 120 00 |
| Detroit (del.) | 17 00 | 17 00 | 20@22 | 43 00 | 44 00 |
| Baltimore (del.) | 20 00 | 20 00 | 20@25 | 38 00 | |
| Atlanta | **11 00** | 10 00 | 20 00 | 40 00 | |
| New Orleans | 14 00 | 14 00 | 25 50 | | |
| Birmingham | 11 50 | 11 50 | | | |

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Vitrified, f.o.b. plant, Baltimore.

**HOLLOW TILE**—Price per block in carload lots to contractors for load-bearing tile.

| | New York | | | | | Perth |
|---|---|---|---|---|---|---|
| | Current (Trucks*) | One Year Ago | Chicago | St. Louis | San Francisco | Amboy, N. J., Factory |
| 4x12x12 | $0 11370 | $0 2444 | $0.0821 | $0 060 | $ | |
| 6x12x12 | 15160 | 3259 | 1343 | 113 | 154 | |
| 8x12x12 | .20210 | 4345 | 1575 | 14 | | $0 17510 |
| 10x12x12 | | | 1853 | 261 | | 22260 |
| 12x12x12 | | | 2408 | 2 | | 26720 |

* 5 per cent off for cash.

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Boston | $ 0065 | 54 | $0 251 |
| Minneapolis (f.o.b. cars) | 084 | 10 | 230 |
| Minneapolis (delivered) | 092 | 17 | 2 |
| Cincinnati | 0682 | 128 | 17 |
| Kansas City | | | 270 |
| Denver | 09 | | |
| Seattle | 10 | 3 | |
| Los Angeles | 103 | 15 | 22 |
| San Francisco | 14 | | 42 |
| Detroit (delivered) | 070 | 15 | 22 |
| Chicago | 1 | 2 | |
| Baltimore | 16 | 29 | 42 |
| Atlanta | 0765 | 11 | |
| Dallas | 124 | | |
| Birmingham | 095 | 115 | |

† Prices equivalent to the new parcel post rates.

**STRUCTURAL MATERIAL**—Following are base prices f.o.b. mill, Pittsburgh, and Birmingham together with quotations per 100 lb. from warehouses at places named

| | Pittsburgh, Mill | Birmingham Mill | New York (del.) | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | 1 65 | $1 90 | $2 88 | $4 00 | 2 97½ | $2 88 | $3 50 |
| Channel, 3 to 15 in. | 1 65 | 1 90 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 50 |
| Angles, 3 to 6 in., ¼ in. thick | 1 65 | 1 90 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 50 |
| Tees, 3 in. and larger | 1 65 | 1 90 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 50 |
| Plates | 1 65 | 1 90 | 2 88 | 4 00 | 2 97½ | 2 88 | 3 50 |

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Warehouse | | | | | |
|---|---|---|---|---|---|---|
| | Pittsburgh, Mill | New York Current | New York One Yr Ago | Chicago | St. Louis | San Francisco | Dallas |
| ½ in. and larger | $2 40 | $3 70 | $6 11 | $3 68 | $3 77½ | $5 50 | $5 50 |

CONE HEAD BOILER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | 2 50 | 3 80 | 7 10 | 3 78 | 3 87½ | 5 60 | 5 65 |
| ⅝ and ¾ | 2 60 | 3 90 | 7 25 | 3 93 | 3 87½ | 5 75 | 5 80 |
| ⅞ and 1 | 2 90 | 4 20 | 7 50 | 4 28 | 3 87½ | 6 00 | 6 05 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2 90 | $3 60 | $4 50 | $5 00 | $3 48 | $4 95 |
| Cut | 3 00 | 6 10 | 6 25 | 7 75 | 4 08 | 5 00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows

| | New York | | | Philadelphia | | |
|---|---|---|---|---|---|---|
| | 1-Ply l.c.l. | 2-Ply l.c.l. | 3-Ply l.c.l. | 1-Ply l.c.l. | 2-Ply l.c.l. | 3-Ply l.c.l. |
| No. 1 grade | $2 12 | $2 48 | $2 90 | $2 02 | $2 38 | $2 80 |
| No. 2 grade | 1 87 | 2 18 | 2 55 | 1 77 | 2 08 | 1 67 |

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.15 per roll in carload lots and $2.40 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $6.15 per square in carloads; $6.40 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft. | $2 35 |
| Tar pitch (in 400-lb. bbl.), per 100 lb. | 1 85 |
| Asphalt roofing (in barrels), per ton | 47 50 |
| Asphalt felt (light), per ton | 77 00 |
| Asphalt felt (heavy), per ton | 78 50 |

**SHEETS**—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

| Blue Annealed | Pittsburgh, Large Mill Lots | St Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $2 50 | $2 87½ | $3 38 | $5 50 | $3 28 |
| No. 12 | 2 55 | 2 92½ | 3 43 | 5 55 | 3 33 |
| No. 14 | 2 60 | 2 97½ | 3 48 | 5 60 | 3 38 |
| No. 16 | 2 80 | 3 07½ | 3 58 | 5 70 | 3 48 |
| **Black** | | | | | |
| *Nos. 18 and 20 | 2 85 | 3 95 | 3 95 | 5 80 | **4 05** |
| Nos. 22 and 24 | 2 90 | 4 00 | 4 00 | 5 85 | **4 10** |
| *No. 26 | 2 95 | 4 05 | 4 05 | 5 90 | **4 15** |
| *No. 28 | 3 00 | 4 15 | 4 15 | 6 00 | **4 25** |
| **Galvanized** | | | | | |
| No. 10 | 3 00 | 4 15 | 4 15 | | **4 25** |
| No. 12 | 3 10 | 4 25 | 4 25 | 5 85 | **4 35** |
| No. 14 | 3 10 | 4 25 | 4 25 | 5 85 | **4 35** |
| Nos. 17 to 21 | 3 40 | 4 55 | 4 55 | 6 15 | **4 65** |
| Nos. 22 and 24 | 3 55 | 4 70 | 4 70 | 6 30 | **4 80** |
| Nos. 25 and 26 | 3 70 | 4 85 | 4 85 | 6 45 | **4 95** |
| *No. 28 | 4 00 | 5 15 | 5 15 | 6 75 | **5 25** |

* Extra per 100 lb. for 1,000 lb. lots, 30c.; for 5 to 28 gage, 25c. to 50c. 19 to 24 gages for galvanized corrugated sheets add 15c. all gages.

**LINSEED OIL**—These prices are per gallon

| | New York | | Chicago | |
|---|---|---|---|---|
| | Current | One Year Ago | Current | One Year Ago |
| Raw in barrel (5 bbl. lots) | $0 72 | $1 15 | $ | $1 2 |

**WHITE AND RED LEAD**—Base price per pound

| | Red | | | | White | |
|---|---|---|---|---|---|---|
| | Current | | 1 Year Ago | | Current | 1 Yr. Ago |
| | Dry | In Oil | Dry | In Oil | Dry and In Oil | Dry and In Oil |
| 100-lb. kegs | 12 25 | 13 75 | 15 50 | 17 00 | 12 25 | 15 50 |
| 25- and 50-lb. kegs | 12 50 | 14 00 | 15 75 | 17 25 | 12 50 | 15 75 |
| 12-lb. kegs | 12 75 | 14 25 | 16 00 | 17 50 | 12 75 | 16 00 |
| 5-lb. cans | 15 25 | 16 75 | 18 50 | 20 00 | 15 25 | 18 50 |
| 1-lb. cans | 17 25 | 18 75 | 20 50 | 22 00 | 17 25 | 20 50 |

## LUMBER

Prices wholesale to dealers in carload lots f.o.b.

**San Francisco**—Prices of rough Douglas fir No. 1 common, in more than carload lots:

| | Lumber Prices in Yards at San Francisco | | | |
|---|---|---|---|---|
| | 6-8 and 12 Ft. | 10, 16, 18 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft. |
| 3x3 and 4 | $25 00 | $28 00 | $31 00 | $35 00 |
| 3x6 and 8 | 25 00 | 28 00 | 29 00 | 31 00 |
| 4x4-6 and 8 | 27 00 | 30 00 | 31 00 | 33 00 |
| 3x10 and 12 | 27 00 | 29 00 | 31 00 | 33 00 |
| 3x14 | 28 00 | 30 00 | 32 00 | 34 00 |
| 4x10 and 12 | 29 00 | 31 00 | 33 00 | 35 00 |
| 4x14 | 30 00 | 32 00 | 34 00 | 36 00 |
| | 24 Ft. and Under | 25 to 32 Ft. | | 33 to 40 Ft. |
| 6x10 | $30 00 | $32 00 | | $34 00 |
| 6x14 | 32 00 | 34 00 | | 36 00 |
| 8x10 | 30 00 | 32 00 | | 34 00 |
| 8x14 | 32 00 | 34 00 | | 36 00 |

**New York, Chicago and St. Louis**

| | Southern Pine | | | |
|---|---|---|---|---|
| | New York* | | Chicago | |
| | 20 Ft. and Under | 20-24 Ft. | 20 Ft. and Under | 22-24 Ft. |
| 3x 4 to 8x8 | $35 00 | $36 00 | $41 00 | $42 00 |
| 3x10 to 10x10 | 37 00 | 38 00 | 43 00 | 44 00 |
| 3x12 to 12x12 | 40 00 | 41 00 | **48 00** | 47 00 |
| 3x14 to 14x14 | 45 00 | 46 00 | 49 00 | 50 00 |
| 3x16 to 16x16 | 50 00 | 51 00 | 59 00 | 60 00 |
| 3x18 to 18x18 | 55 00 | 56 00 | 64 00 | 65 00 |
| 4x20 to 20x20 | 65 00 | 66 00 | 66 00 | 67 00 |

* Wholesale price (to dealers) of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M less.

Price to contractors, on lighters or cars, New York, about $5 additional.

**St. Louis**: Yellow pine, 22@ 24 ft. long, 3 x 4 to 4 x 4, $34 50; 3 x 6 to 8 x 8, $33; 3 x 12 to 5 x 12, $40; 3 x 14 to 4 x 14, $46; 3 x 16 to 4 x 16, $51; 3 x 18 to 5 x 18, $58.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

**Other Cities**

| | 8 x 8-In. x 20 Ft. and Under | | | | 12 x 12-In. 20 Ft. and Under | |
|---|---|---|---|---|---|---|
| | P. | Fir | Hemlock | Spruce | P. | Fir |
| Boston | $47 00 | $52 00 | $55 00 | $48 00 | $57 00 | $52 00 |
| Seattle | | 22 00 | | | | **24 00** |
| New Orleans | 28 00 | 23 50 | | | 33 00 | 27 00 |
| Baltimore | 30 00 | | | | 32 50 | |
| Cincinnati | **42 00** | 50 00 | | | **46 00** | 64 00 |
| Montreal | 78 00 | 85 00 | 68 00 | 78 00 | 78 00 | 100 00 |
| Los Angeles | | 41 00 | 40 00 | | | 41 00 |
| Denver | | **33 25** | | | 50 00 | **38 75** |
| Minneapolis | [illegible] | [illegible] | 33 00 | | [illegible] | [illegible] |
| Atlanta | **29 00** | | | | **40 50** | |
| Dallas | **33 00** | | | | **37 00** | |
| Kansas City | [illegible] | [illegible] | 47 00 | | [illegible] | [illegible] |
| Birmingham | [illegible] | | | | [illegible] | |

| | 1-In. Rough, 10-In. x 16 Ft. and Under | | 2-In. T. and G. 10 In. x 16 Ft. | |
|---|---|---|---|---|
| | P. | Fir | Hemlock | Fir |
| Boston | $47 00 | $48 00 | $57 00 | $45 00 | $48 00 |
| Seattle | | 15 00 | | | **24 00** |
| New Orleans | 32 00 | 25 00 | | 32 00 | |
| Baltimore | 34 00 | | | 32 50 | |
| Cincinnati | 62 50 | 80 00 | | 82 50 | |
| Montreal | 120 00 | 60 00 | 60 00 | 80 00 | 80 00 |
| Los Angeles | | **38 00** | **37 00** | | 63 00 |
| Denver | | **30 75** | | | **29 25** |
| Minneapolis | [illegible] | 31 25 | 29 25 | [illegible] | 29 25 |
| Atlanta | | **16 50** | | **20 00** | |
| Dallas | | 32 00 | 30 00 | **36 00** | |
| Kansas City | [illegible] | **33 00** | | [illegible] | [illegible] |
| Birmingham | [illegible] | | | [illegible] | |

Montreal: Deals 12 ft. and under, white, $3.00 per M. Increase up to 30 ft. [illegible] Deals, 12 ft. and under, [illegible] $2 per M. additional per M. ft. for delivery.

Cincinnati: Prices [illegible] and not over 16 ft.

## FREIGHT RATES

On finished steel products in the Pittsburgh district including plates, [illegible] and galvanized wire, nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following [illegible] per 100 lb., in carloads of 36,000 lb.:

| | | | |
|---|---|---|---|
| Baltimore | $0 [illegible] | Portland | $0 [illegible] |
| Birmingham | 76½ | Kansas City | 81½ |
| Boston | 41 | San Francisco | 91 |
| Buffalo | 29½ | New York | 38 |
| Chicago | 38 | Pacific Coast (all rail) | 1 66½ |
| Cincinnati | 325 | Philadelphia | 35 |
| Cleveland | 24 | Pittsburgh | 47 |
| Denver | 1 [illegible] | Portland | 66½ |

Note—Add 3 cents per 100 lb. [illegible] carload 40,000 lb.

Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or [illegible] products.

## CONTRACTORS' SUPPLIES

**STEEL SHEETPILING**—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $[illegible] | $2 00 | $4.00@$4 50 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | New York and East of Missouri River |
|---|---|
| Hercules red strand, all constructions | 25% |
| Patent flattened strand, special and cast steel | 25% |
| Patent flattened strand, iron rope | 10% |
| Plow steel round strand rope | 40% |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| Iron strand and iron tiller | 10% |
| Galvanized iron rigging and guy rope | +7½% |

California, Oregon, Nevada and Washington: Galvanized iron rigging and guy ropes +12½%; bright plow 35% off.

Wyoming, New Mexico and Colorado: Plow steel, round strand, 35% off, galvanized iron rigging and guy rope +12½%.

Arizona: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Utah: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Western territory not included in above: Plow steel, 35%; galvanized iron rigging and guy rope +12½%.

**MANILA ROPE**—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0 19 | New Orleans | $0 16 |
| New York | 17½ | Los Angeles | 15½ |
| Chicago | 18 | Seattle | 16 |
| Minneapolis | 18½ | St. Louis | 18½ |
| San Francisco | **16** | Montreal | 30 |
| Atlanta | 20 | Detroit | 175 |
| Denver | 18 | Baltimore | 22 |
| Cincinnati | **19** | Kansas City | 17½ |
| Dallas | 29 | Birmingham | 20½ |

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin | |
|---|---|---|
| | 40% | 60% |
| New York | 0 3075 | $0 3425 |
| Boston | 24 | 275 |
| Kansas City | **26** | **295** |
| Seattle | .1875 | 2125 |
| Chicago | .2275 | 2525 |
| Minneapolis | .2274 | 2530 |
| St. Louis | [illegible] | [illegible] |
| Denver | .2350 | 2700 |
| Dallas | .29 | 325 |
| Los Angeles | 25 | **29** |
| Atlanta | .2675 | 3025 |
| Baltimore | 2550 | 27 |
| Cincinnati | 2275 | 2725 |
| Montreal | 32 | 37 |
| Birmingham, Ordinary | .1875 | [illegible] |
| New Orleans | .2725 | 3075 |
| San Francisco | .195 | 24 |

**PILES**—For plain pine piles, delivered New York, the price is as follows:

| | |
|---|---|
| Pine 12-in. butts, 6-in. tops, length 41-50 ft. | $9 00@11 00 |
| Pine 14-in. butts, 6-in. tops, length 51-60 ft. | 18 50@15 50 |
| Pine 14-in. butts, 6-in. tops, length 61-71 ft. | 19 00@21 00 |

| | Dallas | | St. Louis |
|---|---|---|---|
| 6-in. x 20-ft. | $4 60 | 6-in. x 30-ft. | $6 95 |
| | | 7-in. x 30-ft. | 8 30 |
| 6-in. x 30-ft. | 7 10 | 7-in. x 35-ft. | 11 70 |
| | | 8-in. x 35-ft. | 13 90 |
| 8-in. x 30-ft. | 8 45 | 7-in. x 40-ft. | 13 90 |
| | | 8-in. x 45-ft. | 18 70 |
| 8-in. x 35-ft. | 10 38 | 8-in. x 50-ft. | 22 10 |

**SCRAP**—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 heavy melting steel scrap | $10 50 | $11 50 | $13 00 |
| Stove plate | 10 50 | 12 00 | 13 50 |
| No. 1 machinery cast | 16 50 | 13 50 | 16 00 |
| Machine shop turnings | 3 00 | 4 00 | 6 50 |
| Cast borings | 3 75 | 5 50 | 8 50 |
| Railroad malleable cast | 9 50 | 12 50 | 11 00 |
| Re-rolling rails | 11 50 | 13 00 | 12 00 |
| Relaying rails | 30 00 | 30 00 | 27 00 |

**SHIP SPIKES**—Current prices per 100 lb.:

| | San Francisco | | Seattle |
|---|---|---|---|
| In. | Galv. | Black | Black |
| ½ | $9 10 | $8 40 | $8 50 |
| ⅝ | 8 65 | 6 65 | 8 25 |
| ¾ | 8 50 | 6 50 | 8 50 |

Pittsburgh base, $3.25@$3 40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, NOVEMBER 10, 1921 — Number 19

## The Disarmament Conference

IT IS not our purpose to discuss here at length the limitation of armaments, but we cannot refrain in the week in which the disarmament conference convenes from adding our voice to the hopeful, acclaiming chorus from all over the world. The task is a mighty one but who shall say that it is insuperable when it is backed by the public opinion of the whole world! We have just come through the logical result of the nursing of armaments and the accompanying sword rattling. Few are so optimistic as to expect either complete disarmament or an end to war, but still fewer need to be persuaded that relatively disarmed nations are less apt to try the issue of war than those that are heavily armed. Newspaper and magazine discussion has approached the conference chiefly as a means of relieving the world from the oppressing costs of armaments. The terrific cost constitutes a valid argument. Past wars hold a heavy mortgage on the business of every nation. The consequent taxes press on the whole world and, while they may be uppermost in the minds of many who are publicly discussing the disarmament conference, their appeal is not more substantial and not half as pitiful as the prayers of the millions of those bereft in the late war. These particularly raise appealing hands to those who will assemble in Washington, begging that the danger of a repetition of these horrors may be removed as far as possible.

We pray for a fine success of the labors of the Washington conference.

## Too Many Pier Fires

ONCE more a million or so has gone up in smoke in a shipping pier fire in New York harbor. This is one way to modernize port facilities but it is a pretty expensive one. Nevertheless, the frequency of such fires in all the ports of this country would lead an outsider to believe that there is a theory that the way to get new piers is to burn down the old ones, together with a respectable quantity of merchandise that necessarily is stored in such terminals. These frequent fires ought to be reduced, if not stopped altogether. There is nothing about a shipping pier that makes its fire hazards extraordinarily high. On the contrary both in the matter of fire resistance and fire protection its problems are easy compared to most buildings. That there are so many destructive pier fires indicates a lack of proper interest and control on the part of those responsible, a too easy acquiescence in the existence of dangerous conditions and of insufficient structures.

## A World Reserve Bank

WHETHER it is possible to organize a world reserve bank to stabilize the whole economic situation, as has been proposed by Frank A. Vanderlip, the New York financier, remains to be seen. Apparently the details have not yet been fully considered by the great banks of issue and other financial agencies. The plan, though, looks in a direction that bears universal indorsement from those who realize the difficulties of the present situation. International financial stabilization more quickly than any other step would start the world's industries toward normal functioning. If the identical plan proposed by Mr. Vanderlip—which apparently is an amplification of the one he advanced two years ago—does not get support it may furnish the basis of a final plan. The acuteness of the financial situation is greater now than when he proposed the previous plan. That is apparent from the hope expressed in British financial circles that the disarmament conference would approach the question of financial stabilization.

## Making Superpower Practical

SUPERPOWER is a rather grandiose term for what has been common enough in engineering practice—the interconnection of power plants with the consequent savings due to leveling of peak loadings and to the economies of co-ordinated operation. Wherein the so-called superpower survey is new is the application of these principles to a large industrial area—the largest in fact in the country—and the viewing of that district as an engineering entity rather than as a collection of political and financial separates. This is useful work which gives the necessary base data upon which future plans can be made and visualizes for the financier and legislator just what the engineer has to offer toward the reduction in the cost of living. It must be admitted, however, that considering how the world of business now thinks, it is a highly idealistic matter. To consolidate the many sources of power and the many lines of distribution, to say nothing of the many systems of railroads, so that they not only work in mutual harmony but in conformance with state and federal law and control is a herculean task, which the lawyer, the legislator and the financier must attack. The engineer has pointed out the way; it remains for some one else to find the means.

## Vacillating Connecticut

CONNECTICUT legislatures continue to vacillate in matters relating to the study of stream pollution. Some years ago these studies were put in charge of a State Sewerage Commission, but after a relatively short time the work of this commission was brought to a close. The State Board of Health appears to have had some control of the subject at times. A year or two ago an Industrial Waste Commission was created to work in conjunction with the State Department of Health. Recently, after much controversy, the legislature abolished this commission and created a Stream Pollution Commission, noted here last week, at the same time taking all connection with the subject away from the State Department of Health. The new commission has no funds. There have been able engineers connected with the various earlier investigations, and the present commission is strong in this respect;

but no commission can accomplish much without funds, and why the Connecticut legislators cannot hold to any one policy is a nutmeg that we must leave for the citizens of that state to crack.

### Pipe Analysis Analyzed

OF THE engineering problems that persistently elude all attempts to apply approximate calculation, the design of large horizontal pipes is one of the most baffling. It is related to the arch problem, having the same inherent difficulties, but raised to a higher power, since the pipe is in effect an unsymmetrical double arch of undetermined span lengths and subjected to unbalanced loads—conditions which remove the possibility of utilizing the simplifications applicable to the arch itself. No method of solution but the tedious one of complete analysis of the individual case of practice has been available for pipe design. An ingenious flank attack on the problem is made by the expedient set forth by J. M. Paris in this issue. He resorts to the expedient of analyzing the general case of the pipe into a number of fixed, elementary cases. By working out the elastic analysis for each of these, he cuts the knot of the difficulty, since the results may be combined by simple addition in proportion as the several elementary loadings are contained in the actual loading of any given practical case. This expedient makes it possible to deal with any kind of support and any kind of loading, and thus constitutes a method noteworthy for its power and flexibility. The value of the method is to be reckoned not merely in terms of the labor it will save, but also in terms of the errors and missteps which it will prevent, by supplying definite knowledge of pipe strength in the large number of instances where, without the Paris formulas, pure guesswork would be relied on.

## The Fear of Unemployment

A WELL-KNOWN English manufacturer, B. S. Rowntree, is in the United States studying our handling of industrial relations. Incidentally, he has been telling groups of manufacturers and business men his own views on ways of eliminating labor unrest and disputes. His suggestions are not new, but he gives one of them an emphasis that fits in just now with the thinking of American business men. He lays down intelligent rules for wages, for hours of employment, for workers' representation and for profit sharing, but contends that economic insecurity—the ever-present danger of loss of employment—is the most potent cause of industrial unrest. This is the point that fits in with our thinking here, since his suggestions come at a time of great unemployment and immediately after the deliberations of the President's Conference on Unemployment.

The astonishing aspect of Mr. Rowntree's consideration of the subject was his unqualified statement that, while this is the most serious of the causes of industrial unrest, it is the easiest to cure. At Washington recently we considered that the solution was not easy to find. We, however, were proceeding on the theory that the only remedy for unemployment was employment. Mr. Rowntree agrees that this is the best remedy but he does not consider it the only remedy. He proposes a system of mutual unemployment insurance, through a fund to which both employers and employees would contribute. He suggests three methods of procedure: through the State, through groups of industries and by individual industries. In his own organization a 1 per cent reserve on the wage bill is the employer's contribution to the fund.

By many employers, Mr. Rowntree's suggestion of unemployment insurance will be met by the trite rejoinder that it is "socialistic." With fair-minded people who understand that industrial functioning is not a mere private enterprise but is essentially a social activity—a means by which people live and develop and multiply—this rejoinder has no force. The proper attitude is that it is the employer's obligation to consider without prejudice any means that will help reduce the dangers of conflict. We were told a decade ago that workman's compensation acts were a socialistic venture. Today there is common agreement that industrial accidents are a proper industrial charge.

We hold with Mr. Hoover and the delegates to the Unemployment Conference, that it is very desirable to attack the problem of unemployment by devising some method, based upon adequate statistics, of securing the deferment of construction work in boom times to fill up the valley of depression. Nevertheless, thought along the lines suggested by Mr. Rowntree, is needed. Dr. Steinmetz said years ago that the three great fears of workers were the fear of ill-health, of unemployment, and of unprovided-for old age. The industries that will remove these fears will acquire a thoroughly loyal force and one that will not furnish ground for cultivation by agitators. In such companies the efforts of organized labor are helpless because organized labor cannot do as much for the employees as the employers are voluntarily giving.

## Relief Valves Must Function

A SERIOUS accident to the penstock of a Western hydro-electric plant, recently discussed in these pages, serves as a reminder that after rapid advances have been made in any field it is good practice to make a survey of all features affected by the new conditions to see what new problems and possibilities have been introduced. In going over recent developments in hydraulic turbines with that attitude of mind, it is to be noted that the relief valve or pressure regulator has been affected perhaps more than any other feature of hydraulic equipment by the trend in recent years toward higher heads and larger units.

Despite this the relief valve is too often regarded as merely an item on the list of turbine accessories which, once installed, can be passed by the inspector much as he would check off a shaft bearing or a grease cup. Inquiry of a well-known manufacturer of hydraulic equipment develops the fact that only one purchaser in fifty asks about the details of the pressure regulator on his turbine. This is surprising when it is remembered that under modern conditions there is no more vital part in the entire mechanism of the hydro-electric plant. So many combinations of load and pressure may arise that must be met and balanced by different speeds of opening or closing the relief valve that only a complex mechanism could perform all the necessary functions. In addition to this complexity of operation, when the mechanism is called upon to perform heavy duty, as is the case with modern units of large size and high head, it is apparent that the pressure regulator must be accurate and dependable in its operation and of rugged construction. Moreover, even a relief valve properly designed and suited to the characteristics of

the plant in which it is installed still requires to be adjusted under operating conditions. Because of the variety and importance of the operations it is to perform automatically, it is safe to say that in testing out and adjusting a new installation the pressure regulator is likely to require more time and attention than the turbine itself.

When finally put on its own resources, as it were, in the expectation that it will function automatically, the relief valve should fulfill the following conditions: (1) It must be absolutely positive in its opening, (2) after opening it must be absolutely controllable in the rate of closure and equally positive in effecting complete closure, (3) it must open partly and inversely with the closure of the turbine guide vanes when such closure so checks the water flow in the pipe line that relief is necessary to prevent dangerous water ram, but it must remain closed for any movement of the guide vanes that is not of sufficient magnitude to adversely affect the pipe line pressure. These are operating requirements apart from and in addition to the need for perfection of mechanical details, accessibility, simplicity of maintenance and the various other features which will at once be recognized as essential if the plant is to be protected from those dangers against which the relief valve is designed to guard.

Power companies and engineers will do well to give careful thought to the modern relief valve as a separate and distinct feature of the installation worthy of consideration on a par with the turbine itself. The best turbine produced can be sent to the scrap heap by a relief valve that does not function properly.

## A Question of Highway Efficiency

AT THE foot of a grade in a road over which the editor recently passed there is a gully crossed by a newly planked bridge. A warning sign on the approach announced; "This Bridge Closed to Loads over 4 Tons." Some miles farther along, a reminder of horse-and-buggy days appeared in the shape of a venerable bridge bearing the notice, "Five Dollars Fine for Driving Faster Than a Walk." Still a little farther, a more modern note was sounded by another bridge sign, "Slow Down to 8 Miles. Heavy Trucking Prohibited." An automobile rattling at 20-mile speed over the 8-mile bridge threw doubt on the effectiveness of these signs. But, effective or not, they told plainly that our costly highway system is limited in its utilization by inadequate bridges.

Another side of the story is given by Mr. Goldmark's letter in this issue, reporting a bridge that has been allowed to get into a menacing state of disrepair, and to remain so. There are other bridges as dangerous as the one described, though fortunately not many. Supine or ignorant local officials do happen, and sometimes, as in a recent intercounty bridge case, when one county barricaded a weak bridge and the other county pulled down the barriers, there are cases of sheer obstinacy. It is not open to doubt that where such governmental conditions operate to make bridges dangerous, a cure for the evil needs to be found; but it is not so obvious that the cure lies in state control.

We have thus a twofold problem of inadequate bridges that reacts—more and more seriously as time goes on—to the detriment of highway efficiency. It is concerned with well-preserved but obsolete bridges, and with those which are in bad disrepair.

What is to be done? The problem arises from the fact that the most remote bridge, formerly a thing of purely local value, is of widest concern now that power-driven road traffic comes and goes everywhere, while the burden of rebuilding rests in large part on the local residents. They paid for the old bridge, and it still satisfies their needs in the main, while the new one will serve chiefly strangers, they think. Their reluctance to undertake the improvement is thus rather natural. But even though chargeable in part to a kind of selfishness, it is also chargeable to a slender purse. The plain fact is that neither a single township or county, nor a whole state or the nation is able to solve all at once the bridge problem that has been created overnight by the mushroom growth of highway traffic.

Numerous agencies are working on bridge improvements: State highway authorities, many able county boards, the federal Bureau of Public Roads. Yet they are only grazing the surface. In the main they do no more than provide the currently-improved main roads with bridges of ample strength and size. At times they perform remarkable feats, such as the quick rebuilding of the Patuxent River bridge by J. N. Mackall, recorded last week. But financial miracles are beyond their power. They cannot, in a month or a season, tear down all the bridges on by-roads as well as main highways and replace them with 20-ton standards. The attempt would strain our credit system and disrupt our markets.

The problem is obvious; inadequate bridges will continue to exist for a long time, their number decreasing only slowly. Some things may be done to make it less serious. Where a bridge is a traffic danger if not posted, it must be posted. Where the inadequacy of bridges reduces the value of an entire road system, means must be sought to limit this effect; a primary network of full-capacity roads, supplemented by auxiliary networks of graded road-capacities, can be made highly effective, provided proper publicity is given to the arrangement. All the time, moreover, bridge replacement must proceed as rapidly as public moneys (and the earnings of the road system, once we systematize the collection and allocation of these earnings) permit. Unless these things be done—few states are even making an approach to doing them—weak or defective bridges will continue unduly long to throttle transportation and threaten life.

But there is a point of more immediate professional concern that is raised by Mr. Goldmark's reference to the value of publicity, and his striking demand for action by the engineering societies. The point is that to the public, much as we ourselves may look upon highway bridges as routine products of standard designing and construction methods—to the public, bridges are works of engineering, fully understood only by engineers and guaranteed to the community by the profession as a body. The guarantee cannot be repudiated by the profession, and it remains for the societies to stand back of this guarantee. They can surely be of service in the matter of defective bridges; they have means for ascertaining the facts, can warn by public notice, and in case of need can resort to more direct compulsion. It is almost equally certain that they can aid by other methods in the solution of the more general highway bridge problem, as involved in the gradual replacement of structures outgrown by the traffic. The starting-point is recognition of the fact that, in its relation to the community, organized engineering stands behind the integrity of our bridges.

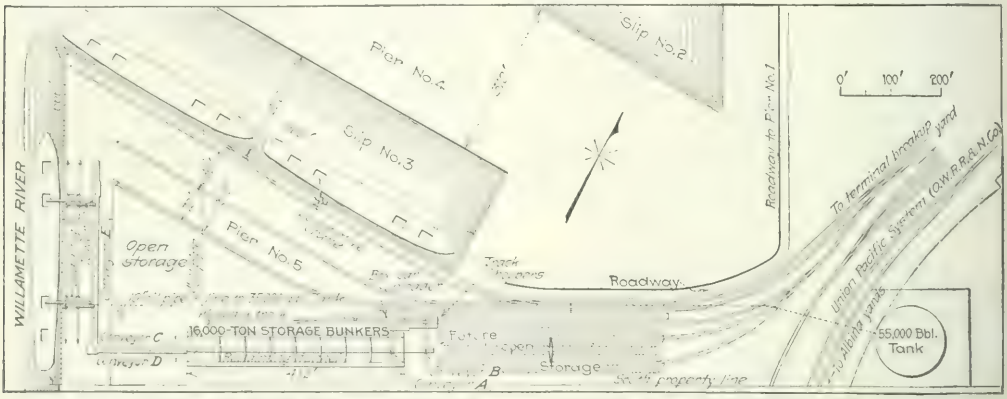
# Bulk Handling Plant at Port of Portland, Ore.

## City Builds Addition to Municipal Ocean-Vessel Terminal to Store and Move Phosphate Rock—Includes Box-Car Dumper and Belt Conveyor System

By G. B. Hegardt
Chief Engineer, the Commission of Public Docks, Portland, Ore.

FACILITIES for the storage and tran-shipment of large quantities of phosphate rock have been provided by the city of Portland, Ore., at its Terminal No. 4 on the Willamette River in the way of a wide pier, with deep water approach, storage bins, belt conveyors, traveling crane conveyors along the pier side and a box-car dumper. The complete installation is somewhat of a novelty in harbor design.

Since the Commission of Public Docks of the City of Portland was created and began functioning, in 1912, for the purpose of providing municipal, commercial terminal facilities for the port, four terminals have been constructed and approximately $8,950,000 expended from a total authorized bond issue of $10,-




PLAN OF BULK STORAGE PIER, MUNICIPAL TERMINAL NO. 4, PORTLAND, ORE.

500,000. Three of these terminals were completed prior to 1914, and the fourth, Municipal Terminal No. 4, is nearing completion, the amount so far expended there being about $4,700,000. When work on Terminal No. 4, a general description of which appeared in *Engineering News-Record,* Oct. 21, 1920, p. 796, was begun in 1918, the then adopted plan contemplated only the construction of a 1,000,000-bushel grain elevator, one pier and, tentatively, a vegetable oil storage plant. With the rapidly increasing commerce of the port, however, the demand for additional facilities has necessitated a practically continuous construction program at this terminal, until at this time, three piers have been placed in operation and work begun on a fourth pier. The dimensions and other features of these piers are given in the article above referred to.

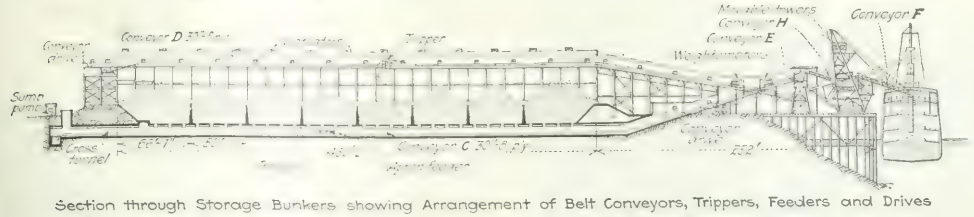
In 1920, a demand was made on the commission to furnish handling and storage facilities for the transshipment, by ocean carriers, of large quantities of phosphate rock, principally to the Orient, from the immense deposits available in the states of Idaho and Montana, amounting, according to Government statistics, to billions of tons. This request for such bulk storage facilities was based on definite contracts then entered into for the shipment through the port of 165,000 tons of phosphate rock. Because of unfavorable financial conditions in the Orient these contracts were cancelled before the bulk storage plant was completed. In view, however, of the representations made at the time referred to, the commission decided to provide the facilities requested and proceeded with the construction of the plant herein described.

As noted on the plan, the bulk storage plant is on Pier No. 5, which is triangular in shape, the pier proper having a length of 900 ft. along slip No. 3 and the quay portion a frontage of 666 ft., the bulk storage plant paralleling the third leg of the triangle, where the most convenient trackage connections could be made available.

The elevation of the original surface of the ground of that portion of the site to be occupied by the bulk storage plant varied from 12 to 14 ft. above low water, the soil formation being a mixture of sand and clay, consisting of the usual river deposit found along the banks of silt-bearing streams. Because of the necessity of bringing the elevation of the terminal site to a considerable height above any possible river freshets and to effect the most practical connections with existing railroads immediately in rear of the terminal site, the entire terminal area was raised to an average elevation of 33 ft. above low water. This fill was made by pipe line dredges from material excavated from the ship channel and the three terminal slips. A total of about 3,250,000 cu.yd. of material was so placed on the 160-acre terminal site.

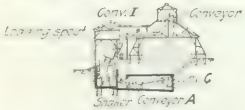
Consideration was given to various types of construction of the storage portion of the plant, both with reference to first cost and to maintenance. The design finally adopted was for concrete construction of bins, tunnels and hoppers, with shed and belt galleries to front of pier of wood, with galvanized iron covering.

No piles were driven for the foundation of the concrete bins or tunnels, but a hydraulic fill was made over the site to the general elevation of +30 ft. and

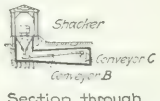



Section through Storage Bunkers showing Arrangement of Belt Conveyors, Trippers, Feeders and Drives

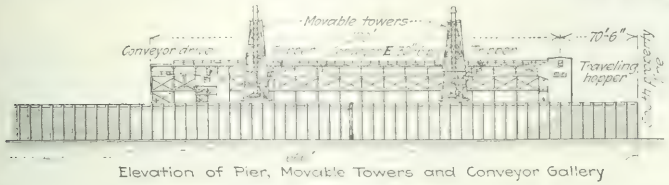
Arrangement of Car Unloading Devices and Trackage Leading to and from same




Section showing Bunkers and Box Car Unloader




Section through Car Pit




Elevation of Pier, Movable Towers and Conveyor Gallery

ARRANGEMENT OF CONVEYOR SYSTEMS, CAR DUMPERS AND UNLOADER CRANES

this fill was later excavated, by clam-shell bucket, to the depth required for the reclaiming tunnel and the side slopes of the concrete bins. Upon the foundation thus prepared was constructed the concrete bunkers of the bulk storage plant. Piles were driven, however, for the foundation of the box car unloader and the track hopper. In the concrete tunnels, bin bulk-

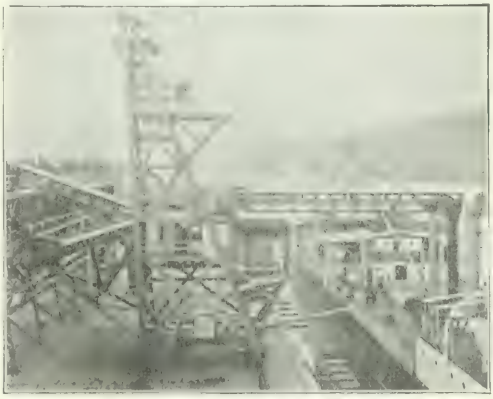
LOOKING TOWARD THE WILLIAMETTE RIVER OVER THE BULK STORAGE PIER

heads, track hopper and the foundation for the box car unloader, bar reinforcement was used and the bin side slopes were reinforced with wire mesh.

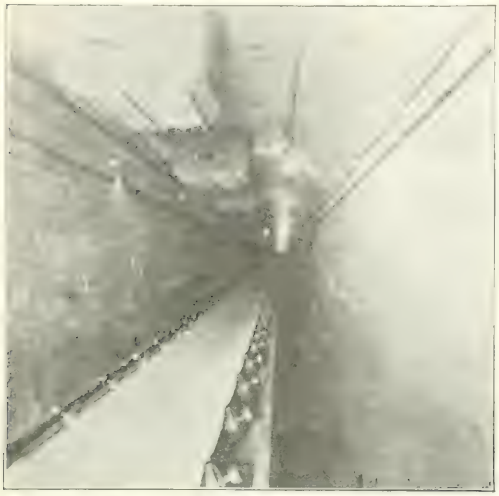
Because of the generally fixed elevation of the pier and trackage connections, it was necessary to carry the foundation of the reclaiming tunnel down to +12.7 ft. at the pier end, with a drainage slope of 2 ft. toward the inner, or shore end, where seepage water is collected in a sump of 230 cu.ft. effective capacity. The top elevation of the tunnel, at the pier, is +25.0.

No attempt was made to waterproof the tunnel, except by a 10 per cent addition of hydrate of lime in the concrete, which it was expected, would make the work sufficiently tight for the sump pump to handle any seepage water that would penetrate the concrete. That this worked out in an entirely satisfactory way was fully demonstrated during a recent freshet in the Columbia River, which produced a maximum back water stage in the Williamette River of +24.4 ft. with a stage of +20.0 ft. for a period of 34 days and a +15.0 ft. stage for 50 days. Very little trouble was experienced during this time from seepage, it being necessary to run the sump pump only twice an hour at maximum river stage to empty the sump and as the water receded to +20.0 ft. only once every hour.

The general layout and construction of this bulk storage plant, with its conveying machinery, is shown in accompanying plans and photographs. The conveyor machinery, including drives, traveling hoppers, trippers, chutes, automatic scales and traveling or



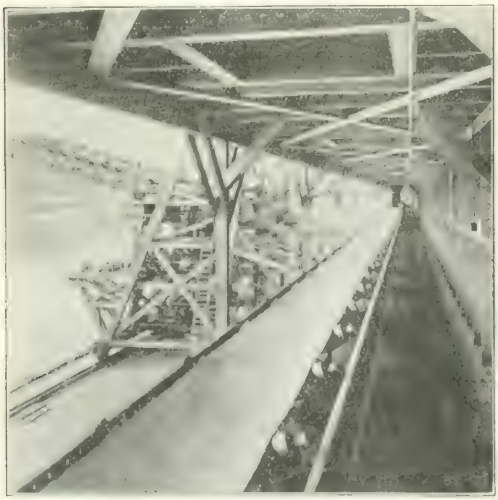
COALING A STEAMER BY THE UNLOADER CRANES



CONCRETE TUNNEL WITH CONVEYOR BELT "C" AND 20 X 30-IN GATES IN ROOF

movable ship loading towers for handling bulk material, performs the following operations: (1), Delivery from hopper bottom cars to bunkers, or directly to vessel; (2), Delivery from box cars to bunkers, or directly to vessels; (3), Delivery from bunkers to vessels; (4), Delivery from vessel to bunkers; and (5), Delivery from bunkers to cars.

The unloading facilities consist of a box-car unloader, a double-hoppered track pit for unloading bottom dump gondolas and "Duplex" shaker feeders for discharging material from the hopper to 30-in. belt conveyor "B". The capacity of the track hopper is, approximately, 250 tons per hour for phosphate rock or 100 tons per hour for coal. The box car unloader and loader, manufactured by the Ottumwa Box Car Loader Co., discharges the contents of box cars into a hopper, from which it is carried, by means of a single shaker feeder, to 30-in. belt conveyor "A." The maximum capacity of the box car tipper is approximately 300 tons of phosphate rock or 125 tons of coal per hour.



BELT CONVEYOR "C", TRIPPER AND SHIP UNLOADERS

This machine will unload a standard box car by side and end tipping. The car, after being run onto a platform of the car unloader, is clamped and held rigid by dogs, which are brought up out of the pit at each end of cradle. After being clamped, the car is given a side maximum tip of 20 deg. and then rocked to a maximum inclination of 45 deg., causing all of the material in the car to be discharged through the car door opening into the concrete hopper. It is operated by electric motors and compressed air. After the car has been emptied it is brought to a horizontal position and is removed from the tipping platform by a car puller, which is also used to pull cars up the 3 per cent grade to the car unloading pits.

BOX CAR ON THE UNLOADER TIPPED FOR EMPTYING

The enclosed storage facilities consist of eight separate bins constructed of concrete and covered by a heavy mill constructed shed, 50 x 432 ft., which also covers belt conveyor "D" used for discharging material into the bunkers. A heavy reinforced-concret tunnel, 580 ft. long, 8 ft. wide and 9 ft. high under the bunkers, housing conveyor "C", is provided for transferring material from the bins to vessel or cars and also for receiving material from the car unloading hoppers.

The bins are sloped on an angle of 35 deg. and the material is discharged from the bins onto conveyor "C" in the tunnel below, through 20 x 30-in. "Duplex" gates and a powered apron feeder, operating on track above conveyor "C", delivers material from the bins onto conveyor "C".

The normal capacity of the eight covered storage bunkers is 16,000 tons of phosphate rock or 8,000 tons

of coal and maximum capacity, with bins fully heaped is 22,000 and 9,300 tons, respectively.

All material handled in the bulk storage plant is conveyed by nine 30-in. belt conveyors, varying in length from 35 ft. for "A" to 642 ft. for "D" and totaling 2,033 ft. The maximum capacity is 600 tons per hour of phosphate rock and 250 tons per hour of coal. Belts "C" and "D" are 8-ply, belts "F" and "G" 7-ply, belts "E" and "H" 6-ply. The others are 5-ply. All are driven by direct-connected electric motors through gear and pinion reductions. The troughing rolls are of standard type with five rolls. The return rolls are also of standard type.

Two traveling or ship's towers operate along the harbor face of Pier No. 5, for transferring material from the 30-in. belt conveyor on the pier to vessels. The towers can be spotted to any location along the pier and the spouting arrangement from the adjustable conveyor on the tower permits the material being delivered to vessel at any stage of the river.

For unloading vessels the movable towers are also provided with return belts for receiving material from vessels for delivery to bunkers or cars. The material being handled from vessels is hoisted by buckets or by clam-shell from the hold of the vessel and discharged into hoppers, located on the towers, and from these hoppers, 30-in. belt conveyors discharge the material onto belt "E" which is reversible, and material from belt "E" is likewise carried over belt "D" to the bunkers or cars. When sufficient business develops it is the intention of providing conveyors for taking material, such as coal, etc., from vessel's hold for delivery into the hoppers on the movable towers.

Two Merrick Scale Manufacturing Co. weightometers are provided, one being installed on conveyor belt "C" leading from the reclaiming tunnel and one on conveyor belt "D" leading to the bunkers. The weightometers automatically weigh the material while in transit on the conveyor belts, with a guaranteed accuracy of 99 per cent.

### Electric Connections

The entire bulk storage plant is electrically operated, 440-volt, 60-cycle, alternating current being used. A complete system of remote control is provided for cutting off the power throughout the plant. The connected load of the entire plant is 600 hp. A system of electric bell and light signals is also installed for the operation of the plant, which is well lighted, both direct and flood lighting being used.

An automatic car puller delivers cars from the terminal tracks to the car unloading pits and a "kick-back" track is provided for taking care of the empty cars after being discharged at the pits.

At the shore end of the bunkers there is available ground storage space for about 20,000 tons of bulk material.

The general design of the conveyor system for the bulk storage plant is from a layout proposed by the Robins Conveyor Belt Co., but the machinery was manufactured locally by the Hesse-Martin Iron Works, on competitive bids. The detail plans and the construction of the entire plant were carried out by the commission's engineering department.

No phosphate rock has been handled through this plant, except for testing purposes. The box car unloader was given a thorough and satisfactory test, fully loaded box cars of phosphate rock being completely emptied in about 9 minutes. The bulk storage plant has been used to some extent for storage of coal and bunkering of vessels, and a delivery of 200 tons per hour was readily attained, with vessel's bunkers clear and no trimming required. The cost of the plant, exclusive of pier construction, was approximately $300,000.

## Tests on Foundation Piers With 1,000-Ton Jack

### Bearing Capacity of Concrete Piers 60 Feet Deep Being Tested in Chicago by 1,000-Ton Hydraulic Jack

LOADING TESTS on full-size foundation piers are being carried on at the Chicago Union Station, using a 1,000-ton hydraulic jack and a reaction load, to determine a safe load for hardpan at considerable depth. This work represents a new development in testing the bearing power of soil, since in most tests of this kind the loaded area is but one or two square feet.

At the site of the headhouse for the new station an 8-ft. bed of hardpan is met about 80 ft. below street level, or 65 ft. below city datum (water level in the river). Rock is 20 ft. deeper, and varied strata of sand and clay lie between the hardpan and the rock. Many large buildings at Chicago have their concrete foundation piers resting on hardpan, as the cost of sinking to a greater depth through the underlying soft strata did not warrant extending the piers to rock. In such cases the bottoms of the piers are belled out to a diameter about double that of the shaft in order to increase the bearing area.

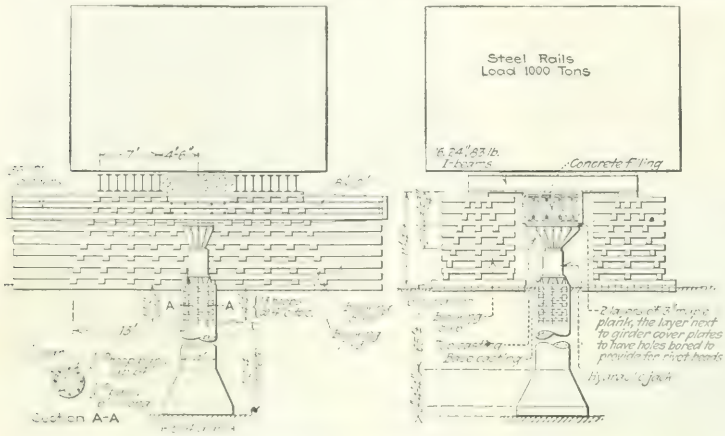
The Chicago building code prescribes no specific loading for hardpan, and the building commissioner can specify such load limits as he considers desirable. It is usual, however, to allow about 6 tons per square foot in foundation designs. The foundation piers already built for the headhouse were designed for a four-story structure, on the basis of a foundation pressure of 6 tons per square foot. As it is now proposed to build a 16-story structure, it was considered desirable to determine what load could be safely imposed on the present piers and what additional piers will be required.

For this purpose it was decided to conduct tests on two of the completed piers, resting on the hardpan. These piers had been built in open wells in accordance with usual Chicago practice; they are of concrete and are 4 ft. in diameter, one cylindrical throughout and the other belled out at the bottom to a base diameter of 8 ft. 4 in. For the main part of the piers the concrete is a 1:2:4 mix made with crushed limestone, and was spouted into the open well, with no tamping in place. at the top a 1 : 1 : 2 mix was used, reinforced by bars and hooping, as shown.

A 1,000-ton hydraulic jack built specially for these tests is about 31 in. in diameter and 37 in. high, with a 21-in. plunger having a stroke of 10 in. This will be seated on a casting like a column shoe on the top of the pier and upon it will be another casting to bear against the reaction girders. For the resistance or reaction loading of the jack there will be a pair of 3-ft. plate girders 44½ ft. long (selected from material for one of the viaducts at the station) these girders being supported at the ends on timber blocking. Across the ends

of the girders will be groups of I-beams and upon these will be piled steel rails weighing over 1,000 tons.

With this loading in place, any desired load on the pier can be applied by means of the jack. Inspection chambers may be dug at the base of the straight pier to enable observations to be made as to progressive results. A maximum load can be reached equivalent to 20 tons per square foot at the base of the belled pier and 80 tons at that of the straight pier, not allowing for the skin friction of the concrete pier (in 70-ft. of wood-lined shaft). This skin friction is estimated to be at least 400 lb. per square foot, amounting to 175 tons on the 70-ft. pier and reducing the total load on the base by this amount.




LOADING TEST ON FOUNDATION PIER

Earlier tests on the Chicago hardpan have been made by loading areas 12 x 12-in. at the bottom of the open wells for the piers. Such tests have shown $\frac{3}{16}$-in. settlement under 24,200 lb. after 44 hr. and under 30,000 lb. after 60 hr. In another case, a 24,200-lb. load caused $\frac{1}{8}$-in. settlement in 33 hr., the unit load adopted for the foundation piers in that case being 13,300 lb. per square foot on the hardpan. Direct loading of an experimental pier 5 ft. in diameter and 10 ft. deep, belled out at the bottom, was tried in foundation tests for the Michigan Central R. R. station at Detroit (*Engineering News*, March 6, 1913, p. 460, and Oct. 1, 1914, p. 704).

The present Chicago tests were planned under the direction of J. d'Esposito, chief engineer and A. J. Hammond, assistant chief engineer, Chicago Union Station Co.

### Irrigation and Drainage in Nebraska

By the 1920 census, 1 per cent of the farm land of Nebraska is irrigated. There are 3,021 irrigated farms aggregating 442,690 acres. This is 73 per cent more acreage than in 1910. Nearly 120,000 acres more were capable of being irrigated. The capital invested in the area capable of being irrigated was $24.73, and the average cost per acre for operation and maintenance was $1.48, an increase of 39c. over 1910 costs. Drains have been installed on 10,793 acres of irrigated lands, but are needed on 365,725 acres. The average quantity of irrigation water entering the canals was 4.2 acre-ft. per acre, but only 2.4 acre-ft. per acre was delivered to the ground.

## Resurvey of the Southern Railway After Improvement

### One Party on 675 Miles in Five Months Surveyed Distance, Alignment and Structures and Set Mile-Post Marks

By Geo. W. White
Civil Engineer, Charlotte, N. C.

CHANGES in mileage on the Southern Ry., having been introduced by numerous revisions of alignment in connection with the double tracking of the 637-mile main line between Washington, D. C., and Atlanta, Ga., it became necessary to establish the correct locations of the mile posts. On the completion of the improvement work, therefore, it was decided to make a continuous remeasurement of the entire line, as part of a complete resurvey for a continuous map and profile, since the records of grades, curves and structures were incomplete.

A resurvey party which started on June 20, 1919, completed its work on Nov. 19, losing about twelve days on account of rain. Progress averaged 5.2 miles per day, exclusive of Sundays, for 675 miles of main line and spurs. This party consisted of an assistant engineer in charge, transitman, levelman, two chainmen, three rodmen, an axeman and a cook. Camp cars were furnished and the party lived along the line, keeping the cars reasonably near the work. The stops averaged three or four days, except in a few cases when they extended to a week or ten days. Movements of the cars were determined by the local train service, the trains being used extensively in going to and from work.

A zero point was established at the Union Station in Washington. Measurement and alignment were taken on the right hand rail of the northbound track, and levels were taken on the low rail of this track. In this way the party was facing traffic most of the time. Slightly greater accuracy would have been obtained by taking the center line between tracks, but it was thought that this would not justify the additional time required to stake out this center line. The error from this cause at any point was small, as each curve in one direction counteracts a similar amount of curvature in the opposite. Where the two main tracks are not parallel, a new northbound or southbound track having been built on a different location, both lines were surveyed. Sections of the old line still in use for local work were also surveyed.

The chainmen went ahead, measuring pluses to all structures, main line switch points, road crossings and existing mile posts, and also marking the correct location of mile posts. Buildings on the right-of-way were located, their size and distance from the center line being measured. Culverts were measured and pluses taken to abutments and piers of bridges. Reliance was placed on existing maps for right-of-way, yard and ter-

minal improvements, and for structures not adjacent to the main line in cities. The assistant engineer usually accompanied the chainmen and took notes of all the information developed by them, as this practice increased both speed and efficiency of the party, but when this was not possible, the transitman took these notes. It would have been well worth the additional expense to have had a topographer for this purpose.

The transit party followed, taking deflections around all curves and taking readings at 100-ft. intervals. At each set-up the vernier was set at zero; thus the total angle for each curve was the sum of deflections to transit points. Curves were not run to intersections, as this would have required too much time. The entire line was referred to true north by observations taken on Polaris at each degree of longitude or oftener. Calculated bearings were carried from one observation point to the next without correction for convergence of meridians, but the error in bearings due to this cause was not more than about 30 minutes for these distances.

Levels were based on sea level datum, using government bench marks near the line. Where there was an error of more than a few hundredths of a foot the levels were corrected to this new elevation. If the discrepancy was large it was distributed back over a distance of 10 to 40 miles. The latter distance was used only once, at the end of the longest run without a check reading, this being from Springfield to Motley, Va., 189 miles. The error at Motley, as compared with government elevations, was only 0.69 ft. Bench marks were established at intervals of two to eight miles, one being placed at or near every station, usually one between stations and two or more in cities. They were marked by crosses chiseled in permanent masonry structures.

Painting all stations on the rail for future reference was the duty of the axeman. He also cut and drove large stakes to mark the new location of mile posts, besides painting the mile post number and station on the rail. Several mile post locations were on bridges and viaducts, two on station platforms, one in a tunnel and one on the headwall of a 50-ft. arch.

This resurvey showed the total distance to be 637.6 miles, or 10.2 miles less than the distance by the original line. All mile posts have been moved to their correct locations, and the numbers of stations, bridges and block signals have been changed to correspond. On Jan. 1, 1921, revised tariffs were put into effect.

Maps in 20-mile sections were plotted to a scale of ½-mile to 1 in., with a profile on the same sheet and a record of bench marks. All information was given that could be shown on such a small scale, but no attempt was made to show right-of-way. Blueprints of these sheets, bound together by divisions, make a ready reference map of the entire line. Complete maps on a scale of 400 ft. to 1 in. and in 4-mile sections show all information developed on the survey and also yards, terminals and right-of-way.

The survey was made under the supervision of E. M. Durham, Jr., and H. Stringfellow, then chief engineer of construction and district engineer respectively. The writer was assistant engineer in charge of the party.

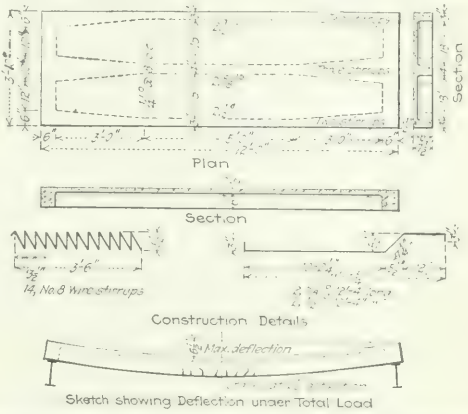
### All Construction Work Under City Engineer

All engineering and construction work carried on by the City of San Antonio, Tex., is put under the city engineer by an ordinance recently adopted by the city commission. D. D. Harrigan is now city engineer.

# Light Weight Aggregate Economical in Concrete Building

## Tests Show Concrete With Burnt Shale Aggregate Stronger Than With Stone and Its Use Effects Saving

DURING the war great interest was taken in the use in the government concrete ships of a light weight aggregate made by burning and crushing certain kinds of shale or clay, and hopes were frequently expressed that there are great possibilities in the material for ordinary structures, where its low weight would reduce dead load, and thus effect savings enough to offset the added cost of the aggregate. Little has been heard of the material in this use, however, though some of the aggregate has been produced commercially since the war. In Kansas City, Mo., the Haydite Co., successor to the American Aggregate Co. has been manufacturing the material in the form which it calls Haydite and has been selling it for use in commercial structures. George E. McIntyre, architectural engineer, of Kansas City, has been studying the use of the aggregate and has brought to the attention of *Engineering News-Record* certain observations of his in regard to it.




DETAILS OF TEST PANELS FOR COMPARING STRENGTH OF ARTIFICIAL CLAY AGGREGATE AND STONE AND SAND AGGREGATE IN CONCRETE

The general history and properties of the light weight aggregate were described in an article in *Engineering News-Record* April 24, 1919, p. 802, and was described there as follows:

"The new light weight aggregate is an artificially burned clay or shale uniformly filled with small, non-connecting coils. Speaking non-technically, it is in bloated brick; that is, the basic clay or shale from which it is formed, when subjected to a temperature of about 1,800° to 2,000° in a kiln, becomes plastic and seared over on the surface, a coating being formed there which retains the gases generated by decomposition, under heat, of the contained compounds. This expanding gas blows the brick or the clay ball full of holes and bloats it to several times its original size."

The article then describes a number of methods of making the aggregate and recites some of the tests on concrete mixed with it, this concrete, however, be-

ing a very rich (1:2/3:4/3) mixture used in the concrete ships. It states also that there is a company in Kansas City under the direction of Stephen J. Hayde which is manufacturing a somewhat similar product to the government aggregate, which product is known as Haydite. This was developed some years before as the aggregate for sand-lime-brick and is produced in a vertical kiln. The government's aggregate, according to the figures given in 1919, would test as high as 5,000 lb. in the rich ship concrete and made a concrete weighing around 115 lb.

Mr. McIntyre states that his attention was called to Haydite about a year ago, when he was designing a twelve-story reinforced-concrete building. The manufacturers desired to have it used on the building, but owing to the fact that it was an unfamiliar material to the engineer and that there were little data available at that time regarding its merits he did not feel justified in permitting its use. It interested him so, however, that he conducted several experiments with it and has been continuing his investigations in regard to the strength of the concrete made from it and to its economic relations to concrete building.

Haydite as made today is crushed to the desired sizes at the manufacturing plant and is taken to the job already graded to meet the engineer's requirements, so that it is only necessary to add cement and water in the mixer to form a high grade, uniformly dense concrete, and none of the difficulties of pre-proportioning common in the Middle West aggregates are present. For ordinary building work it is graded to pass a ¾-in. sieve.

Strength tests have been conducted simultaneously on a Haydite and stone concrete test panel of the details shown in the accompanying sketch. For this test two panels of joist and slab construction were made side by side, one with crushed limestone as aggregate, the other with Haydite as aggregate, both in the proportion of 1:6. Equal care was taken in both cases and test cylinders made at the time showed a high-class concrete for both. The test pieces were tested at the ages of 28 and 90 days by the Kansas City Testing Laboratory with the results shown herewith:

| | Stone Concrete | Haydite |
|---|---|---|
| Crushing strength at 28 days, lb. per sq. in. | 1,558 | 1,814 |
| Crushing strength at 90 days, lb. per sq. in. | 2,208 | 2,460 |
| Weight per cubic foot, lb. | 150 | 106 |

For loading the panels a wooden bin was constructed so that the material contained therein rested directly on the slab. The sides were tapered toward the top slightly so as to do away with frictional resistance. Material for loading was crusher screenings weighing 95 lb. per cubic foot. Deflections were measured by a copper wire stretched under the center joists. Provision was made for a total load of 700 lb. per square foot as calculations showed that the ultimate strength of the concrete should be exceeded before reaching this figure.

The Haydite panel was loaded first and when the bin was full showed a deflection of ⅛ in. and four face cracks along the under side of the middle joist. Since facilities were not then available for increasing the load, it decided to unload the panel to test the one made of stone concrete. When the load was removed the panel recovered its original position and the cracks closed so tightly as not to be noticed by the naked eye. The calculated stress in the concrete was 2,300 lb. per square inch. Loading was then commenced on the stone concrete panel. When the total load reached 650 lb. per square foot the panel failed in compression, at that time having a total deflection of 2¼ in. Calculations showed a stress of 2,180 lb. per square inch in the concrete.

Seven months after the Haydite panel was made it was again set up and loaded until it failed. This time it failed in compression under a total load of 960 lb. per square foot, which would give a calculated stress of 3,075 lb. per square inch.

Following this crude though informing test, Mr. McIntyre instituted a series of investigations of Haydite and stone concrete cylinders, to be broken at seven days, twenty-eight days, three months, six months, and one year. These results are not yet available for report. A test of the fireproofing properties of the concrete shows that samples heated 1,500 to 1,800° F. for 5 hr. and then allowed to cool give an ultimate strength of 1,337 lb. per square inch as compared with the original strength of 2,835 lb. per square inch. Similar samples of stone concrete placed in the same furnace crumpled before they were removed.

So much for the test investigations that have been made. The economic study was principally concerned with the design of a roof over a gymnasium addition at the Westport High School of Kansas City. It had been decided to raise the roof of an existing gymnasium to build a second floor for the use of another gymnasium. The room was 51 x 96 ft. in plan and is spanned by four plate girders 19.3 in. c. to c. which carried the concrete floor of ribbed slab construction. The structural members were designed for a live load of 100 lb. per square foot and a dead load based on stone concrete of 150 lb. per cubic foot. Working drawings were prepared and a contract made on this basis. Drawings were then prepared by Mr. McIntyre using the same live load but using Haydite concrete at 106 lb. per cubic foot instead of the usual stone concrete. In both cases a maximum compressive stress of 750 lb. per square inch was used. The quantities of the materials necessary for the work according to the two designs and their costs are given in the following itemized analysis comparing the use of the two materials:

| | Original Design (Stone Concrete) | Alternate Design (Haydite Aggregate) |
|---|---|---|
| Structural steel | 66,401 lb. | 54,783 lb. |
| Reinforcing steel | 13,140 lb. | 12,840 lb. |
| Concrete | 120 cu. yd. | 97 cu. yd. |
| For the structural and reinforcing steel the savings were as follows: | | |
| Structural steel | 11,618 lb. at 3.88c. | $450.00 |
| Reinforcing steel | 300 lb. at 3.5c. | 10.50 |
| Concrete in the original design required the following: | | |
| Cement | 175 bbl. at $2.80 | $490.00 |
| Stone | 120 cu. yd. at 2.75 | 330.00 |
| Sand | 60 cu. yd. at 2.75 | 165.00 |
| Labor | 120 cu. yd. at 3.00 per yd. | 360.00 |
| Total | | $1,345.00 |
| Concrete in the redesign required the following: | | |
| Cement | 141.5 bbl. at $2.80 | $396.20 |
| Haydite | 116.5 cu. yd. at 6.00 | 699.00 |
| Labor | 97 cu. yd. at 2.75 per yd. | 267.00 |
| Total | | $1,362.00 |
| Excess cost of Haydite concrete | | $17.00 |
| Saving on steel | | 460.50 |
| Total net saving, $460.50 − $17.00 | | 443.50 |

The floor area covered including the locker room over one bay is 6,138 sq.ft., making a saving of approximately 7¼c. per square foot. Mr. McIntyre says he has allowed 25c. per cubic yard less for labor in handling the Haydite, and that he regards this as extremely conservative as the material is delivered to the job in proper grading and only one set of wheelers is required, as it is so much lighter it is more easily

shoveled than stone aggregate, so that to his mind, at least, a greater saving may result. In the above comparison he used the figures given by the contractor.

It will be noticed that the cost of the artificial burnt clay aggregate is $6 a cubic yard as against $2.75 per cubic yard for the stone and sand.

## Wayne County Widens Old Concrete Highways

### Original Roads Less Than 16 Ft. To Be Increased to a Minimum of 20 Ft.—Construction Methods Described

CONSTRUCTION has begun, widening all concrete highways in Wayne County, Michigan, which are now less than 18 ft. wide. Ultimately all of these narrow roads will be enlarged to 20 ft. or, when on main routes, to 22 or 24 ft. This year two 12-ft. roads are being widened to 20 ft. by a 4-ft. strip on each side. One, known as Fort Road, was constructed in 1911-12 and the other known as Eureka Road, 12 miles long, was built in 1910, 1912 and 1914. Neither road, even in its old parts, requires resurfacing or reconstruction

FIG. 1. TWO 4-FT. SIDE SLABS WIDEN 12-FT. ROAD TO 20 FT.

n any other particular, as is indicated by Fig. 1, to conform in smoothness to the new construction.

One side strip is constructed at a time so that about ) ft. of the old pavement and one shoulder are free to carry traffic during construction. This is particularly necessary as traffic is intense and to detour it would be expensive both to the county in providing the detour and to the vehicle users in increased mileage and reduced speed. No practicable saving in cost of construction, which might be obtainable by building the side strips simultaneously, it was considered could make up for the loss to traffic by closing the road. Wayne County roads, with Detroit as their focus, have a traffic of 3,000 to 10,000 vehicles a day.

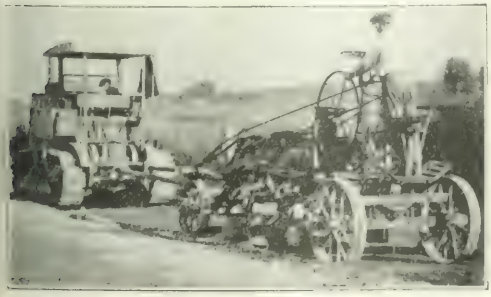


FIG. 2. TRACTION GRADER OUTFIT PREPARES SUB-GRADE FOR SIDE SLAB

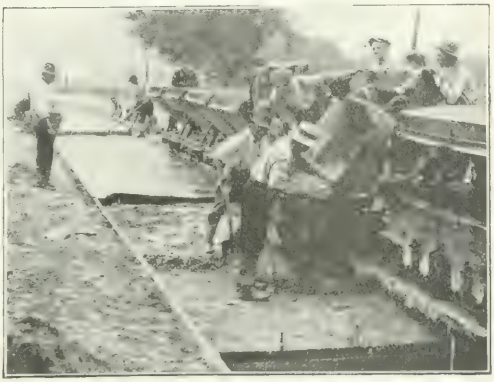


FIG. 3. SIDE SLAB CONSTRUCTED AS MINIATURE ROAD

Construction is begun by plowing the shoulder for the necessary width and removing the earth by means of a blade grader hauled by a tractor. The plowing is also done by the tractor. A trench deep enough for a 9-in. slab is excavated whatever the edge thickness of the old slab may be. Its bottom is smoothed, an outside form is set, and the edge of the old slab is broken down by sledging so as to give the break a rough undercut as shown by Fig. 3. With the sub-grade prepared, the method of constructing the slab is similar to that of standard section road construction.

A ½-cu.yd. portable mixer is set up once every 2 miles as a central mixing plant, and the mixed concrete is hauled a mile each way by industrial railway and deposited as indicated by Fig. 3. The joints are placed opposite the joints in the old slab and the concrete is finished by strike board and belt. Materials for the mixer are brought in by motor trucks and the mixer is charged by wheelbarrow. With a 12-car train about 900 ft. of 4-ft. slab has been placed in a day. The cost of the slab has averaged about $3.50 a square yard.

Construction in Wayne County is by force account and the road widening is being conducted by county forces under the direction of the county road commission, Edward N. Hines, chairman, Detroit, Mich.

### Certification of Steamship Water Supplies

Since April 15 the general scheme of supervision of water supplies used for drinking and cooking purposes on railway trains engaged in interstate commerce has been extended to supplies on board ships on rivers and lakes and between ports of the United States and adjacent countries. Ship water supplies must either be obtained on shore from an approved source or else must be treated on shipboard by an approved method. No connections will be permitted between drinking water pipes and pipes for any other water system. The Public Health Service expresses the hope that by means of this control outbreaks of typhoid fever and dysentery, such as occurred twice on river steamers in 1920, will be prevented.

# Stress Coefficients for Large Horizontal Pipes

## Various Elementary Kinds of Loading Separately Considered and Adaptable by Proper Combination to Actual Loadings Under Any Condition of Support and Surcharge

By James M. Paris
General Fireproofing Co., San Francisco

CALCULATIONS of stresses in large horizontal pipes are tedious and liable to error when the full analysis must be gone through anew for each case of loading. Under these conditions it is rarely practicable to determine the comparative merits of different arrangements of the support or of the surcharge, and it is likely even in an important undertaking that a design of pipe-line may be adopted that is unnecessarily costly. When loadings are split up into their several elementary cases, however, it is possible to compute once for all the formulas for bending moment and tension in the shell, and reduce the labor required in any specific example to mere numerical computation for the formulas, using a proper combination of the elementary loadings to suit the actual loading in the example.

This method is developed in the present article, and is made still more adaptable to the needs of practice by stress-coefficient tables computed for the several elementary loadings. The application of the tables is illustrated by examples.

### General Principles of Analysis

For balanced loads on a large circular pipe, the tangents at the ends of the vertical diameter which bisects the loads do not change direction. The deflection along this diameter may be assumed to take place at one end. Considering the half pipe to one side of this diameter, its one end may be assumed fixed, and the half pipe treated as a cantilever beam; the free end may be imagined to deflect under the applied external loads, and then brought back to its original direction by a moment $M_T$ applied there, and back to its original position by a horizontal force $H_T$. No force is required along the vertical diameter at the free end, as the pipe is free to deflect vertically there. But a force equal to the vertical component of the loads is put at the bottom to prevent translation of the ring.

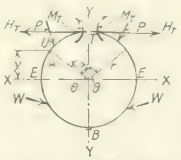
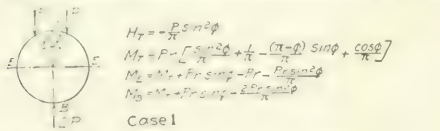


FIG 1. FORCE CONDITIONS IN PIPE SHELL

In this problem the modulus of elasticity, $E$, and the moment of inertia of the pipe shell, $I$, are considered constant; and (see adjoining sketch) the angle $\theta$ and the abscissa $x$ are taken positive on both side of axis $YY$. A positive moment bends the ring inwardly, causing tension on inside of shell, and a negative moment bends it outwardly; a positive $H_T$ is compression in the shell, and a negative $H_T$ is tension. These forces act as shown if the results of the following equations are positive, and in reversed sense for negative answers.

In the integrals, $m$ is the cantilever moment of the external forces on either half of the pipe. From the elastic arch theory, using Maxwell's theory of recipro-



$$H_T = -\frac{P}{\pi}\sin^2\phi$$

$$M_T = Pr\left[\frac{\sin^2\phi}{\pi} + \frac{1}{\pi} - \frac{(\pi-\phi)}{\pi}\sin\phi + \frac{\cos\phi}{\pi}\right]$$

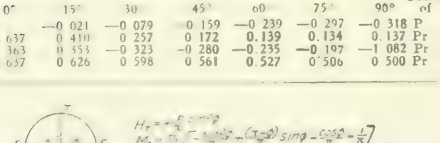
$$M_E = M_T + Pr\sin^2\phi - Pr - \frac{Pr\sin\phi}{\pi}$$

$$M_B = M_T + Pr\sin^2\phi - \frac{2Pr\sin^2\phi}{\pi}$$

Case 1

CASE I. CONCENTRATED LOADS ON TOP

| $\phi$ | 0° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| $H_T$ | 0 | −0.021 | −0.079 | −0.159 | −0.239 | −0.297 | −0.318 | P |
| $M_T$ | +0.637 | 0.410 | 0.257 | 0.172 | 0.139 | 0.134 | 0.137 | Pr |
| $M_E$ | 0.363 | 0.353 | −0.323 | −0.280 | −0.235 | −0.197 | −1.082 | Pr |
| $M_B$ | +0.637 | 0.626 | 0.598 | 0.561 | 0.527 | 0.506 | 0.500 | Pr |



$$H_T = -\frac{P}{\pi}\sin^2\phi$$

$$M_T = Pr\left[-\frac{\sin^2\phi}{\pi} - \frac{(\pi-\phi)}{\pi}\sin\phi - \frac{\cos\phi}{\pi} + \frac{1}{\pi}\right]$$

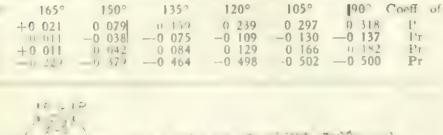
$$M_E = M_T + Pr\sin^2\phi$$

$$M_B = M_T - Pr\sin\phi + \frac{2Pr\sin^2\phi}{\pi}$$

Case 2

CASE II. CONCENTRATED LOADS ON BOTTOM

| $\phi$ | 180° | 165° | 150° | 135° | 120° | 105° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| $H_T$ | 0 | +0.021 | 0.079 | 0.159 | 0.239 | 0.297 | 0.318 | P |
| $M_T$ | 0 | 0.011 | −0.038 | −0.075 | −0.109 | −0.130 | −0.137 | Pr |
| $M_E$ | 0 | +0.011 | 0.042 | 0.084 | 0.129 | 0.166 | 0.182 | Pr |
| $M_B$ | 0 | −0.227 | −0.379 | −0.464 | −0.498 | −0.502 | −0.500 | Pr |



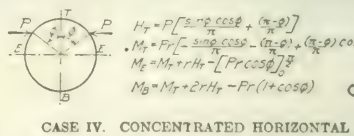
$$H_T = 0 \qquad M_E = M_B = Pr\left(\frac{1}{\pi}\cos\phi - \frac{1}{\pi}\sin\phi\right)$$

$$M_T = M_E - Pr\left(-\frac{1}{\pi}\sin\phi\right)$$

Case 3

CASE III. BALANCED CONCENTRATED LOADS ON TOP AND BOTTOM

| $\phi$ | 0° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| $M_T$ | −0.637 | −0.540 | −0.317 | −0.097 | −0.030 | −0.004 | 0 | Pr |
| $M_E$ | 0.363 | 0.342 | 0.264 | 0.196 | 0.104 | 0.030 | 0 | Pr |
| $M_B$ | +0.637 | 0.599 | 0.419 | 0.097 | 0.030 | 0.004 | 0 | Pr |



$$H_T = P\left[\frac{\sin\phi\cos\phi}{\pi} + \frac{(\pi-\phi)}{\pi}\right]$$

$$M_T = Pr\left[-\frac{\sin\phi\cos\phi}{\pi} - \frac{(\pi-\phi)}{\pi} + \frac{(\pi-\phi)}{\pi}\cos\phi + \frac{\sin\phi}{\pi}\right]$$

$$M_E = M_T + rH_T - \left[Pr\cos\phi\right]\frac{r}{2}$$

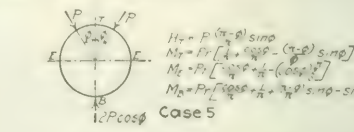
$$M_B = M_T + 2rH_T - Pr(1+\cos\phi)$$

Case 4

CASE IV. CONCENTRATED HORIZONTAL LOADS

| $\phi$ | 0° | 15° | 30° | 45° | 60° | 75° | 90° |
|---|---|---|---|---|---|---|---|
| $H_T$ | +1.00 | 0.996 | 0.971 | 0.909 | 0.804 | 0.663 | 0.500 |
| $M_T$ | 0 | −0.028 | −0.090 | −0.154 | −0.196 | −0.215 | −0.182 |
| $M_E$ | 0 | +0.002 | 0.015 | 0.048 | 0.109 | 0.199 | 0.318 |
| $M_B$ | 0 | −0.002 | −0.014 | −0.043 | −0.086 | −0.137 | −0.182 |

| $\phi$ | 105° | 120° | 135° | 150° | 165° | 180° | Coeff. of |
|---|---|---|---|---|---|---|---|
| $H_T$ | 0.337 | 0.196 | 0.091 | 0.029 | 0.004 | 0 | P |
| $M_T$ | 0.138 | −0.086 | −0.042 | −0.014 | −0.002 | 0 | Pr |
| $M_E$ | 0.199 | 0.109 | 0.048 | 0.015 | 0.002 | 0 | Pr |
| $M_B$ | −0.205 | −0.195 | −0.154 | −0.090 | −0.019 | 0 | Pr |



$$H_T = P\frac{(\pi-\phi)}{\pi}\sin\phi$$

$$M_T = Pr\left[\frac{1}{\pi} + \frac{\cos\phi}{\pi} - \frac{(\pi-\phi)}{\pi}\sin\phi\right]$$

$$M_E = Pr\left[-\frac{\sin^2\phi}{\pi} + \frac{1}{\pi} - \frac{(\pi-\phi)}{\pi}\cos\phi\right]$$

$$M_B = Pr\left[\frac{\cos\phi}{\pi} + \frac{1}{\pi} - \frac{(\pi-\phi)}{\pi}\sin\phi - \sin\phi\right]$$

$\frac{1}{2}P\cos\phi$ Case 5

CASE V. CONCENTRATED RADIAL INWARD LOADS

| $\phi$ | 0 | 15° | 30° | 45° | 60° | 75° | 90° |
|---|---|---|---|---|---|---|---|
| $H_T$ | 0 | +0.237 | 0.417 | 0.530 | 0.577 | 0.563 | 0.500 |
| $M_T$ | +0.637 | +0.388 | +0.177 | +0.013 | −0.100 | −0.163 | −0.182 |
| $M_E$ | −0.363 | −0.330 | −0.272 | −0.164 | −0.023 | +0.141 | +0.318 |
| $M_B$ | +0.637 | +0.604 | +0.511 | +0.366 | +0.188 | −0.002 | −0.182 |

| $\phi$ | 105° | 120° | 135° | 150° | 165° | 180° | Coeff. of |
|---|---|---|---|---|---|---|---|
| $H_T$ | 0.402 | 0.289 | 0.177 | 0.083 | 0.021 | 0 | P |
| $M_T$ | −0.167 | −0.129 | −0.084 | −0.041 | −0.011 | 0 | Pr |
| $M_E$ | +0.235 | +0.160 | +0.093 | +0.042 | +0.010 | 0 | Pr |
| $M_B$ | −0.329 | −0.417 | −0.437 | −0.375 | −0.228 | 0 | Pr |

cal deflections, the following equations for the unknown reactions $M$ and $H$ are easily deduced:

$$H_T = \frac{\int_o^\pi m\cdot ds \int_o^\pi (r - y)\cdot ds - \int_o^\pi m\cdot r - y\, ds \int_o^\pi ds}{\int_o^\pi (r-y)^2 ds \int_o^\pi ds - \left[\int_o^\pi r - y\, ds\right]^2}$$

$$\frac{2}{\pi r}\int_o^\pi m\cdot\cos\theta\cdot d\theta$$

$$M_T =$$

$$\frac{\int_o^\pi m\,(r-y)ds \int_o^\pi (r-y)ds - \int_o^\pi m\cdot ds \int_o^\pi (r-y)^2 ds}{\int_o^\pi (r-y)^2 ds \int_o^\pi ds - \left[\int_o^\pi r - y\, ds\right]^2}$$

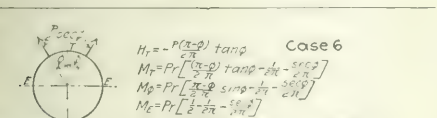
$$= -rH_T - \frac{1}{\pi}\int_o^\pi m\cdot d\theta$$

The shell moment at any point $U$ is,

$M_\theta = M_T + H_T r\,(1 - \cos\theta) + M_\theta$, where $m$ is the moment of loads between $T$ and $U$ around $U$.

By substituting for $m$ in these integrals its actual value for any loading, values of $H_T$, $M_T$, $M_E$, $M_B$, are found for that loading. When this has been done for various simple or elementary loadings, as in the present article, any number of these loadings may be combined, and by addition of the separate values the resultant value of $H_T$ or $M_T$ may be found.

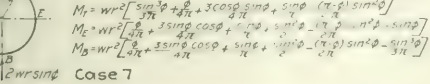
Cases 7 to 15 may be used in combinations for earth loading according to the judgment of the engineer. For example, Cases 16, 18 and 8 acting together give $w_s r \sin\phi = \pi r^2 w_{16} + 2\pi r w_{18}$, and this gives $w_s = (\frac{1}{2} r w_{16} + w_{18})/\sin\phi$, which is the value to be used in case 8. For $\phi = 7\frac{1}{2}°$, $H_T = 0.0002 r w_s - 0.5 r w_{16} - .25\, r^2 w_{18}$.



Case 6

CASE VI. CONCENTRATED RADIAL OUTWARD LOADS

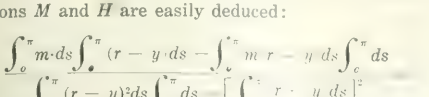
| $\phi$ | 0 | 15° | 30° | 45° | 60° | 75° | Coeff. of |
|---|---|---|---|---|---|---|---|
| T | 0 | −0 123 | −0 241 | 0 375 | 0 577 | 1 089 | P |
| T | −0 318 | −0 211 | −0 102 | 0 009 | +0 100 | +0 315 | Pr |
| E | +0 182 | +0 176 | +0 157 | +0 116 | +0 023 | −0 274 | Pr |
| B | −0 318 | −0 313 | −0 295 | −0 259 | −0 189 | +0 003 | Pr |
| B | −0 318 | −0 205 | −0 135 | 0 119 | 0 189 | 0 442 | Pr |



Case 7

CASE VII. UNIFORMLY DISTRIBUTED LOAD ON TOP

| | 7½° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| T | −0 0002 | −0 002 | −0 013 | −0 037 | −0 069 | −0 096 | −0 106 | wr |
| T | +0 085 | 0 134 | 0 213 | 0 257 | 0 281 | 0 295 | 0 299 | wr² |
| E | −0 047 | −0 093 | −0 175 | −0 238 | −0 279 | −0 300 | −0 307 | wr² |
| B | +0 084 | 0 164 | 0 312 | 0 432 | 0 518 | 0 570 | 0 587 | wr² |



Case 8

CASE VIII. UNIFORMLY DISTRIBUTED LOAD ON BOTTOM

| $\phi$ | 7½° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| T | +0 0002 | 0 002 | 0 013 | 0 037 | 0 069 | 0 096 | 0 106 | wr |
| E | −0 0001 | 0 001 | 0 006 | 0 018 | 0 035 | 0 045 | 0 049 | wr² |
| E | +0 0001 | 0 001 | 0 007 | 0 019 | 0 036 | 0 051 | 0 057 | wr² |
| B | −0 0001 | 0 031 | 0 105 | 0 193 | 0 270 | 0 320 | 0 337 | wr² |

It will be observed that by supporting the pipe under all conditions of loading by a single reaction at the bottom, one is able to use several types of loading together. It is only necessary to equate the sum of their reactions to zero, as the upward reactions of one or more types must balance the downward reactions of the others. Thus, if a pipe is supported by a uniform upward reaction over part of the bottom (Case 8), and loaded by two concentrated loads on top (Case 1), $R_s$ must be equal and opposite to $R_1$, or $2w_s r \sin\phi = 2P_1$, so that $w_s = P_1/r \sin\phi$. Using the table of Case 8 with this value of $w$, the values of $H_T$, $M_T$, $M_E$ and $M_B$ are taken out, and added to $H_T$, $M_T$, $M_E$ and $M_B$ respectively. The sums are the required values.

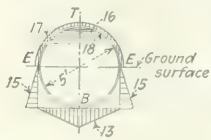



FIG. 2. COMBINATION LOADING I

This method will be applied to two examples, in which five types of loading occur in combination.

EXAMPLE I—A 60-in. steel pipe with ½-in. shell is half buried in slightly yielding ground, and covered with 8 in. of earth. The pipe is full of water. Earth is taken at 105 lb. per cu.ft., and horizontal earth pressure at one-third the vertical pressure. The reaction is computed thus:

| | |
|---|---|
| Shell (Case 16) | 321 lb. per lin.ft. |
| Water (Case 18) | 1223 lb. per lin.ft. |
| Earth cover (Case 17) | 550 lb. per lin.ft. |
| Horizontal earth pressure (Case 15) | 0 lb. per lin.ft. |
| Vertical reaction (Case 13), total of above | 2094 lb. per lin.ft. |

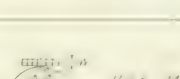
Since the total reaction in Case 13 is $wr^2$ per lineal foot, $2094 = wr^2$ or $w_{13} = 335$ lb. The results are as follows:

COMBINATION LOADING I

| Case | HT Lb. per Ft. Run | MT Lb. per ft. run | MT Ft.-lb. per ft. run (=in.-lb. per in. run) |
|---|---|---|---|
| 16 | −0 5000$w_{16}r$ | −25 5 | − 2.1 | +0 500$w_{16}r^2$ | + 64 |
| 18 | 0 750$w_{18}r^2$ | −292 1 | −24 3 | +0 250$w_{18}r^3$ | +242 |
| 17 | −0 250$w_{17}r$ | − 43 7 | − 3 6 | +0 387$w_{17}r^2$ | +170 |
| 15 | +0 0625$w_{15}r^2$ | + 13 7 | + 1 1 | −0 027$w_{15}r^3$ | − 15 |
| 13 | +0 0265$w_{13}r^2$ | + 55 5 | + 4 6 | −0 013$w_{13}r^3$ | − 67 |
| | Total = 24 3 lb. per in. run (tens.) | | | Total | +394 |

| Case | ME Ft.-lb. per ft. run (-in.-lb. per in. run) | MB Ft.-lb. per ft. run (= in.-lb. per in. run) |
|---|---|---|
| 16 | −0 571$w_{16}r^2$ | − 73 | +0 50$w_{16}r^2$ | + 191 |
| 18 | −0 285$w_{18}r^3$ | −278 | +0 75$w_{18}r^3$ | +731 |
| 17 | −0 434$w_{17}r^2$ | −190 | +0 887$w_{17}r^2$ | +388 |
| 15 | +0 035$w_{15}r^3$ | + 19 | 0 069$w_{15}r^3$ | + 38 |
| 13 | +0 014$w_{13}r^3$ | + 72 | −0 126$w_{13}r^3$ | −660 |
| | Total | −450 | Total | +612 |

As the ½-in. plate has a section modulus of $\frac{1}{24}$ per inch run, the bending stress at $T$ is 9,450 lb. per sq.in. (pipe bends in), that at $E$ is 10,800 lb. per sq.in. (pipe bends out), and that at $B$ is 14,700 lb. per sq.in. (pipe bends in).



Case 9

CASE IX. BALANCED UNIFORMLY DISTRIBUTED LOADS, TOP AND BOTTOM

| $\phi$ | 7½° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|
| MT MB | +0 085 | 0 133 | 0 207 | 0 239 | 0 248 | 0 249 | 0 250 | $wr^2$ |
| ME | −0 047 | −0 092 | −0 168 | −0 219 | −0 243 | −0 249 | −0 250 | $wr^2$ |

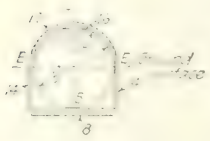


FIG. 3. COMBINATION LOADING II

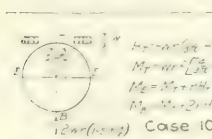
EXAMPLE II—For the same pipe as in the preceding example, but in very firm ground, allowing the bottom reaction (and the lateral earth loading) to be taken uniform, the calculation is as follows: Vertical reaction same as before, 2,094 lb.; $w_s = R_s/2r = 419$ lb. Taking values for Cases 16, 18, 17 from the table given for Example I, and those for Cases 14, 8 from the coefficient tables for those cases, the figures become:

COMBINATION LOADING II

| | $H_T$ | $M_T$ |
|---|---|---|
| | Lb. per sq. in., Ins. pipe Ft., Run | In.-lb. per in. run In., Run |
| 14 | 0.212w | 0.087$wr^2$ 128 |
| 8 | 0.167w | 0.042$wr^2$ 329 |
| | 380 + 167 = 547 | Total, +476 − 147. |

| | $M_E$ | $M_B$ |
|---|---|---|
| | Case Ft.-lb. ft. run (=in.-lb. per in. run) | In.-lb. per ft. run (=in.-lb. per in. run) |
| 14 | +0.125$wr^2$ +27 | 0.163w 36 |
| 8 | −0.057$wr^2$ −159 | 3.537w 880 |
| | Total, −541 + 186, −355 | Total, +1,310 − 916, 394 |

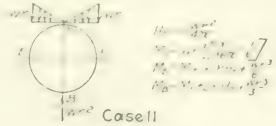
The flexural stresses due to these moments are: at $T$, 7,900 lb. per sq.in. (pipe bends in); at $E$, 8,520 lb. per sq.in. (pipe bends out); at $B$, 9,460 lb. per sq.in. (pipe bends in). The stresses are more uniform and less in amount than those of the first example, as might be expected.



Case 10

CASE X. UNIFORMLY DISTRIBUTED PARTIAL LOADING

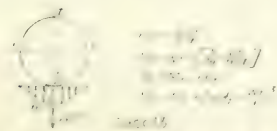
| | 0° | 7.5° | 15° | 30° | 45° | 60° | 75° | 90° | Coeff. of |
|---|---|---|---|---|---|---|---|---|---|
| $H_T$ | 0.166 | 0.165 | 0.163 | 0.155 | 0.142 | 0.117 | 0.080 | 0 | $wr^1$ |
| $M_T$ | +0.299 | 0.210 | 0.165 | 0.087 | 0.052 | 0.018 | 0.004 | 0 | $wr^2$ |
| $M_E$ | −0.307 | −0.273 | −0.216 | −0.131 | −0.059 | −0.028 | −0.007 | 0 | $wr^2$ |
| $M_B$ | +0.587 | 0.490 | 0.423 | 0.276 | 0.165 | 0.069 | 0.016 | 0 | $wr^2$ |



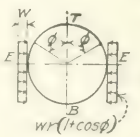
Case 11

CASE XI. WEDGE-SHAPED LOADING, ZERO AT CROWN

CASE XII. WEDGE-SHAPED LOADING, ZERO AT HAUNCHES



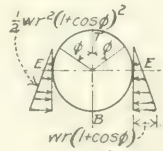
CASE XIII. WEDGE-SHAPED LOADING



Case 14

CASE XIV. UNIFORM HORIZONTAL LOADING

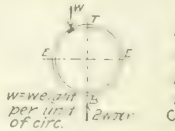
| | 0° | 15° | 30° | 45° | 60° | 75° | 90° | |
|---|---|---|---|---|---|---|---|---|
| $H_T$ | +1.000 | 0.966 | 0.868 | 0.718 | 0.540 | 0.363 | 0.212 | |
| $M_T$ | −0.250 | −0.249 | −0.244 | −0.214 | −0.187 | −0.138 | −0.087 | |
| $M_E$ | +0.250 | 0.250 | 0.249 | 0.244 | 0.228 | 0.192 | 0.125 | |
| $M_B$ | −0.250 | −0.250 | −0.249 | −0.245 | −0.232 | −0.205 | −0.163 | |
| | 105° | 120° | 135° | 150° | 165° | 180° | Coeff. of | |
| $H_T$ | 0.104 | 0.040 | 0.011 | 0.002 | 0.000 | 0 | $wr$ | |
| $M_T$ | −0.045 | −0.019 | −0.005 | −0.001 | −0.000 | 0 | $wr^2$ | |
| $M_E$ | 0.059 | 0.022 | 0.006 | 0.001 | 0.000 | 0 | $wr^2$ | |
| $M_B$ | −0.112 | −0.063 | −0.027 | −0.008 | −0.001 | 0 | $wr^2$ | |



Case 15

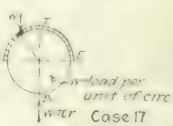
CASE XV. WEDGE-SHAPED HORIZONTAL LOADING

| | 0° | 15° | 30° | 45° | 60° | 75° |
|---|---|---|---|---|---|---|
| $H_T$ | +0.625 | 0.592 | 0.500 | 0.374 | 0.244 | 0.136 |
| $M_T$ | −0.208 | −0.199 | −0.174 | −0.138 | −0.095 | −0.056 |
| $M_E$ | +0.250 | 0.243 | 0.219 | 0.177 | 0.128 | 0.077 |
| $M_B$ | −0.292 | −0.281 | −0.256 | −0.219 | −0.169 | −0.117 |
| | 90° | 105° | 120° | 135° | 150° | 180° Coeff. of |
| $H_T$ | 0.062 | 0.022 | 0.006 | 0.001 | 0.000 | 0 $wr^2$ |
| $M_T$ | −0.027 | −0.010 | −0.003 | −0.000 | 0.000 | 0 $wr$ |
| $M_E$ | 0.035 | 0.012 | 0.003 | 0.001 | 0.000 | 0 $wr$ |
| $M_B$ | −0.069 | −0.033 | 0.012 | −0.001 | −0.000 | 0 $wr$ |



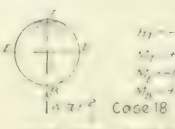
Case 16

CASE XVI. WEIGHT OF PIPE



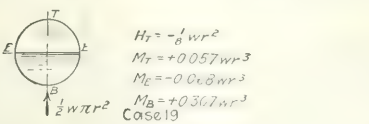
Case 17

CASE XVII. UNIFORM BLANKET ON TOP HALF



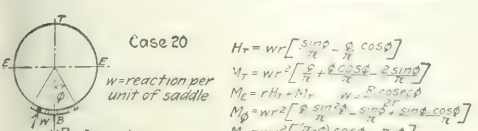
Case 18

CASE XVIII. PIPE FULL OF WATER




Case 19

CASE XIX. PIPE HALF FULL OF WATER


Case 20
T
E
E
φ
w=reaction per unit of saddle
$wR = 2wr \sin\phi$
$H_T = wr\left[\frac{\sin\phi}{\pi} - \frac{\phi}{\pi}\cos\phi\right]$
$M_T = wr^2\left[\frac{\phi}{\pi} + \frac{2\cos\phi}{\pi} - \frac{2\sin\phi}{\pi^2}\right]$
$M_E = rH_T + M_T \quad w = R\cos\phi$
$M_D = wr^2\left[\frac{\phi}{\pi}\sin\phi - \frac{\sin^2\phi}{\pi} + \frac{\sin\phi\cos\phi}{\pi}\right]$
$M_B = wr^2\left[\left(\frac{\pi-\phi}{\pi}\right)\cos\phi - \frac{\pi-\phi}{\pi}\phi\right]$

CASE XX. UNIFORM RADIAL SADDLE REACTION

| φ | 7½° | 15° | 30° | 45° | 60° | 75° | 90° |
|---|---|---|---|---|---|---|---|
| T | 0.0002 +4 | 0.0018 | 0.0148 | 0.0483 | 0.1090 | 0.1995 | 0.3183 |
| [T | −0.00012 | −0.0009 | −0.0072 | 0.0234 | −0.0514 | −0.0902 | −0.1366 |
| [E | +0.00012 | 0.0009 | 0.0076 | 0.0149 | 0.0576 | 0.1093 | 0.1817 |
| [ | −0.00820 | −0.0313 | −0.1116 | −0.2197 | −0.3333 | −0.4324 | −0.5000 |

# Tastes and Odors in Water Due to Low Oxygen Content

## laumee River Investigations Indicate Water in Ice-Bound Channel Subject to Anaerobic Bacterial Decomposition

DISAGREEABLE tastes and odors in the winter in the water taken from the Maumee River for domes-c consumption at Toledo, Napoleon and Defiance, Ohio, ave several times in past years been so pronounced to cause severe complaints by consumers as well as ss of fish life. In 1920 the complaints of the water rveyed in Toledo and Napoleon became so general at the State Department of Health was induced to ake an investigation to determine, if possible, the use as well as to recommend remedial measures. In report made to W. H. Dittoe, chief engineer of the ard, by F. H. Waring, assistant engineer, the con-usion is reached that the trouble is due to lowered ssolved oxygen content brought about by a long con-nued ice layer. The following notes are from this port:

The water of the Maumee River is naturally hard and ntains an abnormally high chlorine content (NaCl), prob-ly due to the gas- and oil-well wastes which are dis-arged into the smaller tributaries in and around Findlay d Lima. There is not sufficient salt in the river water, wever, to cause any inconvenience. In addition to the l- and gas-well wastes mentioned, the river receives sewage llution from a large number of communities aggregating ore than 15,000 in population along the banks of the aumee and its tributaries.

All of the eleven communities within 180 miles, with e exception of St. Mary's, which has a treatment plant, scharge sanitary sewage untreated into Maumee River. t a point about five miles below Defiance, the state has nstructed a dam across the Maumee River to divert a rtion of the flow to the Miami and Erie Canal. The dam 400 ft. long and 7 ft. high and causes slack water as r upstream as Defiance.

A detailed study of the disturbance to the Toledo supply 1912 and 1913 was made by R. Winthrop Pratt for the partment of public service. He concluded that the trouble as due to coal-tar wastes entering the Maumee River not r below the water-works intake. The wastes were car-ed upstream under certain conditions of wind and slack ater currents past the intake to the filter plant. The moval of these wastes to a point farther downstream iminated the source of complaint.

During the winter of 1916 and 1917 a very marked re-occurrence of tastes and odors exhibited itself in the Toledo public water supply. The department of public service employed George W. Fuller, J. W. Ellms and W. G. Clark as consultants to advise the city regarding the source and possible means for overcoming the objectionable conditions. In a conference with the chief engineer of the State Department of Health, the conclusion was reached that the tastes and odors were due to the growth and subsequent decay of vegetation on the river bed and banks, taking place at a time when the river was low and continuously ice-bound for a long period. The engineers recommended that the city attempt to remove the objectionable gaseous constituents by aeration and the dissolved constituents by more complete coagulation with sulphate of alumina. No action was taken, however, to provide the aeration recommended.

### Fish Life Destroyed

The State Fish and Game Commission had received notification from its several deputy wardens in the Maumee River watershed that a serious condition to fish life was observed during the winter of 1919-1920. As far as could be learned the conditions this year were much more injurious to fish life than have ever been noted in the past.

Investigations made in 1920, when there was 2 ft. of ice on the river and during the breaking up of the ice, indicate as low as 35 per cent saturation before and 65 per cent after the break-up. At Toledo the figures were 58 and 82 per cent respectively. The odors, which were strong grassy, and tastes, were most objectionable when the dissolved oxygen was lowest. Only one sample had a faint tarry odor.

During the period of these investigations, information was secured from the State Department of Health of Michigan that a similar condition prevailed throughout that state for those public water supplies that were obtained from surface sources. Dissolved oxygen studies on streams frozen over indicated that on streams receiving no pollution of industrial or municipal character whatever, the dissolved oxygen reached as low as 40 per cent saturation. Some streams exhibited as low as 4 per cent saturation when influenced by sewage and other wastes.

As far as could be determined in this survey in Ohio in 1920, the one river of size tributary to the Maumee River which receives no pollution of an industrial or municipal character, namely, the Tiffin River, showed equally as low a dissolved oxygen factor as the other points examined. It is not possible to state how greatly the industrial wastes and municipal sewage affected the dissolved oxygen and oxygen demand factors, and a more extended study would be necessary to reach such a conclusion. Nevertheless, it is felt that sufficient data are at hand to make the following general conclusions:

The winter just past has been severe and prolonged for an unusual period, extending from very early in December to almost the middle of March. Stream flow in the Maumee River has been at a minimum continuously; in fact as low as can be remembered by the older inhabitants in the vicinity. The dissolved oxygen reached a point low enough to endanger the life of fish seriously. Concentration of organic materials in the river water coming from vegetative sources natural to the watershed, and coming from industrial and municipal wastes, made heavy demand upon the oxygen in the water, such that decomposition took place largely under anaerobic conditions. Ice-bound conditions unbroken over the entire period favored the anaerobic decomposition.

Analytical evidence indicates that the sources of the tastes and odors are the products of such anaerobic decomposition of organic matter. The opinions advanced in 1917 by the consulting engineers employed by the city of Toledo would seem to be confirmed and a satisfactory relief for similar conditions in the future would consist of aeration of the public water supplies, in conjunction with proper coagulation in the water treatment processes, so as to remove objectionable gaseous constituents by aeration and the dissolved constitutents by coagulation.

# Drainage Reclamation of Alkaline Irrigated Lands

## Ditch and Tile Drains Remove Alkali and Excess Water from Land in Utah at Reasonable Cost—Old Drains Utilized

By Charles F. Brown
Consulting Engineer, Salt Lake City, Utah

DRAINAGE of irrigated lands which have become waterlogged and alkaline through excessive application of water is an increasingly necessary supplement to irrigation projects. An example of the successful reclamation of such lands is afforded by Millard County Drainage District No. 1, near Hinckley, Utah, which comprises 5,040 acres in the Escalante Valley and is irrigated by the Deseret Irrigation Co.'s gravity canal from the Sevier River.

With an abundant water-supply, various portions of the land have been successively waterlogged, made alkaline and abandoned, sometimes returning after many years of temporary productiveness even without drainage. Such land responds rapidly to drainage and requires but a short time for reclamation, the cost per acre being small in relation to the ultimate productivity and value of the land so treated. Mistakes of design and construction in some tile drainage work had tended to give the impression that these lands could not be drained and reclaimed successfully.

The most important problems with which the pioneer drainage engineers and contractors were confronted were as follows: (1) Caring for running sands in such a way that the water could be drained into the tiles without a flow of sand to cause stoppage of the drains; (2) securing within economical cost a filter medium which would accomplish the objects of drainage with permanency and durability of operation; (3) control of irrigation water so as to prevent damage to the newly filled trenches and the consequent menace of washing out or displacing the tiles; (4) salvaging earlier works on which from $40,000 to $75,000 had been spent upon drains which were damaged by sand and erosion and were inefficient owing to the use of small tiles and especially long tile lines of small sizes.

### Soil Treatment—Construction Methods

Although the trouble was due in part to the use of 3 to 4 acre-feet of irrigation water per season on lands that should not have been given more than 2½ acre-feet, alkali would form on the most carefully irrigated lands without artificial under-drainage. It has been demonstrated on similar lands that even if there is no surplus of water applied in irrigation, so that the groundwater table is not raised and the water can be disposed of entirely through the plants and from the surface of evaporation, there will still follow accumulations of alkaline salts within the surface foot of soil, thus preventing the growth of crops.

Land in this district is sandy clay loam of high quality, but much of it has deteriorated and was suitable only for pasturage when the drainage district was formed. Other portions threatened to fall into a similar condition.

The first construction was 1¼ miles of open ditch 8 to 10 ft. wide on the bottom, with side slopes of 1 on 1½ for the firmer portions and 1 on 2 where the soil was less stable. The depths ranged from 3½ at the Sevier River outlet to a maximum of 12 ft. through a slight ridge. These dimensions made it possible to discharge the tile drains into the ditch above the surface of the water, thus preventing backwater in the tiles with possible clogging by sand and sediment. The open ditch is calculated to carry 15 sec.-ft. To protect it from the accumulation of weeds and other debris a wire mesh fence on each side of the spoil banks will be hung on iron posts, permitting the burning of weeds as they are blown across the fields and lodged against the fences. This ditch of approximately 80,000 cu.yd. was completed with one dragline excavator in 15 days.

### Tile Drain Layout

Work was then started on the laying of 224,000 lin.ft. of 6 to 15-in. tile, about 58,000 ft. of the largest size being laid in several parallel lines affording both field drainage and outlet drains. All tiles have their tops approximately 5 ft. below the ground and the laterals drain into the main tiles at the top, again preventing backwater. Drains are from 400 to 1,000 ft. apart, depending upon the degree of waterlogging and the character of the soil. One trenching machine with a crew of seven men had laid as high as 40,000 ft. of tile a month, and the average daily output per machine from Oct. 1 to June 1 was 1,000 ft. This is rapid work, especially as 60 per cent of the tiling had cinders from a sugar factory packed around the joints.

This type of construction is used in all quicksand pockets and in sandy lands, wet or dry, the cinders operating as a filter to strain out the sand. A shield and tile laying apparatus attached the trenching machine enabled this packing to be placed around the joints at a cost of less than 1c. per foot. The machine also had an attachment which provides an end thrust of several hundred pounds on the tile until the cinders and partial back-filling are in place, thus overcoming the tendency of the tiles to "creep" behind the machine and leave wide joints through which the earth might enter. In soft ground the tiles were laid on 1-in. boards 8 in. wide, breaking joints with the tile.

When water is first applied to the newly filled trenches or onto the lands in irrigation, a thin iron sheet is fitted between the tile joints at intervals of 600 ft. to cause backwater and consequent saturation until the filling is thoroughly puddled and settled. This is removed after the irrigation supply has been cut off and the roughly filled trenches have settled compactly down to the level of the surrounding lands so that no subsequent erosion would occur due to ordinary irrigation

### Sand Traps Installed

Sand traps 3 x 6 ft. with bottoms 18 in. below the bottom of the tiles and open to the surface were installed where required. These are of wood, but will serve as forms for future concrete boxes. These sand traps are specially frequent at junctions with old tiling which it was sought to salvage. In the earliest stage of the salvaging these traps had to be emptied of sand twice daily, but the necessity is much less frequent when flushing the old lines had ceased.

Spring crops have been grown on lands which a year ago were white with alkali. The efficiency of the system is indicated by the fact that the 15-in. tiles are running full while irrigation is in progress and about half full when the section drained is not being irrigated. Cross-connecting drains have been installed t

distribute any excess flow of one line during irrigation to other lines not so heavily loaded.

About $15,000 worth of the former ineffective work has been salvaged by adapting new plans to old and by the use of sand traps wherever water could make its way through the old drains. More than half of the old drains will be put back into service, but in some cases it has been necessary to build new tile drains around sections that have been completely clogged. Benefits were assessed at an average of about $100 an acre. The total cost of old and new work will average $48 an acre.

The writer's direction of the work began in February, 1920, but he had been engaged previously on surveys and investigations. Three separate contracts were let: open ditch, D. A. Foley Construction Co.; manufacturing the concrete tile on the ground, J. T. Corbridge, Salt Lake City; laying the tile drains, Baer Drainage Co., Ogden, Utah.

## Strength of Concrete at Increasing Intervals After Mixing

By Ross C. Durst
Assistant Professor of Civil Engineering, Municipal University of Akron, Ohio

THE tables below show the results of an experiment performed in the regular laboratory testing classes in the University of Akron, Ohio. Eight parties made tests which are averaged in the tables. The object was to determine the loss in strength caused by using concrete which had been allowed to stand for some time before using. The tests were performed with 1 : 3 mortars, using a variety of brands of cement.

TABLE I. STRENGTH OF CONCRETE MOLDED AT INCREASING INTERVALS AFTER MIXING

(Lb. per Sq In.)

| Time After Mix | Av. Tens | Av Comp. | Per Cent of Normal Tension | Per Cent of Normal Comp. |
|---|---|---|---|---|
| Normal | 383 | 2,396 | 100 00 | 100 00 |
| 1 hour | 338 | 2,410 | 88 2 | 100 6 |
| 2 hours | 336 | 2,367 | 87 9 | 98 7 |
| 3 hours | 323 | 2,019 | 84 3 | 84 3 |
| 4 hours | 299 | 2,228 | 78 0 | 92 9 |
| 5 hours | 269 | 1,508 | 70 2 | 62 9 |
| 6 hours | 235 | 1,392 | 61 4 | 58 1 |
| 7 hours | 208 | 1,401 | 54 3 | 58 5 |
| 8 hours | 168 | 1,108 | 43 9 | 46 2 |
| 9 hours | 111 | 555 | 28.9 | 22 9 |

In the experiments in Table I the entire mass was thoroughly mixed, using normal consistency. At intervals of one hour, just sufficient material for molding a sample was cut off and molded, leaving balance of mass undisturbed. In the experiments of Table II the same procedure was followed except the entire mass was remixed at intervals of one hour. The experiment given in Table III was performed very carefully by two seniors using ½ hour intervals. They also ran a third test adding a small amount of water each time.

TABLE II. STRENGTH OF CONCRETE REMIXED AT INTERVALS OF ONE HOUR

(Lb. per Sq In.)

| Time After Mix | Av. Tens | Av. Comp. | Per Cent of Normal Tens. | Per Cent of Normal Comp. |
|---|---|---|---|---|
| Normal | 348 | 2,014 | 100 00 | 100 00 |
| 1 hour | 328 | 2,238 | 94 25 | 111 1 |
| 2 hours | 335 | 2,253 | 96.26 | 111.8 |
| 3 hours | 322 | 2,162 | 92.53 | 107.3 |
| 4 hours | 291 | 1,945 | 83.6 | 96.6 |
| 5 hours | 289 | 1,794 | 83.0 | 89 7 |
| 6 hours | 205 | 1,324 | 58.9 | 65 7 |
| 7 hours | 192 | 1,135 | 55.2 | 56.3 |
| 8 hours | 179 | 1,013 | 51 4 | 50.3 |
| 9 hours | 145 | 565 | 41 7 | 28 0 |

TEST III. STRENGTH OF CONCRETE AT INTERVALS OF ONE-HALF HOUR

(Lb. per Sq In.)

| Time of Making | Remixed Tens | Remixed Comp. | Unmixed Tens. | Unmixed Comp. | Tempered Tens. | Tempered Comp |
|---|---|---|---|---|---|---|
| Normal | 315 | 2,700 | 347 | 3,680 | 268 | 3,017 |
| ½ hour | 341 | 2,767 | 335 | 3,217 | 287 | 2,822 |
| 1 hour | 355 | 3,590 | 362 | 3,818 | 322 | 2,797 |
| 1½ hours | 387 | 3,325 | 366 | 4,090 | 310 | 3,085 |
| 2 hours | 432 | 3,577 | 370 | 4,047 | 222 | 3,230 |
| 2½ hours | 420 | 3,427 | 360 | 3,900 | 320 | 3,212 |
| 3 hours | 349 | 3,370 | 372 | 3,830 | 306 | 2,895 |
| 3½ hours | 382 | 2,870 | 397 | 3,520 | 312 | 3,075 |
| 4 hours | 316 | 2,840 | 367 | 3,837 | 334 | 3,577 |
| 4½ hours | 324 | 3,012 | 347 | 3,085 | 287 | 3,287 |
| 5 hours | 346 | 2,712 | 315 | 2,935 | 332 | 3,617 |
| 5½ hours | 312 | 2,835 | 302 | 2,335 | 364 | 3,355 |
| 6 hours | 203 | 1,948 | 243 | 2,257 | 325 | 3,740 |
| 6½ hours | 233 | 2,075 | 277 | 2,255 | 341 | 3,610 |
| 7 hours | 170 | 1,742 | 235 | 2,170 | 358 | 3,312 |
| 7½ hours | 207 | 1,360 | 201 | 1,477 | 387 | 3,250 |
| 8 hours | 121 | 800 | 156 | 1,510 | 320 | 3,585 |
| 8½ hours | 228 | 1,540 | 214 | 1,902 | 326 | 4,207 |

Three briquettes made from Pile No. 1, and immediately immersed in water gave the following test:

| Tension | Comp. | |
|---|---|---|
| 153 | 1,425 | Average tension of 168 lb. and compression of 1,472 lb., |
| 214 | 2,037 | which shows that the immersion in water did not help to |
| 137 | 955 | increase the strength. |

As shown by the last column of Table III there was a slight but continuous increase in strength showing a greater strength at the end of 8½ hours than at the beginning. No sweeping conclusions can be drawn from these results. They seem to indicate that very little strength is ever lost up to the third or fourth hour while in practically every case there is an increase in strength at the end of the first hour.

## Concrete Bridge Floor Replaced by Wood

REPLACEMENT of the concrete floor of an important highway bridge in Indiana by wood is now in progress, under direction of the State Highway Commission. The structure crosses the White River at Bloomfield, and has three spans, two of 142 ft. and one of 300 ft. c. to c. end pins. It has a 16-ft. roadway. Its concrete floor has been giving frequent trouble from heavy trucks breaking through, and repair work has been found difficult, according to William J. Titus, bridge engineer.

A strength survey and investigation of the old structure indicated that substitution of a wood floor for the concrete floor would not only do away with the present maintenance difficulties, but would make it possible to increase the live-load capacity of the structure (with respect to the strength of the floor members) from about 10 tons to 15 tons. Accordingly a contract was awarded to E. C. Wright, of Bloomfield, for removing the old floor and putting in a creosoted wood-block floor, at a price of $9,370.86. The new floor consists of 3-in. blocks in 1-in. diagonal sheathing on 3-in. transverse subplanking on nailing strips bolted to the I-beam stringers. All the timber is creosoted.

The concrete floor now being removed is not believed to be the original one. It is thought probable that the spans were originally built with timber floor, and the concrete floor was applied later; this belief is supported by the fact that the concrete floor was very thin, which may be attributable to the fact that when the substitution was made the trusses were found not strong enough to permit of placing a heavier concrete floor. Apparently, also, the concrete was injured by freezing at the time of laying. Mr. Titus says, "There is nothing about the transaction which would indicate that a properly designed and placed concrete floor can by any possibility be destroyed by abrasion by traffic. All of our new steel bridges are being constructed with concrete floors, with a 1½-in. monolithic wearing surface.

# Washington Building Reconstruction—Columns of Lower Story Replaced by Girders

**Modernization of an Early New York Office-Building Involves Difficult Operation—40-Ton Girders in Pairs at Second Floor Carry Weight of Eight Stories, Transferred From Columns by Wedging**

By T. Kennard Thomson
Consulting Engineer, New York City

IN THE EARLY eighties one of the old New York Schuyler family sold his residence at No. 1 Broadway, which was then torn down and the big and imposing (for those days) Washington Building was erected on the site. This building was recently bought by the International Mercantile Marine Co. Having long since lost its imposing appearance, due to the dingy brick exterior and hopelessly dark entrance halls and the like, it needed renovating badly. So the new owners retained Walter B. Chambers, architect, to turn the dismal old building into a modern office structure of the very highest class. Mr. Chambers' artistic genius has succeeded in transforming an eyesore (Fig. 1) into a really beautiful edifice (Fig. 2). The accomplishment of this feat involved some very interesting engineering problems, which were successfully solved by ingenious design and construction methods.

FIGS. 1 AND 2. WASHINGTON BUILDING BEFORE AND AFTER RECONSTRUCTION

The building has a frontage on Broadway of 96 ft. 1½ in., on Battery Place of 171 ft. 6¾ in., and on Greenwich St. of 103 ft. 11½ in. Rearranging its lower floors into steamship booking offices was one of the main structural elements of the work.

In order to obtain a steerage booking office in the basement, and a first and second class booking office on the ground floor, an entire row of eight columns (and two others, or ten in all) was removed, producing two rooms clear of columns for the full width from the Battery Place wall to the court wall on the whole length of the building from Broadway to Greenwich St. The columns were removed for three stories in height, which enabled the old floor on the Broadway level to be taken out and replaced by a new floor, about a foot higher than the old, and the old second floor to be removed entirely, together with the columns immediately above and below it.

This makes the old third floor the new second floor. It makes the steerage booking office a room 40 x 100 ft., 15 ft. high, and the first and second class booking office a room 40 x 160 ft., 24 ft. high. These booking offices in addition to their artistic merit will have the great advantage of large windows on three sides. The light and natural ventilation thereby secured make decided contrast with the old Washington Building.

The first operation in the reconstruction was shoring up the window openings and stripping the red brick and brownstone facing from the entire surface of the three fronts, replacing it with a beautiful Indiana limestone. Care was taken to strip only one-half of the old brick piers at a time, so as to avoid endangering the safety by cutting off too much at once. Owing to the pressure of time and the necessity of arranging with the tenants so as to cause them the least possible incon-

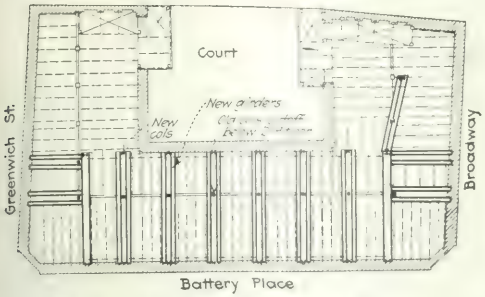



FIG 3. PLAN OF SECOND FLOOR GIRDERS
Middle columns in first story removed after eight-story load was transferred to girders.

venience, it was necessary to place the outside ashlar work before tackling the ticklish job of removing the three tiers of columns from under the eleven stories above.

Fortunately, the old building was founded for the most part on bedrock. And to be safe beyond a doubt—safety first was the keynote of this work—it was decided to put reinforced-concrete distributing girders, as shown in the sectional drawing, Fig. 4, under the column bases. These girders are spread at the middle to pass on either side of the middle columns, which were to be removed later.

It should be stated here that the old building is of wall-bearing construction. The outside walls consist of heavy brick piers between the various window openings, and the floors are supported by these walls in conjunction with interior cast-iron columns. If one had judged solely by the cross-sectional area of the old brick piers and the high grade of the brickwork, which had been laid up in good cement mortar (very unusual in those days), he would not have hesitated to strip the old work for the new ashlar without elaborate precautions such as the shoring shown in the view, Fig. 7; but examination showed that the apparent factor of safety had been very largely reduced by chimney and other flues as well as numerous vertical chases or recesses for pipes, etc. For this reason one of the first steps was to wash out the soot and dirt of the flues and other openings as found, and fill them with concrete.

To carry the ground-floor framing on a clear span between walls, new girders were inserted, each being

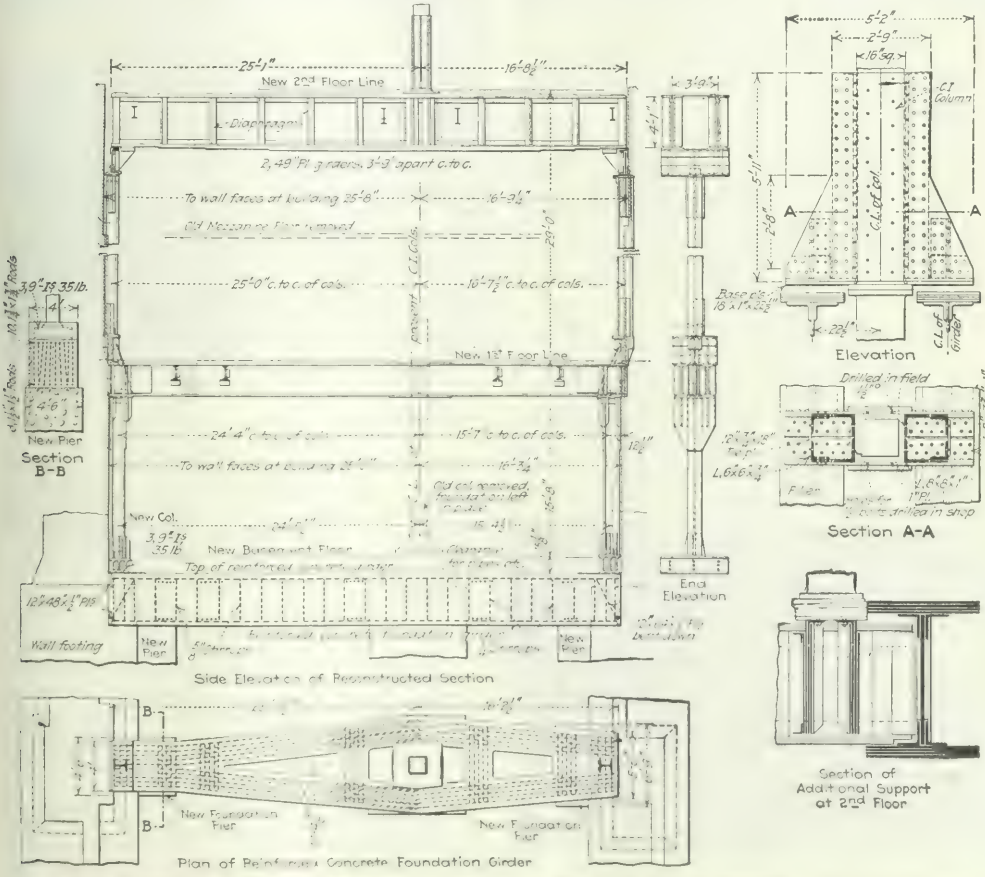



FIG 4. NEW STRUCTURAL SYSTEM IN FIRST STORY; COLUMN BRACKETS FOR TRANSFERRING LOAD TO GIRDERS

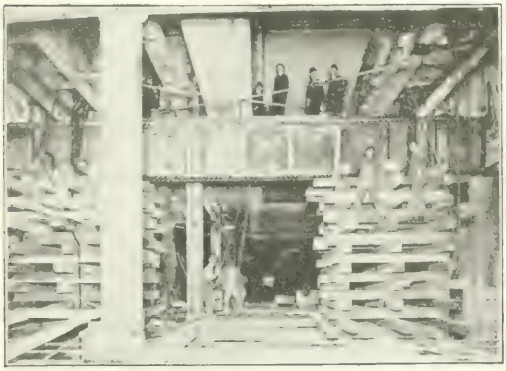


FIG. 5. HALF OF DOUBLE GIRDER BEING RAISED
Two chain blocks hung from wooden trusses traveling on second floor were used to lift the 40-ton load. Cribbing was placed to follow up the lift.

double so as to pass around the center column, which was later removed. They consisted of two 28-in. I-beams of 180 lb. per lin.ft. On top of the ends of these girders were set steel columns with cantilever tops to carry the main girders of the second-floor framing. These latter were designed to carry the eleven floors above after the columns below had been cut out their arrangement and proportions are given by the plan and section, Figs. 3 and 4.

Each of the second-floor girders was built up of 48 x $\frac{7}{8}$-in. web plate, a two 8 x 6 x 1-in. flange angles, and four 21 x $\frac{7}{8}$-in. cover plates for each flange. The girders are 41 ft. 9½ in. long. The girders at the east and west ends are of special design because of local conditions.

In the meantime, two new floors had been added to the top of the building by transformation of the old mansard roof into two new stories, and construction of a new roof over these.

As the owners and architects did not wish to take the slightest risk of cracking the new ashlar facing or in any other way damaging the building, or alarming the tenants, considerable expense was incurred to accomplish these results. The company's chief of construction, William F. Gibbs, held a series of conferences including the architect, his engineers and consulting engineer, and the various contractors concerned. At these meetings several methods of shoring, raising the girders, etc., were considered by the help of a working model, after which the plan subsequently carried out was approved.

FIG. 6. BUILDING WEDGED UP ON GIRDERS AT SECOND-FLOOR LEVEL.

The first intention was to roll the heavy main girders in from Battery Place and raise them two floors by means of two gin poles operated by hoisting engines. But it was realized that there is always a chance of the rope slipping, or some other slight accident, which might cause the girders to drop, thereby alarming the tenants or producing even more serious results. So it was decided to build two frames or travelers to run on the second floor, each consisting of a pair of heavy wooden Howe trusses, long enough to span one panel of the floor, and lift the girders by chain hung from these travelers. The travelers were set on rollers, so that after one girder had been lifted they could be rolled to the next panel. After being rolled into position, a bent of 12 x 12 timbers resting on the basement floor was placed under each of the travelers to avoid straining the old floor system.

Each pair of trusses carried a 25-ton differential chain block. To make assurance doubly sure, as the girders were lifted a timber-crib blocking was built up near each end as fast as the girder was lifted, so that even if the hoisting tackle slipped the girders could not drop more than a few inches. As the girders were hoisted to the old second and third floors, a few beams were removed until the girder had passed up, after which they were replaced. But before doing this, an elaborate system of temporary wooden shores and struts was inserted, and in addition two 1½-in. tie rods were anchored in each brick pier, and run diagonally across the building, just below the new second-floor level, very effectively tying the four walls together. These rods were left in place and buried in concrete.

### Wedges Under Brackets

When a pair of girders was in place, the steel brackets shown in Figs. 4 and 6 were securely bolted to the old cast-iron columns just over the girders by 32 1¼-in. turned-bolts. Between the bottom of the bracket and top of the pair of girders were placed six pairs of steel wedges, three over each girder, which were gently driven into place.

These wedges were each 33 in. long, 6½ in. wide, 1½ in. thick at the butt, tapering down to about ⅛ in. at the other end, which gave a slope of about ½ in. per ft. They bore on a ¾-in. plate 21 in. square which rested on the girders. When necessary, when the wedges had been driven in as far as they could without obtaining the full deflection of the girders, two pairs of wedges were driven a little more, allowing the third pair to be withdrawn and a shim plate to be inserted. Then the other two pairs were also taken out, one pair at a time and shim or filler plates inserted as before. Had only one pair of wedges been used over each girder, it would have been a very serious matter to remove them if the slope or length of the wedges had not been sufficient to secure the deflection of the girders which the weight of the superimposed building would cause. With three pairs side by side the change became easy.

When all of the brackets were bolted to the columns, the driving of the wedges commenced as follows: Two long steel rails, for use as rams to drive the wedges home, were slung from a movable frame on two sides of the columns so that the wedges could be driven

simultaneously over each girder and from each side. The men thus swung the four rails or rams simultaneously. When slack had been entirely taken out of the wedges over the first pair of girders, a similar operation took place on the next column, and when all of the columns had been so wedged, work was resumed on the first set again. Thus the operation was repeated in a number of stages, to avoid any danger of one column being lifted more than another.

The object of the wedging was to transfer the entire weight of the eleven stories above to the new girders, and to assure that the ultimate deflection of the girders had taken place before removing the columns below. As the following table shows in detail, the girders deflected from ¼ in. to 33/32 in., and the columns were raised from 5/16 to 11/16 in.:

FIG. 7. SCAFFOLDING FOR REPLACEMENT OF STONE FACING

EFFECT OF WEDGING

| Column Number | Column Raised, In. | Girder Deflected, In. | Combined Effect, In. |
|---|---|---|---|
| 22 | 1 4 | 15 32 | 23 32 |
| 32 | 5 16 | 15 16 | 36 32 |
| 33 | 5/16 | 13 16 | 36/32 |
| 34 | 3/8 | 1 4 | 20/32 |
| 35 | 7/16 | 3 8 | 26 32 |
| 36 | 7/16 | 1 2 | 30/32 |
| 37 | 11/16 | 5 16 | 32 32 |
| 38 | 1 2 | 15 32 | 31 32 |
| 39 | 5/16 | 25 32 | 35 32 |
| 29 | 3/16 | 19 32 | 25 32 |

No effort was made to hurry the wedging, which was spread over two weeks.

It is probable that this wedging was carried slightly farther than necessary, as daylight was seen at the joint of the columns to be removed and the columns which were left in place, which was hardly necessary evidence, as tapping with a hammer clearly indicated that the lower columns had been relieved of their load. As the upper columns were raised, the section of the column below seemed to follow up, due to expansion of the cast iron and to the release of pressure on the foundations. Theoretically the columns should not have been raised at all, and the wedging performed only for the purpose of getting the ultimate deflection out of the girders and just releasing the strain on the columns. Practically, however, the results are as shown on the preceding table. After it was evident that the new girders were carrying the entire load, the new concrete floor was put in place, without, however, causing any further deflection of the girders.

The next operation was to burn off the heavy cast-iron columns. One complete cut from the acetylene gas torch at an angle of 45 deg. permitted an easy removal of the old columns. When they had been removed, each pair of girders was connected by a pair of plate-girder diaphragms directly under the superimposed columns and on top of these diaphragms and under the columns were placed two broad wedges, 21 x 1¾ x 24 in. These wedges were driven snug, simply to take up the slack without releasing the pressure from the wedges on top of the plate girders. The diaphragms would carry half the load above if called upon to do so, and were simply inserted as an additional factor of safety. The space between diaphragms and girders will be filled with concrete, and the cast-iron columns above will be filled with grout or concrete up to the top of the 1¼-in. bolts, to avoid any danger of the latter rusting out. The brackets themselves, which are in the partition walls, will also be encased in concrete.

The contractors were: The Whitney Co., general contractors; A. E. Norton, Inc., steelwork; Miller-Daybill & Co., shoring.

O. F. Semsch, N. Lorentz Malmros, and A. I. McGloughlin, architectural engineers for Walter B. Chambers, deserve great credit for the unique design and capable supervision. F. Rabbe, Jr. was the superintendent on the site for the architect, who retained the writer as consulting engineer.

## Number of Persons in Family and Dwelling 4.3 and 5.1, Respectively

The average number of persons to a family in the United States, according to the 1920 census, is 4.3 and the average per dwelling is 5.1. A family is any number of persons living together as a single household, whether it be one person or all the occupants of a hotel. A dwelling is any structure whatsoever in which one or more persons regularly sleep, be it a tent or an apartment house sheltering many families. Both the size of families and persons per dwelling have declined in each decade since 1880, as follows: Families, 5; 4.9; 4.7; 4.5; 4.3. Persons to each dwelling, 5.6; 5.5; 5.3; 5.2; 5.1. In general, the average size of families (1920) is greatest in the Southern and least in the Western states, but for individual states the range is from 3.5 in Nevada to 5 in North Carolina. Population per dwelling (1920) is greatest in New England and the Middle Atlantic States and smallest in the West, while by separate states the minimum is 3.7 in Nevada and the maximum 7.8 in New York. For the entire United States, the 1920 population is 105,710,620, in 24,351,476 families, living in 20,697,004 dwellings, the corresponding figures for 1880 are: Population, 50,155,783; dwellings, 8,955,812; families, 9,945,916. The number of families per dwelling was 1.18 in 1920 and 1.1 in 1880

# A Few of the Engineering Problems of Municipalities

Abstracts of Papers and Reports Presented at the Annual Convention of the American Society for Municipal Improvements Held at Baltimore, Md., Oct. 24-28, 1921

## Report on Traffic and Transportation

By Arthur H. Blanchard
Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich.

The Committee on Traffic & Transportation (consisting of Prof. Blanchard, chairman, Robert Hoffman and Charles O. Boyd) submitted the following report:

Investigations conducted during 1921 influence the committee strongly to urge the general adoption, by municipal governments, of the recommendations embodied in its 1920 report relative to the following subjects:

(1) Use of "dummy cops" at street intersections.

(2) Installation of rotary traffic at street intersections, wherever practicable.

(3) Design and construction of long-radius curb corners.

(4) Economic design of street widths on through thoroughfares in small towns and cities.

(5) Utilization of by-pass highways for towns and cities located on important national, state, and county trunk highways.

(6) Consideration of the installation of motor bus routes in municipalities when an extension of the public passenger transportation system is required, in view of the resulting advantages of such installations from the standpoints of maintaining the maximum practicable traffic capacity of streets and of avoiding the use of car tracks in roadways.

Based on a careful analysis of public passenger transportation, the committee considers that it is highly desirable, from the standpoints of economic public service transportation and the efficient use of municipal streets by traffic, that the society should strongly condemn the development of "wild-cat" jitney service. Not only is the installation of such service undesirable from the standpoint of overcrowding of streets with five-passenger public transportation vehicles but it is obviously unfair to public service corporations, operating under franchises, to be forced to compete with a jitney service which almost universally is operating on an uneconomic basis.

### Highway Transportation Division Recommended

The committee recommends that a highway transport division should be installed in engineering or highway departments of municipalities having a population of over 100,000. The duties of this division would be to deal with all matters pertaining to traffic and transportation which affect the economic design and maintenance of streets and their efficient use by pedestrians and all classes of vehicles.

One of the important functions of such a division would be to make highway transport surveys as preliminary to the design and redesign of streets, the determination of efficient methods of maintenance and the formulation of recommendations pertaining to efficient traffic regulations.

A highway transport survey embodies all investigations in the field and office which are necessary to determine the probable amount, character and effects of the future traffic which will use a given highway during the lives of its several component parts. Such a survey for a given street may cover a consideration of all of the following factors: (1) All highway elements which affect economic highway transport; (2) legislation relative to franchises and rates, weights, dimensions, and speeds of passenger cars, trucks, tractors and trailers; (3) state and urban traffic regulations; (4) vehicular and population statistics; (5) traffic censuses of motor and horse-drawn vehicles and cars operating on tracks; (6) vehicular operation as affecting roadways and other parts of highways; (7) present and future traffic and commercial transport developments in such fields as agricultural and dairy farming, mines, quarries, gravel and sand pits, oil fields, lumber tracts, fisheries, plants, factories, wholesale and retail stores, parks and parkways, summer and amusement resorts, and real estate improvements, which affect or will affect the traffic on the street under consideration; (8) common carriers such as steam and electric railroads and waterway transportation companies and their relationship to street traffic; and (9) the characteristics of the methods of highway transport such as street car, rural, interurban and urban motor-bus operation, municipal haulage, long and short general rural haulage, rural motor express, intercity haulage, intercity express, and horse transport.

Men assigned to a highway transport division should be experienced highway engineers who have or are rapidly acquiring a knowledge of the following subjects: City planning; highway transport economics, legislation, surveys and methods; highway transport management, including delivery systems, scheduling and routing; traffic regulations; interrelationship of highway, railway and waterway transport; port, terminal and warehouse facilities; and the fundamentals of the mechanism and operation of automobiles, motor trucks, tractors and trailers.

* * *

## Subways for City Transportation

By Robert Ridgway
Chief Engineer, Transit Commission, New York

Prior to the War, New York's subways cost to construct, including track, stations and other appurtenant work, maintenance and underpinning of abutting buildings and maintenance and restoration or reconstruction of surface and subsurface utilities, but excluding the furnishing and installation of third rail, signals, lights and other equipment, from $700,000 per track-mile in an outlying portion of Brooklyn to $2,500,000 per track-mile in a very congested section of lower Manhattan. Similar costs at pre-war prices for a steel elevated railroad were about $275,000 per track-mile for a three-track line and about $235,000 per track-mile for a two-track line. These costs would be much greater at the present time. To put it in another way: a given amount of money for rapid transit construction would build from four to five times as much elevated line as subway.

With these facts in mind it would seem that subways, notwithstanding their many advantages, must be confined to the congested portions of a city, using elevated structures or open cuts for the extensions into the less congested and outlying parts. It is a fact that other considerations than financial ones sometimes govern. For instance, an elevated railroad could be constructed in the narrow street of the most intensely used business section of a city for a fraction of the cost of a subway, but public opinion might not permit it to be built there and might insist upon having the subway, notwithstanding the much higher cost.

### First Subway Work in 1900

In 1900, the City of New York, by the Rapid Transit Railroad Commissioners, began the construction of the first subway to be municipally owned and to be privately operated under a lease running 50 years, with a provision for a 25-year renewal. Operation was begun in October, 1904, in the first portion to be completed and was extended from time to time until, in 1908, the first two contracts were in full operation.

The number of passengers carried by the Dual System, that is, the rapid transit lines, for the year ended June 30, 1921, amounted to over 1,418,000,000. The average on business days is about 4,172,500 and the maximum for one day was about 4,929,000. This occurred in February, 1920, on the occasion of a snow storm, partially tying up surface

car traffic which increased subway traffic. These figures are exclusive of the passengers carried by the surface lines, the bus lines and the suburban services of the trunk line railroads.

The intensively developed portion of New York is beyond question a subway district but the roads are taken out of the ground as the outlying or less congested portions of the city are reached and the extensions are carried on elevated structures. Compared with subways, elevated railroads are simple to construct and can be built in far less time. In normal times, an elevated structure can be finished ready for track in from 18 to 24 months of the date when work in the field is begun and the discomfort to the public and interference with traffic on account of the construction, is confined to a small part of this period. The disturbance of the street surface and of the utilities underlying it is relatively slight. With a section of a subway, on the other hand, from 3 to 4 years' time is usually required for construction and, except where it is at such depth that the work is done by tunneling methods, it requires generally the entire reconstruction of the street and of the sewers, water and gas mains and other structures beneath it.

An analysis of 57 subway contracts showed the total expenditures on account of them to have been distributed as shown in the accompanying table.

PERCENTAGE DISTRIBUTION OF SUBWAY CONSTRUCTION COSTS

| Item of Work | Percentage of Cost |
|---|---|
| Earth excavation | 25.6% |
| Rock excavation | 15.9% |
| Concrete | 14.0% |
| Riveted steel, furnished and erected | 7.4% |
| Rolled steel, furnished and erected | 7.2% |
| Steel rods, furnished and erected | 1.0% |
| Underpinning buildings | 6.5% |
| Supporting existing railroads | 2.7% |
| Construction of new sewers | 3.8% |
| Relocating pipes and ducts in street | 2.8% |
| Waterproofing, railroad ducts and miscellaneous work | 13.1% |
| Total | 100.0% |

The design of a subway must take into account, among other things, the geological conditions, the location of the rock, if any, the character of the soft ground, the presence or absence of ground water, the widths of the street and the character of the buildings abutting on them, the character, size and number of the subsurface utilities, the surface tracks and the elevated railroads, if any, the depth to which the subway must be placed to cross over or under or to join other subways already constructed or to be constructed. Careful surveys must be made showing all of the conditions, reference points and bench marks established, borings made, the surface, subsurface and overhead structures located and plotted, notes made of the condition of pavements, buildings, etc.

New York's subways differ from those of other cities in that their trunk lines provide for express as well as local service in both directions. This means that four or more tracks are required.

The stations are of the local and express type. The local stations are located from ¼ to ½ mile apart and the express stations usually at longer intervals, generally from 1½ to 2 miles apart. The typical local station has side platforms and those of the express stations are usually between the local and express tracks. In the Interborough subway, the platforms of the express stations are about 480 ft. long to accommodate their 10-car trains, the cars of which are 51 ft., 2 in. long. The platforms of the original local stations now accommodate 6-car trains while those constructed within the past ten years are designed for the full 10-car trains. The cars of the Municipal Railway Corp. are 66 ft. long and the platforms of their local and express stations are now made 530 ft. long to accommodate 8-car trains.

The city-owned subways were built under construction contracts prepared by the commission's engineering force and the construction was supervised by it. The work, exclusive of Contracts 1 and 2, was divided into 87 construction contracts, in addition to which there were many other construction contracts for track work, station finish, yards, shops and miscellaneous work. The construction contracts varied from about $500,000 to $6,000,000 in value. Prior to 1912, the lump sum form of contract was used, but, since then, the unit price form has been employed except in a few special cases.

The cost of constructing the Dual System will be, when completed, over $400,000,000 and of equipping the lines and improving and extending the companies' own lines over $186,000,000. These costs include the city-owned lines built between 1900 and 1913, but do not include the extensive company-owned lines constructed prior to 1913. About one-quarter of the construction cost and all of the equipment cost are borne by the two operating companies and the two systems will include, when completed, approximately 70 miles of subway, 17 miles of railroad in open cut below street grades and on embankment, 126 miles of steel and concrete viaducts and bridges, a total of 213 miles of railroad and 619 miles of single running track. All but 10 miles of this total mileage of railroad is in operation.

* * *

## *Engineer Student and Public Service*

By A. N. Johnson
Dean, Engineering College, University of Maryland

An Important Field which the engineer has scarcely entered, and in which he now plays but a small part, is the direction of public affairs. The role that is to belong to the engineer is hardly realized, even by the profession itself, much less by the general public. But there is arising in the minds of engineers of vision a realization of the larger field of usefulness that awaits the technically trained man.

All the many arguments that are to be found in the proceedings of engineering societies show conclusively, at least to the satisfaction of the engineers, that their training and attainments would secure for the public a more efficient management of many of its more important undertakings; and the engineers are probably right. But the fact remains that the public does not intrust its affairs to engineers, even in those instances where all agree that the technical skill of the engineer must be employed. And so the engineer reports, while someone else directs.

If members of the engineering profession should be intrusted with greater responsibility in the management of public affairs, and such has not happened, it seems obvious that the engineers themselves have not, as yet, made the right move for the desired end. That tradition is against such recognition, and that the engineer is usually handicapped by lack of intimate knowledge of the relation between political organization and management of public affairs, is to suggest that engineering schools have an obligation to assist their students to gain a different viewpoint as to what their careers may be. When the only outlook presented the student is to become a good technician, there need be little surprise felt if these men individually, or as a group, develop a field of activity that occupies in the public mind a position secondary to that of men who look forward to careers in public life and take, and are conceded, leadership in public activities.

It was with these considerations in mind that the following statement was written as it appears in the 1921-22 catalogue of the University of Maryland. Under the heading, Engineering College, it states that the courses are undergoing reorganization and that "the general purpose is to broaden the courses of instruction the better to prepare young men to enter the public service. The large public works program contemplated in practically every state in the union makes urgent the demand for engineers trained for such work. The public service demands the electrical and mechanical, as well as the civil engineer. Maryland needs such men to carry on her great highway and large public undertakings contemplated in various cities and counties. Such training seems pre-eminently a function of the State's university. It is not the intention that the subject matter of the courses shall be essentially different from that usually given, but that the viewpoint of the student and the application of the principles will be that of public service. In order to give the time necessary both to the technical subjects and to those of a more general character, a careful

revision of all courses of study is being made so that the utmost time available in each term may be used to the best advantage."

* * *

# *Sewage Disposal for Small Municipalities*

By John F. Skinner
Principal Assistant City Engineer, Rochester, N. Y.

The Sub-Committee on sanitation, including sewage disposal (John F. Skinner, chairman) submitted the following report:

The present study is intended to cover villages and small cities. One principle only may be postulated which will apply to all cases, viz: Each situation is a distinct problem to be studied and solved truthfully, always remembering that the truth upon any subject is obtained by marshalling all the facts in their proper relations. In view of the above it may be helpful to outline the data to be considered, the conclusions therefrom, the resulting type of plant applicable, the elements of disposal plants and certain observations.

## I.—Data to Be Considered

1. Physical Conditions.
   - A. *Area of Territory*
     - (a) Present
     - (b) Future
   - B. *Character of Territory*
     - (a) Compact or scattered
     - (b) Residential, commercial or industrial
     - (c) Flat or hilly, gentle or steep slopes
     - (d) Low, requiring pumping, or high, allowing gravity outfall
     - (e) Geology: sand, gravel, clay, quicksand, rock
   - C. *Population, Density and Total Numbers*
     - (a) Present
     - (b) Future
     - (c) Resident
       - a. Home and business
       - b. Home only (commuters)
     - (d) Nonresident (industrial)
     - (e) Seasonal (summer colony)
     - (f) Transient (summer resort)
2. Sewerage System.
   - A. *Character of Sewer System*
     - (a) Separate
     - (b) Combined
   - B. *Amount of Sewage*
     - (a) Dry weather flow } obtained by:
     - (b) Maximum flow }
       - a. Amount of water supply and population
       - b. Sewer gagings
       - c. Proportion of storm water admitted in case of a combined system
       - d. Precipitation, run-off data, percent impervious, etc.
   - C. *Character of Sewage*
     - (a) Domestic waste
     - (b) Industrial waste
       - a. Solids
       - b. Color
       - c. Odor
       - d. Source
       - e. Chemical constituents
       - f. Temperature
     - (c) Ground water
     - (d) Street wash (in case of combined system), quantity of manure, leaves, grit, etc., received through surface sewers
     - (e) Settleable and suspended solids with their settling rates
     - (f) Effect of various precipitants, especially in the case of preponderating trade wastes
     - (g) Oxygen demand — putrescibility
3. Body of Water Receiving Effluent
   - A. *Non-Potable, no Bathing*
   - B. *Salt Water with Beaches to Protect*
   - C. *Tidal Stream—Bathing*
   - D. *Fresh Water Lake*
     - (a) Bathing
     - (b) Water supply
   - E. *Fresh Water Stream*
     - (a) Large or small
     - (b) Riparian uses
     - (c) Industrial uses
     - (d) Bathing
     - (e) Water supply
   - F. *State Regulations Regarding Discharge of Sewage*
   - G. *Currents*—Dilution and dispersion
   - H. *Deep or Shallow*
   - I. *Constant or Variable Level*
     - (a) Fluctuation due to tides
     - (b) Fluctuation due to precipitation
     - (c) Fluctuation due to storage
   - J. *Temperatures*—Water and sewage
   - K. *Wind*—Prevailing direction and intensity
   - L. *Vegetation*
   - M. *Pollution Other Than By This Effluent*
   - N. *Protection of Fish, Oysters, etc.*
   - O. *Visual and Aërial Nuisance*
4. Funds Available for Sewage Treatment

## II.—Conclusions From the Data

1. Volume of Sewage to be Treated
   - A. *Dry Weather Flow*—Present and future
   - B. *Maximum Flow* — Present and future
   - C. *Distribution* — Through day and week
2. Character of Sewage
   - A. *Variation in Density*
   - B. *Solids*—Settleable and suspended
   - C. *Oxygen Demand* — Putrescibility
   - D. *Color, Odor,* etc.
3. Character of Treatment Indicated
   - A. *Discharge into Non-Potable Water*
     - (a) Remove floating and coarse suspended objects
     - (b) Remove grit where necessary to prevent deposits in stream, lake or long outlet pipe
   - B. *Discharge into Small Non-Potable Stream*
     In addition to "(a) and (b)" above treat further sufficiently to prevent nuisance
     - (c) Remove settleable solids and 40 to 90 per cent of suspended solids by tank-treatment
     - (d) Oxidize effluent
   - C. *Discharge into Large Potable Stream or Lake where there is Ample Dilution and Oxidation.* Treat as in (a), (b) and (c). "(c)" may be omitted if the effluent does not appreciably effect the receiving body of water
     - (e) Disinfect the effluent when sewage pollution, possible from the effluent, can be detected near bathing beaches or water works intakes
   - D. *Discharge Into Small Potable Stream or Lake*
     Treat as indicated in "(a), (b), (c), (d) and (e)" above

## III.—Type of Plant Applicable

Without entering into controversy as to the amount removable by screens, in this paper, *coarse* solids are distinguished from *fine*, in that the latter are best removed by sedimentation or precipitation.

The above operations may be accomplished respectively by means of the following devices:

- (a) Remove floating and coarse suspended objects — by coarse racks, fine racks or mechanical screens
- (b) Remove grit—By detritus chambers
- (c) Remove settleable solids and 40 to 90 per cent of suspended solids—By tank treatment with or without precipitants
- (d) Oxidize Effluent—By irrigation, sand filtration, contact beds, trickling filters, or aëration or activation
- (e) Disinfect the Effluent—By liquid chlorine or bleach

## IV.—Elements of Disposal Plants

1. Removal of Solids
   - A. *Screening Devices*
     - (a) *Coarse Racks:* Bars 2 to 4 in. apart for large objects in Combined Sewage
     - (b) *Fine Racks:* Bars ⅜ in. apart for coarse floating and suspended matter in fresh sewage, when followed by tank treatment
     - (c) *Fine Mechanical Screens:* For coarse floating and suspended matter, particularly in the case of stale or septic sewage when followed by further treatment. The removal is mainly garbage. Also where no further treatment is required, as above in II - 3 - A and C.
   - B. *Detritus Chambers:* For the removal of grit and heavy (mainly inorganic) solids which will settle from a stream flowing at a mean velocity of one foot per second. This should precede fine racks or screens; more important for combined sewage
   - C. *Tanks:* For the removal of settleable solids and 40 per cent to 90 per cent of suspended solids
     - (a) Septic tanks, 8 to 12 hours detention
     - (b) Biolitic tanks
       - a. Agitation chamber 6 to 8 hours detention
       - b. Settling chamber 2 to 3 hours detention
     - (c) Imhoff Tank
       - a. Flow chamber—3 hours mean detention for best removal
       - b. Digestion chamber—4 to 6 months sludge
     - (d) Settling Tank—3 hours mean detention with continuous removal of sludge for separate digestion, with or without a precipitant
2. Oxidation of Effluent
   - A. *Dilution* in lakes or streams

B. *Broad Irrigation:* Only applicable under unusual conditions of isolation and cheap land
C. *Sand Filters:* Only applicable where large areas of natural sand and gravel are available in suitable location
D. *Contact Beds:* For locations so close to habitations that the spray from sprinklers would cause nuisance
E. *Trickling Filter*: of broken stone or brush. This is probably the best known method of artificial oxidation of tank effluent. When carefully designed and constructed they have been uniformly successful on well settled sewage which does not contain unusual elements, trade wastes, etc. They are expensive to construct but cheap to operate. They should be followed by settling basins for secondary sludge.
F *Aëration or Activation:* The process known as "Activated Sludge" produces a well oxidized effluent by means of agitation and thorough mixing of sewage, air and previously aërated sludge. It is a plant relatively cheap to install but most expensive to operate. It requires less area than any other artificial method of oxidation but it is limited to situations where cheap power is available where fertilizer can be produced as an offset to the expense of operation and upon a large scale. Certain adaptations still in the experimental stages offer promise of success.

3. Disposition of Solids
A. *Screenings*
(a) Incineration
(b) Composting for fertilizer
(c) Treated as garbage
a. Buried
b. Burned
c. Reduced
B. *Grit:* Dumped for filling
C. *Sludge*
(a) With or without digestion
a. Dumped in deep water or discharged during flood conditions
b. Lagooned or dried in furrows and covered
(b) With digestion — Drained on drying beds and used
a. For fertilizer
b. For fertilizer base
c. For filling

4. Disposition of Effluent
A. *Direct* into receiving body of water
B. *Through Long Conduit* to avoid local pollution
C. *Chlorination* where necessary with
a. Liquid chlorine or
b. Bleach
To Protect
(a) Water Supply
(b) Shell Fish
(c) Bathing Beaches

### V.—Observations

There are certain details in the construction and operation of disposal plants which are too often overlooked, as they are generally omitted in the literature of the subject. Provide the plant, where necessary, with: (1) Water under pressure; (2) industrial railway; (3) light; (4) heat in buildings where men work in cold weather; other buildings will be kept from freezing by the sewage; (5) repair shop with forge, pipe cutter, stock and dies and bench tools; (6) laboratory and apparatus; (7) power for the above and other uses; (8) labor under competent supervision.

The moving of sludge, grit and screenings is often most conveniently accomplished by an industrial railroad preferably operated by storage battery locomotives, as this method obviates the danger of exposed trolley wires. In fortuitous situations like two of the present and two of the future plants of Rochester, N. Y., power is obtained from the fall of the sewage and fuel is only used for heating, otherwise it must be provided and becomes an important element in the expense of the plant.

A certain amount of labor may be effectively employed in hosing and washing down decks and walls, skimming tanks, agitating scum in gas slots by streams or by the use of tampers to prevent the formation of a continuous crust and afford free vent for the gas. Labor is also required in operating gates, removing sludge, grit and screenings; raking over the surface of trickling filters when the first "ponding" appears, inspecting and cleaning spray nozzles daily as well as the distributing and collecting pipes. Such operations are most certainly performed when a methodical schedule is maintained and directed by a responsible man on the job.

*Flies*—Flies in large numbers are disgusting around a disposal plant and can be largely avoided by reasonable precautions. As they come to obtain food, they can be discouraged by keeping all surfaces washed clean and by barring floating solids from quiescent water in tanks. In the relatively rapid current of a detritus chamber in advance of screens, it is only necessary to keep the walls washed clean. Grit from a properly operated detritus chamber will not attract flies, neither will well-digested Imhoff sludge whether wet, spadable or dry. Fine screens and efficient scum boards, hosing and occasional skimming will minimize the floating solids in a settling tank, or reduce them to such size that they will not support a fly. Screenings attract flies as they are largely composed of garbage. They should be covered with grit, earth or ashes or compacted and sprinkled with borax solution. Small moth flies which are found in warm weather on and above a Trickling Filter come from the larvae resident on the stones just below the surfaces. They do not travel far from the filter and are not objectionable. They may be kept out of other portions of the plant by screening doors, windows and other openings, and by providing curtain walls dipping below the surface of the sewage.

*Odors*—The best plan for dealing with odors is to surround the plant by a large tract of land municipally owned and controlled, but even then certain odors which reach to considerable distances may produce nuisance unless controlled.

Well digested Imhoff sludge is not objectionable and can be noticed only in the immediate neighborhood. Odor from screenings can be controlled by covering as suggested above. Liquid sewage when undisturbed does not give much offense, but when it is broken up in rapid currents by means of baffles, or tumbled over weirs, it becomes more noticeable.

Odors have been found objectionable at distances of half a mile when sewage is blown into the atmosphere as spray, by air under pressure. This nuisance does not occur when the wind direction is unfavorable, nor yet when there is perfect quiet. A strong wind or good breeze does not seem to cause trouble to leeward for the vapor is too attenuated when mingled with a considerable volume of air. Smells seem to be carried furthest with a scarcely perceptible drift of the air. The remedy for this condition consists in covering so that rising spray or vapor will impinge upon the under surface of the cover and be condensed.

At the main (Irondequoit) sewage disposal plant of Rochester, N. Y., where the total cost, including the site of 315 acres on the shore of Lake Ontario, was $975,500, and where 45 ft. head is available most of the time, the cost of accessories such as water works, railroad, grading, light and power was $108,000. In general such accessories, including equipment of shop and laboratory, may amount to 10 or 15 per cent of the cost of the plant.

* * *

## *Sludge Disposal at the Rochester Sewage Disposal Plant*

By N. Adelbert Brown,
Engineer in Charge of Sewage Disposal, Rochester, N. Y.

The sludge beds at the Rochester sewage-works were designed on the generally accepted rule of 1 sq.ft. to three persons, and under the local climatic conditions this area has proven satisfactory. The Irondequoit plant handles combined sewage. The ten Imhoff tanks are preceded by grit chambers and Riensch-Wurl screens and are designed to serve 200,000 people. There are forty individual beds, each approximately 44 ft. square. The tanks are built in double units with a common sludge trough. This trough is on the wall between two rows of four beds, allowing the sludge from any tank to be diverted to one of eight beds. The troughs have a slope of 1 in 50, which gives a high velocity, and are nearly self cleaning. The sludge is discharged onto the center of the bed through an 18-in. opening controlled by stop boards in the side of the trough. The sludge falls onto a concrete splash plate. A depressed channel extends transversely to the sludge troughs between

the first and second and the third and fourth beds of each tier. This channel is 4 ft. below the top of the bed and 9 ft. deep and 9 ft. wide. In this channel is laid a narrow gage track for the sludge cars and on the walls are tracks for a gantry crane.

The beds are level and consist of 2 in. of fine sand, 3 in. of coarse sand, 8 in. of gravel and 6 in. of broken stone. They are underdrained by 3-in. farm tile laid with open joints, 8 ft. c. to c. These tile discharge into an open drain under the track channels.

The Imhoff tanks have two rings of perforated pipe in each hopper and the sludge is agitated each week. The sludge pipes are also blown out and left filled with clear water after each drawing. No cones are found in the sludge surface and no plugging of the pipes has been experienced.

Drawings are made during the season as often as the removal of the dried sludge permits. Nine inches of wet sludge are drawn on a bed. The drawing season is reasonably constant, as shown by the following table:

| Year | First Drawing | Last Drawing | Period in Days |
|---|---|---|---|
| 1918 | April 15 | November 15 | 214 |
| 1919 | April 29 | December 10 | 225 |
| 1920 | May 2 | December 21 | 228 |
| 1921 | March 24 | | |

While the season is nearly the same each year the number of drawings varies according to the weather. In 1920 each bed received nine fillings, an average of one every 25 days. In 1921, an extreme drought permitted seven drawings between March 24 and June 23, an average of one every 13 days, with the longest drying period 22 days and the shortest 10 days. Up to Aug. 10 four additional drawings have been made which gives a season's average to date of 12.6 days per bed.

To remove the dried sludge, two trains of 6½-cu.yd. industrial cars are used. The trains are run in the depressed channel under the gantry crane which lifts the car bodies from the trucks and sets them on the bed and replaces filled bodies on the trucks. In loading cars, stone forks are used and the sludge lifted in cakes approximately 12 in. square. A few extra car bodies set on the beds permits the moving of trains without delaying the labor force. The trains are hauled by storage battery locomotives and the crane is electrically operated, as power is developed at this plant from the effluent.

The usual force consists of one foreman, one hoist man, two locomotive runners and eleven laborers. Eight men do the loading, one is on each train to dump the cars and one is at the dump to keep the track clear. This crew will remove on an average 200 cu.yd. of loose dry sludge in 8 hr. With labor at 50c. and 55c., and neglecting power costs, this sludge is delivered to the spoil bank at 33c. per cubic yard.

During much of the season, the sludge is sold to farmers as removed from the beds. The cars are run to the tipple and dumped directly into the wagons or trucks. As the tipple is located further from the beds the additional haul and delays in dumping increase the cost of removal 10 per cent.

The sludge when drawn contains from 79 to 86 per cent of moisture. It is more dense in the first drawings each season and is thinner as the season progresses. At the time of removal the moisture is reduced to from 50 to 60 per cent. A rain on the beds after the cracking has occurred packs the sludge so that it is difficult to reduce the moisture below 60 per cent in any reasonable time. The shrinkage in drying is normally a little more than half of the wet volume. Analysis of a dry sample yields 2.2 per cent nitrogen and 56.3 per cent mineral matter.

Due to the depth of the tanks, the entrained air bubbles expand greatly when drawn onto the bed and make the dried sludge a light, porous cake.

### Quantity of Sludge

The quantity of sludge varies, but the average for three years has been 1.51 cu.yd. of wet sludge per million gallons. In a large plant the disposition of the dry sludge becomes a problem. Realizing this, the plant at Rochester started in 1918 to develop a demand for it as a fertilizer. During that time it was given to any farmer who would load and draw it away. The plant is located in a fruit and truck garden section having a sandy loam soil. Reports of the use of this fertilizer were not enthusiastic. This was in part due to a belief that enthusiastic reports would increase the price. In 1919 a charge of 50c. a load was made, the buyer loading from the dump, and more was drawn away than in the previous year with no charge. A proposal came from the farmers that with a more convenient method of loading they would pay a higher price. The tipple was erected and the price put at 75c. per car, the car holding nearly 2 cu.yd. When sludge is not being removed, the dump is still open at 50c. per yard. During 1920 the income from this source was $1,015. To July 1, 1921, it has been $650. The income is small but the disposal of continually increasing quantities is preventing an accumulation on the grounds of the plant.

It is being hauled for distances up to five miles. In peach, cherry and pear orchards it is used as a top dressing spread around the trees. On the truck farms it is spread at the rate of 50 cu.yd. per acre and ploughed under. The truck men use it under corn, tomatoes, celery, cabbages and melons. It is still impossible to obtain reports favorable to sludge, but the same farmers are drawing it after four years of trial and using more than ever before.

## St. Paul to Vote on Abandoning Commission Government Plan

The Charter Commission of St. Paul, Minn., has submitted a draft of a proposed new charter to the City Council and the latter has set Dec. 29 as the date of a special election to vote on the scheme.

The charter provides for changing from the present commission plan to the so-called federal plan, with complete separation of the legislative, executive, and judicial departments of the city. If the new charter is adopted there will be a mayor vested with broad executive power, elected at large; a council of 15 members, of which 12 will be elected one from each of as many wards, and three elected one each from three districts composed of four wards each. The departments of Public Works, Public Utilities, and Safety will be vested in single commissioners, but there will be boards in charge of Park, Educational, Library, and Efficiency departments, the latter including civil service. There will be a City Planning Commission consisting of the mayor, the chairman of the Park Board, a civil engineer, an architect, a landscape architect, and three citizens of undesignated class.

The Commissioner of Public Works is to be a registered professional engineer of ten years' experience as a designing and constructing engineer. He is to be the chief engineer of the city and no limit is placed on his salary. The mayor will be paid $7,500 a year and the councilmen will receive $25 per month.

As the charter was originally drawn $6,000 was the limit for the Commissioner of the Department of Public Works, but this limitation was removed at the request of the Engineers' Society of St. Paul. They also requested that he be a registered professional engineer which was inserted in the final draft of the charter thus supporting the new registration law of the state.

The mayor will appoint all executive officers excepting the comptroller and he will appoint the members of all boards, with the exception of the Board of Efficiency which will be appointed by the comptroller. The latter is an elective official.

# Superpower Report Recites Gains from Power Consolidation

## Economic Advantages in Joining New Steam and Hydro-Electric Plant With Present Utilities on Eastern Coast

THE so-called superpower report made to the United States Geological Survey by a group of engineers headed by W. S. Murray, of New York City, has just been made public. This is a short-period study into the "possible economy of fuel, labor, and material resulting from the use in the Boston-Washington region of a comprehensive system for generating and distributing electricity to transportation lines and industries." The investigation was made under an appropriation of $125,000 plus $26,000 contributed by utilities, and was completed within the year ended the first of last July.

The so-called superpower zone lies between the thirty-ninth and fourty-fourth parallels of latitude, and extends from the coast approximately 150 miles inland, that is roughly the Atlantic coast from Boston to Washington and as far west as Harrisburg and Utica. Within it is concentrated one-quarter of the population of the United States and are operated, most of them independently, 315 electric public utilities, 18 steam railroads, and 96,000 industrial plants. The idea of the superpower system was to co-ordinate and supplement the existing utilities so as to carry to a higher degree the economies incident to their present operation. The engineering staff set out to determine the total amount and location of the power load that would be required for private, municipal, industrial, and railroad purposes at a date sufficiently in advance to permit the construction of a system of the highest economy to supply it. The date chosen was 1930. In the study special reports were made on electric utilities, proposed electrification of heavy traction railroads, performance and cost of the superpower system, steam-electric plants, hydro-electric plants, transmission systems, reliability of service, relation of coal and coal deliveries to the system, use of process fuels, basic costs, and existing stations.

The report states that the market for superpower energy will be furnished by the electric utilities, the industries, and the railroads. The estimated requirement of energy supplied through the electric utilities for municipal, private, industrial, and railroad purposes in 1930 is 31,000,000,000 kw.-hr. This energy could be supplied by a co-ordinated power system at an annual cost of $239,000,000 less than by the unco-ordinated system now in use. The total investment in generating and transmission facilities for such a system would be in excess of $1,000,000,000, of which $400,000,000 will represent the value of existing facilities. Within the superpower zone there are 36,000 miles of railroad, measured as single track. Of this total about 19,000 miles can be profitably electrified, so as to yield by 1930 an annual saving of $81,000,000 compared with the cost of operation by steam. The capital expenditure necessary to electrify the 19,000 miles would be $570,000,000.

It is believed that the quickest return on the investment in a superpower system would be obtained by following in chronological sequence an order of procedure as follows:

1. The construction of a steam-electric plant near Pittston, Pa., to supply a part of its energy to the anthracite division of the superpower zone and the remainder to the metropolitan division, particularly New Jersey.

2. The construction of a steam-electric plant near Sunbury, Pa., to supply a part of its energy to the anthracite division, a part to the Reading load center, and the remainder to Philadelphia.

3. The construction of hydro-electric plants on the Delaware and Susquehanna Rivers to supplement the steam plants indicated above.

4. The progressive development of the Hudson River projects to meet the growth of energy requirements at the Schenectady, Utica, Poughkeepsie and Pittsfield load centers.

5. The construction of a steam-electric plant near Boston to supply the Boston, Lowell and Newburyport load centers.

6. The construction of a steam-electric plant near New Haven to supply the New Haven, Bridgeport, Waterbury and Norwich load centers.

7. The partial construction of the first hydro-electric plant in the development of the Potomac River as soon as the power demands of the Baltimore and Washington load centers require additional plant capacity.

It is stated that the hydro-electric resources of the district are comparatively small. When the increases during the last ten years are projected to 1930, about 21 per cent of the total energy requirement can be supplied from water power, that is about six billion kilowatt-hours. However, some of the best coal deposits in the world lie near this territory and the prime economic purpose should be so to join the hydro-electric supply power to the steam electric supply as to produce a maximum of energy for a minimum investment of capital and a minimum operating expense. This means locating the steam-electric plants so as to obtain the fullest advantage of low freight rates, easy coal-delivery routes and ample condensing water.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT

| | Capacity, Kw. | Output (Millions of Kw.-Hr.) | Investment | Production Cost (Mills per Kw.-Hr.) |
|---|---|---|---|---|
| Potomac | 200,000 | 950 | $22,000,000 | 3.36 |
| Susquehanna | 185,000 | 1,230 | 28,000,000 | 3.22 |
| Delaware | 350,000 | 1,250 | 51,500,000 | 5.95 |
| Hudson | 150,000 | 900 | 38,350,000 | 5.84 |
| Connecticut | 165,000 | 760 | 29,000,000 | 5.455 |

The average capacity of the 558 electric utility plants now in operation in the zone is 7,900 kw. and that of the steam-electric plants, 10,000 kw., while the hydro-electric plants average only 2,800 kw. The capacity of the base load steam plants projected would range from 60,000 to 300,000 kw., and in none of them would there be a turbo generator having a capacity of less than 30,000 kw.

The average unit production cost for electric utilities in 1919 was 1.98c. per kilowatt-hour, and the cost of the electric power produced by steam was 2.12c. and that of hydro-electric power, 0.94c. In the steam-electric base load plants for the superpower system the production cost based upon the same capacity factor that is applied to independent electric operation would be 0.99c. per kilowatt-hour, as compared with 2.12c. The unit investment cost in new power plants for the superpower system is $118.25 per kilowatt of effective capacity. That for all plants is $125 per kilowatt. The unit reproduction cost of the electric utilities in 1919 was $156 per kilowatt.

It is also stated that under present construction and operating costs power purchased at Niagara or on St. Lawrence River at $20 a horsepower ready for transmission at those points at potentials of not less than 220,000 volts, can be placed at Utica and Schenectady, N. Y., and at Northampton, Mass., for 4.6 mills per kw.-hr. and at Paterson, N. J., for 5.7 mills. These figures assume purchases of not less than 300,000 kw. delivered at a load factor of not less than 80 per cent.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## National Societies Should Act On Highway Bridge Safety

Sir—The deplorable failure of the Third St. bridge at Chester, Pa., described in your issue of Sept. 15, by which 24 persons lost their lives, calls for more extended comment than it has received in the daily and technical press. It is very clear that neither your editorial note of Sept. 22, which ascribed this "accident" to a "cracked plate which somebody's conscience had allowed him to slip back into place" nor the letter of Edward Piercy, in your issue of Oct. 13, according to whom "the blame rests solely on the man or men who inspected or passed such a piece of work" goes to the root of the matter. The really important question is: What safeguards are there against similar failures on the thousands of highway bridges all over this broad land?

Is there any systematic procedure by which the plans for new bridges are examined and approved and their construction supervised by competent state officials?

Is there any periodic inspection of existing spans, to ensure their strength under the constantly increasing loads?

An examination of the laws in the different states shows that the provisions for the protection of the public are very inadequate. In the state of New York, for instance, there seems to be at present absolutely no supervision under state authority, as the law which formerly empowered the state engineer to stop traffic over bridges found to be unsafe was repealed some years ago. This retrograde action is said to have been due to the country members in the legislature, whose constituents found the maintenance of safe bridges unduly burdensome. As a consequence neither the state engineer nor the state highway department has any jurisdiction in the matter of bridge construction or maintenance. Except in the larger cities, this important matter is entirely in the hands of town and county boards whose qualifications and interest in the subject are, as a rule, extremely meager.

In former years vehicles were much lighter and the highways were used almost wholly by nearby residents, so that local control was natural and was not likely to lead to serious accidents. At the present time, even in many quite remote districts, there is a heavy traffic of travelers from distant points riding in high-speed touring cars, while heavy motor trucks are numerous. The strength of bridge spans has therefore become a matter of general concern and should be ensured by state, if not federal regulation.

As a matter of fact, even a cursory examination of the bridges on an average country road shows a very unsatisfactory state of affairs. They are as a rule of all ages, types and conditions of repair, some new, others 30 or more years old, of very light construction and with poor details.

It is rather appalling to realize that in this state there is absolutely no power except public opinion compelling the local authorities to make repairs to a bridge, even when it is manifestly unsafe; while public opinon is very difficult to arouse in matters of this kind.

In proof of the last statement, the writer would refer to his personal experience in the case of a bridge in the Adirondacks which crosses the Ausable River above the village of Keene Valley.

This bridge is a light pin-connected pony truss 75 ft. in length and about thirty years old. It carries a very heavy traffic during the summer season. About five years ago one of the abutments was washed out, allowing the steelwork to drop into the rocky river bed, and bending it seriously. Since that time, the bridge, which was rebuilt, using the old material, has been in very poor shape. Many of the eyebars are badly bent and the end posts are out of plumb, the top overhanging the bottom as much as 12 in. in a height of 8 ft. The entire upper chord is very much out of line. A moment's inspection is sufficient to show the dangerous condition of this bridge, as there is no lateral system or bracing of any kind to keep the top chord from buckling.

In the face of these facts the writer found it impossible to arouse much interest in the condition of the bridge among either the local residents or the summer visitors. The structure has remained in its precarious condition for four or five years, except that one of the end posts has been pulled into line and secured to a tree by a piece of telegraph wire. As a result of renewed agitation it seems possible at the present writing that some repairs may be undertaken before long, although the town board is much averse to spending even the moderate sum required to make the bridge reasonably safe.

In view of the rigid regulations for building construction, steam boilers, etc., now so general, the absence of similar restrictions in the case of bridges, where proper supervision is at least equally necessary, is remarkable.

The need for reform seems sufficiently great to call for action on the part of the national engineering societies, who of late, through various agencies, have exerted so powerful and beneficent an influence in questions of this kind.

The purpose of this letter is to elicit expressions of opinions from your readers so that the matter may be fully discussed in all its phases.

New York, Oct. 22. HENRY GOLDMARK, Consulting Engineer.

## Two Veterans on the Engineer Corps

Sir—Your issue of Oct. 6 contains references to the pamphlet prepared by a committee of the A. A. E. in the matter of the Department of Public Works which makes some statements that cannot be passed without challenge.

The writer is strongly in favor of the establishment of a Department of Public Works and is in sympathy with much of this pamphlet. Certain statements, however, are made in the pamphlet which, to the writer's personal knowledge, are not wholly correct.

Military engineering is as much of a specialty as any other branch of the profession and the training of the Corps of Engineers is and should be primarily along this line. It is only through this military training that a proper sense of relative military values becomes appreciated. These values are entirely different from those developed in civil engineering as time is the item of primary importance instead of the cost and economics as in the case of civil engineering.

Generally, in France, a large part of the friction between regular and volunteer officers was caused by the lack of understanding on the part of volunteer officers of proper relative military values and in these cases it is safe to say that generally the regular officer was more nearly right than the volunteer.

On page 7 of this pamphlet there occurs the following statement: "In the general case, those officers, regular and temporary, who were the most successful in engineering work in France were those who one way or another had succeeded in getting their work practically out from under the Chief Engineer and who were able to manage it under the Commanding General without interference on the part of the Chief Engineer or of the regular army engineering establishment in the United States." The next paragraph furnishes the numerous illustrations quoted in the article in *Engineering News-Record*.

As a matter of justice to the Corps of Engineers, the writer wishes to take exception to these statements. It is a very debatable question whether the railroad service, the chemical warfare service and the operation of ports was or is properly a function of the Engineering Department. Certainly the Corps of Engineers could not be expected to become expert in these lines and in the reorganization of the army the chemical warfare service is made a separate department as it should be. The Purchasing Department of the A. E. F. certainly was not properly a function of the engineers alone. The engineering section of the Gen-

eral Purchasing Board, however, was continuously under a regular officer and it operated efficiently. The construction of ports, cantonments, hospitals, etc., was also under a regular officer reporting to the Chief Engineer except for a few months late in 1917 and early in 1918 when a small portion of the port and railway construction reported to the Transportation Department. This work, however, was later returned to the Chief Engineer, and aside from this brief period all construction was under the direction of the Chief Engineer throughout the history of the A. E. F. It was the writer's experience with one of the Directors of Construction and Forestry, under whose immediate direction a large portion of this work was done and whose chief staff officer, as well as himself, was a regular, that almost the first question asked on the inspection trip was whether any delays were being experienced due to red tape or other similar delays in the office of the director. In most cases the reply could be made that delays were not occurring from these causes. This same condition existed under other directors and many of the delays that did occur were caused by civilian specialists.

The writer makes these statements from personal knowledge and because he feels that the pamphlet in question does not do justice to the Corps of Engineers, of which he has never been a regular officer.

It would appear that there are plenty of arguments for the proposed new department without reflecting on the excellent war record of the Corps of Engineers. The regulars made mistakes as did the volunteers and efforts should be made to improve the training of both the regulars and reserves rather than to restrict that of the regulars.

WM. G. ATWOOD,
St. Louis, Mo., Oct. 21 formerly Colonel of Engineers.

Sir—The writer was very much interested in your editorial on "Over-emphasizing the Corps of Engineers." At the beginning of the world war the writer held a reserve commission as captain in the Engineer Reserve Corps and was later transferred to the construction branch of the Quartermaster Corps and handled some $12,000,000 worth of construction, reaching the rank of lieutenant colonel.

The article was timely and very pertinent. The writer came in intimate and generally conflicting contact with the officers of the Corps of Engineers and was extremely surprised to find that as military engineers they were the finest that the world can produce but that their knowledge of commercial engineering was of the stereotype school-boy textbook and that they were woefully ignorant of engineering principles, due mostly to the fact that they did not have the experience and had not had the experience which commercial engineering only can give.

Even the high ranking officers with between twenty and thirty years commissioned service in the Corps of Engineers failed to grasp the progress of the time and appeared to have depended for their technical knowledge upon the civilian engineers from the civil service who were permanent fixtures in the different offices and who practically developed and handled all of the plans and details, leaving the commissioned officer as an executive without the primary knowledge which is so necessary under keen competition in present day commercial life.

I do not desire to condemn the Corps of Engineers as a whole but I do believe that it is very essential that either they should remain purely and strictly military engineers with troops or they should be given training and such experience in commercial engineering that when the next war breaks that they will be in a position to handle the entire construction program which is now required for mobilizing and concentrating an entire nation for war.

Either let us give our army engineers the experience of operating huge camps, water, sewer systems, steam heating plants, structural designs and construction and engineering as a whole or else let us make them purely engineers with troops and build up a branch of the army which will be trained and which can handle the commercial engineering so vital in this modern time to the essential winning of a big war.

FIDELIO G. CHAMBERLAIN,
San Antonio, Tex., Oct. 11. Consulting Engineer.

## The Baltimore Centrifugal Pump Test

Sir — The caption, "Baltimore Pump Sets New Duty Record for Centrifugals," heading the article in your issue of June 2, p. 938, on the test of a 30-m.g.d. steam-turbine-driven centrifugal pump, challenges criticism, principally for two reasons:

1. That although the discharge was measured both by Pitot tube and by Venturi meter and the Venturi meter showed 3.5 to 4 per cent lower delivery than did the Pitot tube, the latter alone was, in spite of the generally recognized greater reliability of the Venturi, used in calculating the duty, and

2. That while on the basis of the Venturi measurements the overall efficiency of the turbine and pump was 53.8 per cent at the specified rating and 57.2 per cent at 50 per cent overload, a pump of about the same capacity tested at Toronto some six years ago showed an efficiency of 56.5 per cent at the load for which it was designed. The Baltimore pump can hardly, therefore, be said to set "a new duty record."

The unapproached trustworthiness of the Venturi meter arises from the fact that the conditions of flow are definitely determined by the construction of the meter, and if the tube is properly installed it should have exactly the same coefficient in use as when calibrated by the maker. The Venturi tube gives a large differential pressure, which is favorable to exact measurement. The form of the tube has not only been standardized by several makers, but the tubes of one maker differ so little from those of other makers that, in the large sizes here under consideration, their coefficients can be assumed almost with certainty to lie between 0.98 and 0.99.

The Pitot tube, on the other hand, is peculiar in that while the action of the impact tube itself agrees exactly with theory, in practical use Pitot tubes give rise to considerable error. The principal source of error is lack of knowledge of the relation between the velocity indicated by the tube in any given position and the average velocity over the whole cross-section of the pipe.

The results obtained with the Venturi tube have, in view of the consideration just presented, been used in the following analysis of the Baltimore test. For the 4-hr. test made at about the specified rating of 30 m.g.d. the values given are:

| | | |
|---|---|---|
| Steam pressure, lb. gage | 174 34 | |
| Superheat, deg. F | 43 6 | |
| Vacuum, in., referred to a 30-in. barometer | 28 937 | |
| Condensate pump discharge, lb. per hr. | 13,087 8 | |
| Delivery of main pump, m.g.d. | 30 43 | |
| Total head, ft., including 3.01 ft. correction for velocity head | 187.14 | |
| Water horsepower | 1,000 | |
| Brake horsepower at pump shaft, estimated | 1,252 | |
| Pump efficiency, per cent | 79.9 | |
| Steam consumption, lb. per brake hp.-hr. | 13,087 8 / 1,252 | = 10.42 |
| Steam consumption of a perfect turbine expanding steam between the terminal conditions given, lb. per hp.-hr. | 6.9 | |
| Rankine cycle efficiency of turbine, including gears, per cent. | 66.2 | |
| Overall efficiency of turbine and pump, per cent. | 52.8 | |

The above-named efficiency includes the auxiliaries. As the steam or power consumption of auxiliaries may vary quite considerably for the many different types used, it would be interesting to know the overall efficiency of turbine and pump alone, which in this case can be very closely calculated with the information given.

In order to give the unit credit for the work consumed by the Pelton wheel driving the condensate pump, we can use the following figures:

| | |
|---|---|
| Wheel nozzle pressure, lb. per sq.in. | 117 4 |
| Consumption of water, gal. per min. | 61 6 |
| Water hp. used | 4.22 |

4.22 hp. is 0.422 per cent of the water hp. above credited to the main pump.

The water used by the hurling-water air pump amounted to 548 gal. per min. at 77.6 ft. head, or 10.7 water horsepower. Assuming the efficiency of the pump supplying this water, which is driven from the main unit, to be 65 per cent, the shaft horsepower becomes 16.5, which is 1.32 per cent of the shaft horsepower generated by the turbine.

In the published report no reference is made to the amount of steam withdrawn by the hurling-water air pump, and hence not accounted for in the condensate and not

charged against the turbine. A hurling-water air pump is really a high-velocity jet condenser and is in free communication with the vapor space of the main condenser. Such jet condensers are sometimes used to condense *all* the steam, as well as to remove the air, as in the well-known Schutte & Koerting low-level jet condenser.

The condenser friction may be estimated at 0.3 ft., which is 0.16 per cent of the head developed by the unit. We therefore have the total power consumption of the auxiliaries 0.422 + 1.32 + 0.16 = 1.9 per cent, and 1.019 × 0.528 = 53.8 per cent as the overall efficiency of turbine and pump. Using 66.2 per cent as the efficiency of the turbine and gears, this gives a centrifugal pump efficiency of 81.3 per cent.

In the test at 50 per cent overload, the duration of which was 1 hr. only, the following results were obtained:

| | | |
|---|---|---|
| Steam pressure, lb. gage | 173 38 | |
| Superheat, deg. F. | 53 | |
| Vacuum, in. Hg., reduced to 30-in. barometer | 28 955 | |
| Condensate pump discharge, lb. per hr. | 17,282 | |
| Main pump discharge, in gal. | 44 87 | |
| Total head, ft., including 6.51 ft. correction for velocity head | 180 16 | |
| Water hp. | 1,419 | |
| Brake hp. at main pump shafts, estimated | 1,701 | |
| | 1,419 | |
| Pump efficiency, per cent | ——— | = 83 45 |
| | 1,701 | |
| | 17,282 | |
| Steam consumption per brake hp.-hr., lb. | ——— | = 10 16 |
| | 1,701 | |
| Steam consumption of a perfect turbine for the same terminal conditions, lb. per hp.-hr. | 6.84 | |
| | 6.84 | |
| Rankine cycle efficiency of turbine, including gears, per cent | ——— | = 67.4 |
| | 10.16 | |
| Overall efficiency of turbine and pump, per cent | 56.2 | |

For making similar corrections as before for power used by auxiliaries we have:

| | |
|---|---|
| Pelton wheel nozzle pressure, lb. per sq. in. | 108 9 |
| Water used by Pelton wheel, gal. per min. | 59.5 |
| Water hp. | 3.78 |
| Total head on hurling water supply pump, ft. | 89.3 |
| Water used by hurling-water air pump, gal. per min. | 591 |

Assuming 65 per cent efficiency of the pump which supplies the hurling water, this gives a brake horsepower of 20.5.

Assuming condenser friction to be 0.6 ft., we have as the percentage power consumption of the auxiliaries 0.266 + 1.2 + 0.333 = 1.8 per cent and the overall efficiency of turbine and pump alone 0.562 × 1.018 = 57.2 per cent, which, assuming 67.4 per cent turbine efficiency, gives a pump efficiency of 84.85 per cent.

This performance is obtained at 50 per cent over the rating specified, but this maximum capacity can probably be taken advantage of for short periods only, as it imposes a 50 per cent overload on the gears.

For comparison, figures may be taken from the official test of one of the De Laval pumps at Toronto, referred to above, designed and built some six years ago, since which time material improvements have been made in the efficiency of both turbines and pumps. The official acceptance test was made and reported by Prof. Robt. W. Angus, of the University of Toronto, acting for the city.

The test extended over 24 hours. The steam pressure was 144.6 lb. gage and the steam contained 0.35 per cent of moisture, but no correction was made for this moisture. The vacuum was 29.27 in. The capacity developed was 20,900 gal. per min. against 252.57 ft. head, corresponding to a water horsepower of 1,333. This was the normal rating of the unit, and is about 10 per cent less than the power developed by the Baltimore pump in the test showing the highest duty. The duty, excluding auxiliaries, was 160,500,000 ft.lb. per 1,000 lb. of steam. The steam consumption per water horsepower was 12.34, while the steam consumption of a perfect turbine and pump working between the same terminal conditions would be 6.97 lb. per hour, giving an overall efficiency of turbine and pump of 56.5 per cent.

DE LAVAL STEAM TURBINE CO.,
Trenton, N. J., Aug. 8. Per A. PETERSON.

Sir—In the foregoing letter, Mr. Peterson claims, among other things, that a Venturi meter is a more accurate instrument for the measurement of water than a pitometer. The accuracy of the results obtained with either instrument depends upon care taken in calibration and observation.

The Baltimore contract specified that the water measurements should be made by two Pitot tubes, one placed in the suction and the other in the discharge line of the pump. Extreme care was taken to make an accurate traverse of the pipe lines. A pilot Pitot tube was used to insure all traverse readings being taken at the same capacity. The small variation in the readings of the two instruments is evidence of the accuracy of the results obtained.

The Venturi meter was read during the test for the convenience of the city, and for the purpose of ascertaining its approximate percentage of error. It was not calibrated; no manometer was used; the readings were taken from the dial and were not used in the calculation of results.

The suggestion is made that the duration of the test was not sufficient to assure accurate results. Providing a pumping unit has been running under contract conditions for a period sufficient to allow the flow in pipe lines to become stabilized, a carefully conducted test of one hour on this type of pumping unit will show the actual duty within a very small fraction of 1 per cent.

The tendency of an air pump to steal steam depends entirely upon the manner in which it is connected and the relative size of the condenser and pump. The conditions were such at Baltimore that the amount of steam removed by the air pump and unaccounted for was negligible. This is evidenced by the temperature of the water in the well into which the air pump discharges.

I do not agree with Mr. Peterson that the performances of pumping engines should be compared on the basis of disregarding the power required for the condenser auxiliaries. Excellence of design resulting in economical performance of the condenser and its auxiliaries should be considered in determining the efficiency of a complete pumping engine. The comparison of the performance of the Toronto and Baltimore pumps should, therefore, be made on this basis.

The final test of the Toronto pump was published in *Canadian Machinery*, Dec. 27, 1917. Prof. Angus of Toronto University gives the duration of the test as 10 hr., not 24 hr. At point of normal operation the test was run for 4 hours.

The quality of the steam at Toronto and Baltimore was somewhat different. The proper manner to compare the performance of these two pumps is on the basis of available heat. The mean available heat on the two tests at Toronto was approximately 380.45 B.t.u., the difference between the two tests being very slight. The average available heat on the tests at Baltimore was 386 B.t.u., the difference in these tests also being very slight. This means that the unit at Baltimore had available 1½ per cent more heat than the unit in Toronto. Prof. Angus' report gives a duty of 150.92 for one unit and a duty of 153.92 for the other unit. Allowing a 1½ per cent increase in duty for difference in steam conditions, this would give a duty of 153.2 m.ft.-lb. for the first, and 156.2 m.ft.-lb. for the second Toronto unit. The Baltimore pump developed a duty of 160.2 m.ft.-lb. at contract capacity and 170.2 m.ft.-lb. duty per 1,000 lb. of steam at excess capacity.

It is suggested that the higher duty obtained on the Baltimore pump at excess capacity should be disregarded as it is of no value to the city. On the contrary, the Baltimore pump, since its installation, has operated for considerable periods at a capacity of approximately 40 m.g.d. Its excess capacity was considered by the city to be of such value that it was deemed undesirable to make slight alterations on the pump which would have resulted in its maximum performance being obtained at the contract capacity.

The Toronto tests were made March 6 and 8, 1917, with undoubtedly very low temperature condenser cooling water. The Baltimore test was made Aug. 4 and 6, 1920. The temperature of the condensing water was slightly over 70 deg. F.

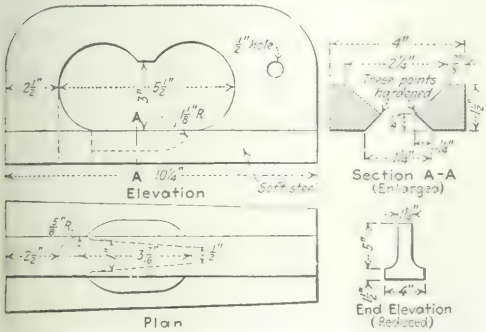
From the facts given above it is apparent that both under contract conditions and under excess capacity conditions, the performance of the Baltimore pump substantiates the statement appearing in *Engineering News-Record* of June 2, entitled "Baltimore Pump Sets New Duty Record for Centrifugals."

ROBERT W. ALLERTON,
New York City, Worthington Pump & Machinery
Sept. 30. Corporation.

# HINTS FOR THE CONTRACTOR

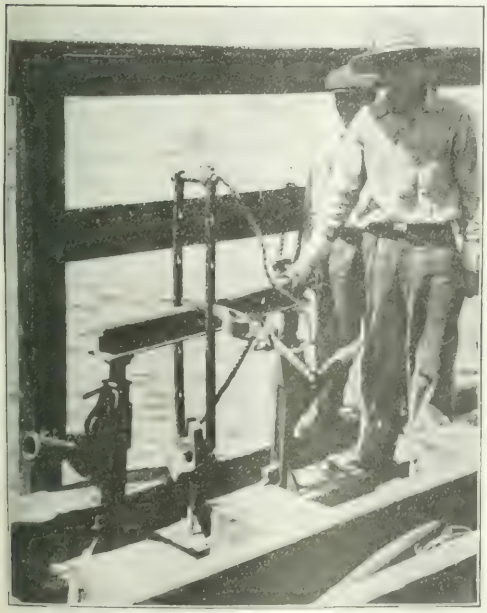
## Drift-Bolt Puller Speeds Renewal of Lucin Trestle Deck

IN RENEWING the deck on 11.8 miles of the Lucin cutoff trestle on the Southern Pacific R.R., an average of about 4,600 drift bolts per mile have to be pulled. Due to natural conditions the bolts which are ¾ x 25 in. in size, galvanized, have "frozen" very firmly into the wood and when the work started were removed only




THE CLAW THAT GRIPS THE TOP OF THE BOLT

with great difficulty by clawbars or other ordinary methods.



DEVICE RAISING A DRIFT BOLT FROM THE STRINGER OF A TRESTLE DECK

A device was therefore developed by the maintenance of way forces and constructed in the shops at Ogden with which the bolts are now being removed speedily and easily.

The first operation is to adz away the top of the stringer to a depth of an inch or more entirely around the bolt and for a distance of 5 or 6 in. each way. A steel claw, shaped as shown in the accompanying drawing, is then placed over the bolt and tapped with a sledge so as to drive it horizontally and cause the narrowing edges of the claw to bite into the bolt.

A "lifter" or clevis-like device is attached to the puller and by the use of two jacks and a short piece of rail, as shown in the accompanying illustration, the puller is raised vertically, bringing the bolt with it. The jacks stand on the stringer itself, so there is no tendency to pull the stringer away from the cap. The ropes shown in the illustration are to prevent the several pieces from falling into the lake in case of any slip.

## Storage Reservoir Insures Constant Water Supply on Road Work

ON CONCRETE road work near Garden City, Kan., where daily runs of over 800 ft. of 16-ft., 7-8-7-in. section pavement, have been made, a storage reservoir has been found a useful regulator of a water supply taken from a deep well. The road passes through a stretch of country 2½ miles from the nearest place where water can be secured. A concrete reservoir, as

CONCRETE LINED STORAGE RESERVOIR FOR ROAD WORK

indicated by the illustration, was built ½ mile from the well, and from the reservoir the water is pumped 2 miles to the paving mixer. One pump, a 4-cylinder, triplex, portable outfit, pumping alternately from well to reservoir and from reservoir to mixer, is employed. During working hours the pump supplies the paver, and on Sundays and at night it fills the reservoir. The reservoir is about 40 ft. in diameter and the concrete lining is 6 in. thick. The contractor is the Ammerman Contracting Co., Garden City, Kan., which has a contract for 28 miles of pavement.

The information contained in this note was supplied by the Chain Belt Co., Milwaukee, some of whose equipment was used on this job.

# NEWS OF THE WEEK

New York, November 10, 1921

## Delaware River Bridge Plans Taking Definite Form

The plans for the caissons and masonry of the two river piers of the Delaware River Bridge are practically complete. Plans and the contract were brought up for adoption at the meeting of the joint commission on Nov. 9 and it is expected that bids will be advertised for within a couple of weeks after that date for tenders to be received toward the end of December. These piers will measure 70 x 143 ft. at the base and will require for both some 62,000 cu.yd. of masonry. They will be granite faced down to a point below low water level. The borings at the site of the two piers are practically complete and show rock at from El. —58 to El. —73 on the Philadelphia side and from El. —80 to El. —90 on the Camden side. The boring contractor will now move to the sites of the anchorages.

Formal approval to the plans for the bridge was given by the Secretary of War and Chief of Engineers, U. S. Army, Sept. 26, 1921. The plans were submitted in accordance with the results of the hearing of last February, when it was concluded that a clearance of 135 ft. above mean high water and a span with piers outside the pierhead lines, would be acceptable.

Notices of condemnation have been served on owners of property at the sites of the river piers and anchorages. The joint commission has authority to enter on such properties and commence work within sixty days after serving notice.

An investigation of the feasibility of eliminating the top lateral bracing in the stiffening truss of the main spans has been made, as a result of which it has been concluded that this is practicable and desirable.

M. B. Case, now resident engineer on the reconstruction of the Cincinnati Southern Ry. bridge over the Ohio River at Cincinnati, has been appointed senior resident engineer and will have full charge of the work in the field.

## Technical Unemployment Small

Records of the American Association of Engineers show that unemployment among professional technical men is small as compared to the trades. Roughly estimated about 2 per cent of the technical men are actually unemployed.

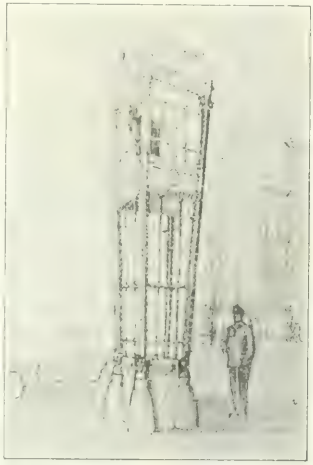
The Employment Bureau of the Association is planning a further development of its employment service to professional technical men. The plan contemplates establishing offices in at least eight employment centers to act as clearing houses for different sections of the country. During the year ending Sept. 30, 1921, notices of 6,165 positions open were sent to all members of the association that asked to receive them. There were 3,018 men placed, 1,824 through the Chicago office and the remainder through the branch offices. The annual saving to the members affected exceeded $300,000.

## Highway Bill Goes to President

Those who were disposed to withhold unanimous consent for the consideration of the conference report on the highway bill in the Senate, following its recent approval by the House of Representatives, finally were induced to allow the report to come up and it was approved without debate and hurried to the White House. In the regular course President Harding referred it to the Secretary of Agriculture for his recommendation.

## Select Design for Fifth Avenue Traffic Signal Towers

Final selection of a design for the five permanent traffic signal towers which are to replace the present temporary structures on Fifth Ave., New



York City, has been announced by the Fifth Avenue Association, which is to present the towers to the city. Joseph H. Freedlander, a New York Architect, submitted the design which was unanimously adopted, in competition with 129 others, as the most practical as well as the most appropriate to the dignity and beauty of Fifth Ave. In addition to the cash prize of $500, Mr. Freedlander will be retained by the association as architect to prepare the working drawings and supervise the construction of five towers.

The new signal towers are to be constructed almost entirely of bronze, with a granite base 4 ft. square and 3 ft. high. They will be 23 ft. in height. The lower part of the structure will be open so as to allow an unobstructed view up and down the avenue. The space at the top, which is to house the traffic policeman, will be enclosed in glass windows, so operated as to allow the policeman in the tower to open or close all of them at one time with a single swing of a lever. The tower base, as shown in the illustration, is subject to modification.

## Fire Destroys Four Erie Piers Causing $2,000,000 Loss

Fire of an unknown origin, starting about midnight November 3, completely destroyed four ship piers at Weehawken, N. J., belonging to the Erie R. R., and caused other property damage variously estimated at from $2,000,000 to $4,000,000. Loss sustained by the Erie R. R. alone amounted to $2,000,000, of which $500,000 was in merchandise stored on the piers and in box cars lying in the adjoining yards, the remainder of the loss being sustained through the destruction of the four piers, and the destruction of and damage to 22 barges and lighters and a string of seventeen freight cars.

Plans are already under way for rebuilding the piers, a meeting of the board of directors of the road having been held last Tuesday to decide upon some plan. It is possible that but one of the piers will be rebuilt at the present time, though that one may be extended out to the pier-head line, which will give much greater length to the new pier than the old ones had. Two of the four destroyed piers, Piers A and B, were built in 1882 and the other two, C and D, were built in 1891.

## Boston Advised to Accept Bid of $3,795,000 for Garbage Disposal

The city council of Boston will hold a hearing Nov. 16 on the recommendation made by the special committee on garbage disposal and approved by Thomas P. Sullivan, commissioner of public works and by Mayor Peters that the contract for garbage disposal for the ten years beginning July 1, 1922, be awarded to Coleman Bros., Inc., for $3,795,000. The two bids for this contract received Sept. 7 were published in these columns Sept. 15, p. 465. Since then, the other bidder, the Boston Sanitary Development Co., holder of the contract for the ten years now ending, notified the city that owing to improved conditions it could do better than its bid of $4,202,000. New bids were invited. The company last named reduced its bid to $3,914,000 and Coleman Bros. held to its former bid of $3,795,000. It is expected that the award will be made the subject of several hearings.

## Big Sewer Contract To Relieve Unemployment at Dallas

In order to improve employment conditions at Dallas, Texas, the Board of Commissioners is preparing to ask for bids on a $300,000 storm sewer to be built in Pacific Ave., a street that has just recently been freed from a double-track steam railway and switch tracks. This project is one of the large city plan undertakings and is the first step in the transformation of a street that was practically an industrial route into a first-class retail thoroughfare. It is planned to place a large sanitary sewer underneath the storm sewer. Engineers are watching this project as the problem of handling the excavation will be unusual on account of earth conditions.

## Logging Engineers in Convention at San Francisco

Problems involved in logging engineering occupied the most prominent place among the topics discussed at the twelfth annual Pacific Logging Congress, held at the Palace Hotel, San Francisco, Oct. 26-29. One session was devoted to discussion of standardizing courses of study preparation for the profession of logging engineering. Four colleges which have been offering courses in forestry and logging engineering were represented by graduates. These schools are the Universities of California, Washington and Idaho and the Oregon Agricultural College. Among the several hundred delegates in attendance were representatives of logging interests from eight states and British Columbia. Some of the papers which were more particularly within the engineer's field were as follows:

"A Standard System for Management of Camp Mess-Houses," by W. C. Ruegnitz, Portland, Ore.; "Utilizing Flumes for Handling Pacific Coast Timber," by A. P. Allison, Brooks-Bidlake & Whittall Co., Ltd., Vancouver, B. C.; "Logging With Motor Trucks in California Pine District," by A. M. Mortensen, Manager, California Fruit Exchange, Graeagle, Cal., "Motor Trucks in Douglas Fir Logging," by J. P. Van Orsdel, Portland, Ore.; "Camp Building," by James O'Hearne, English Lumber Co., Mt. Vernon, Wash.; "Intensified Railroad Construction Versus Donkey Hauls," by L. T. Murray, West Fork Logging Co., Tacoma Wash.; and "Steam Shovel in Logging Railroad Construction," by Minot Davis, Clemons Logging Co., Montesano, Wash.

Officers elected for the ensuing year were: President L. T. Murray; vice-President, James O'Hearne; and secretary-treasurer George M. Cornwall, Portland, Ore.

## Mechanical Engineers Plan Annual Meeting Dec. 5-9

Elimination of industrial waste will be stressed at the annual meeting of the American Society of Mechanical Engineers to be held in New York City Dec. 5-9. The report of the Committee on Elimination of Waste in Industry of the American Engineering Council will provide the basis for the discussion. The leading session will point out the necessity for waste elimination and develop essential principles of standardization and stabilization. The professional sections will consider in technical fashion the steps that can readily be taken more effectively to utilize our national resources.

Two sessions on education will be held, one under the auspices of the Committee on Education and Training in the Industries, and the other a joint meeting with the Society for the Promotion of Engineering Education. A new development in annual meeting projects will be launched at the December convention. The Committee on Relations with Colleges has charge of a session at which the papers will be prepared and presented by students. Discussion will be limited to students and the meeting will be conducted by students.

The honorary memberships which have been granted to Henry R. Towne and Nathaniel G. Herreshof will be formally bestowed on the evening of Dec. 5, following the address of President Carman. The business meeting has been scheduled for Dec. 7. The entire day will be given over to the discussion of the policies of the society and especially of the new constitution.

## Federal Road Bureau Starts New Research Program

### Will Study Wavy Surfaces, Bridge Impact and Effect of Vibration On Subgrade Moisture

The U. S. Bureau of Public Roads is preparing to undertake a number of new experiments, including an investigation to determine the cause of wavy road surfaces, a study of the warping of concrete road slabs as a result of temperature changes, an experiment to determine the effect of slab vibration upon the movement of moisture in the subgrade, a study of impact stresses in bridges and other frame structures, and a large-scale experiment to test various designs of concrete surface sections.

The study of the cause of wavy road surfaces will be made on a circular track 15 ft. wide and 180 ft. in diameter, which is being built at the Arlington Farm, just outside of Washington, D. C. The circumference of the circle will be divided into sections, each of which will be surfaced differently with various kinds of tar and asphalt pavement, some of them on concrete bases. The "traffic" to which these sections will be subjected will be supplied by a driverless motor truck, which will be held to the circular path by means of a long arm extending from the center. By a simple device the course of the truck will be altered from time to time so that the entire width of the roadway will be traveled over. It is not likely that the actual experimental work will be begun until next season.

#### New Impact Device

The study of impact stresses in bridges will be made with a new instrument devised in the bureau and now practically perfected. Attached to any member of the bridge the instrument makes a photographic record of the effect of a moving load. The deformation resulting from the impact is represented by a fine line on the photograph. From the preliminary tests which have been made it appears that the results of the quickest blows are measured by the instrument. It is now being calibrated and will shortly be put into use to obtain experimental data.

The experiments on concrete sections will be made on the Columbia road in Arlington County, Va., and the cost of the construction will be shared by the county. Only a part of the road will be used for experimental purposes. Various sections will include surfaces with different kinds of joints, some with longitudinal joints and some without. Some will be built with gravel sub-bases; others will be built over especially treated subgrades in which the soil will be mixed with cement for a depth of 6 inches, using 1 part of cement to 20 parts of earth. Of special interest will be the various forms of ribbed sections and the various arrangements of different kinds of reinforcing material. The road is now under construction, but it will not be completed until next season. The various surfaces will be subjected to normal road traffic, the weight and volume of which will be determined by careful traffic counts.

## Railroad Executives Will Press Wage Cut Action

Railroad executives of the eastern roads will endeavor to secure from the Railroad Labor Board authorization for a further reduction in the pay of operating employees, so that the 20 per cent increase put in effect during 1920 will be written off. The 12 per cent cut ordered in July has written off part of that increase. Conferences with employees are to start within a few days and when a concrete plan has been evolved it will be put before the Railroad Labor Board. As that body secured a recall of the strike order, scheduled to go in effect Nov. 1, on the basis of no further wage reductions being ordered, it is doubtful that any immediate action by the board will be forthcoming.

## California County Engineer Act Held Unconstitutional

The supreme court of the State of California recently rendered an opinion declaring unconstitutional the Ream bill passed at the 1919 session of the California Legislature which created the office of county engineer, leaving it to the board of supervisors in each county to fix the salary of the office. The legislation was popularly known as the California County Engineer Act. The act stated that the "county engineer shall be deemed an employee and not a county officer."

A number of counties with extensive work under way handled by well-organized county engineering staffs now face the situation of having no authority to pay the county engineer's salary. Some of these salaries are $5,000 to $6,000 per year in counties where the salary of the county surveyor, fixed by the legislature, is limited to $3,200, with not more than one deputy at not more than $85 per month.

The supreme court decision holds that the act "violates the constitutional requirement that the system of county government . . . shall be uniform throughout the state."

## To Study Properties of Steel Reinforcing Bars

Announcement has been made by the American Society for Testing Materials that a special committee has been appointed to conduct an investigation of the physical properties of plain and deformed concrete reinforcement bars. The personnel of the committee is: E. E. Hughes, Franklin Steel Co.; Richard L. Humphrey, consulting engineer; A. E. Lindau, Corrugated Bar Co.; C. F. W. Rys, Carnegie Steel Co.; W. A. Slater, Bureau of Standards, and J. J. Yates, Central Railroad of New Jersey.

The primary object of the investigation is the study of physical properties of steel reinforcement bars,—plain, deformed and twisted,—rolled from the four different grades now in commercial use, tested in the form as rolled and as machined specimens. The data obtained will serve as a basis for possible revisions of the society's specifications for reinforcement bars. The investigation will have a direct bearing upon the work of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete. This committee has suggested an extension of the scope of the investigation to include a study of the efficiency of de-

formed bars when used as reinforcing in concrete, with special reference to the effect of the design of the bar on its bond resistance.

## Sanitary Engineers at Public Health Convention

Besides the general sessions of the fiftieth annual convention of the American Public Health Association at the Hotel Astor, New York City, Nov. 14-18, there will be various section meetings, including sanitary engineering, laboratories, public health administration, vital statistics and others. On the afternoon of Nov. 16, the sanitary engineering section will meet jointly with the American Society of Civil Engineers at the United Engineering Societies Building, where the program will be on stream pollution and sewage disposal.

The first session of the sanitary engineering section of the A. P. H. A. will be held Tuesday afternoon, Nov. 15, when there will be an address by the chairman, S. A. Greeley, consulting engineer, Chicago. The Thursday morning session will listen to a report of the committee on water supply and purification, George W. Fuller, chairman; a report of the committee on sewerage and sewage treatment, Kenneth Allen, chairman; and other papers.

Two subsequent sessions will take up the sanitation of bathing places, beaches, and swimming pools; mosquito extermination; milk pasteurization; and city zoning in relation to health. There will also be presented the report of the committee on garbage and refuse disposal, M. N. Baker, chairman.

## Am. Soc. C. E. To Hold Conference on Sanitary Engineering

In recognition of the fiftieth annual convention of the American Public Health Association, in New York City, the American Society of Civil Engineers has arranged for a general conference on sanitary problems to be held Nov. 16 and 17 at the Engineering Societies Building, New York City. All interested in sanitary engineering problems are invited to attend, particularly members of the sanitary engineering section of the A. P. H. A. The general conference will have sessions at 2 and 8 p.m. Wednesday, Nov. 16, and at 8 p.m. Nov. 17.

The first of the three sessions will be devoted entirely to stream pollution and sewage disposal, with papers by George T. Hammond, Brooklyn; Kenneth Allen, New York; John F. Skinner, Rochester, N. Y.; W. L. Stevenson, Harrisburg, Pa.; Earle B. Phelps, New York City; Paul Hansen, Chicago; W. H. Dittoe, Columbus; and Langdon Pearse, Chicago.

The second session will be given up to discussions of odors by George C. Whipple, Harvard University; Stephen DeM. Gage, Providence, R. I.; I. S. Osborn, Cleveland; Andrew J. Provost, New York; and Robert Spurr Weston, Boston.

Water supply and water purification will be the subject of the third and final session. The speakers will be Prof. Whipple; Allen Hazen, New York; C. A. Emerson, Jr., Harrisburg, Pa.; C.-E. A. Winslow, Yale University; C. A. Holmquist, Albany; Robert Spurr Weston, Boston; and Samuel A. Greeley, Chicago.

## American Road Builders Plan Annual Meeting

The annual meeting and dinner of the American Road Builders' Association will be held at the Automobile Club of America, New York City, Nov. 15. In the afternoon the officers will render their reports and in the evening the dinner will be held, after which the incoming president and other officers for the ensuing year will be installed, followed by speeches by members of the association. One of the matters to be considered is the coming convention and good roads show of the association to be held at the Coliseum, Chicago, Ill., Jan. 16-20.

## State Highway Policies on Fall Lettings of Contracts

*These statements of policy on the fall letting of highway contracts supplement others published in recent issues of "Engineering News-Record":*

**South Dakota**—"The highway commission in October awarded five contracts amounting to $232,000 for grading, culverts and bridges on 61 miles of road, and nine contracts amounting to $230,000 for gravel surfacing on 106 miles of road already graded.

"On account of the weather, grading work cannot, in general, be economically done in this state during December, January and February, so our field organization is put in the office during these months preparing plans for work to be let during the months of March, April and May. It is, therefore, expected that the major portion of our next year's work will be under contract by May. Plans are being made anticipating that pending legislation in Congress will provide additional funds."—*By F. D. Hudgins, State Highway Engineer.*

**Colorado**—"I am heartily in accord with the principle of letting contracts in the fall, so that the preliminary work can be got out of the way during the winter, and the contractors can be ready to begin active construction as soon as the season permits.

"There are practical reasons, however, that prevent any further letting this fall. Our yearly budget is made up in December, hence the estimated allotment to various projects is not known till then. Furthermore, we are depending upon the sale of a $3,000,000 bond issue to finance the state's proportion of federal-aid projects covered in the 1922 program. This sale cannot take place until June, 1922, and hence we will not know till then whether or not the funds are available.

"We hope to get matters adjusted so that our financial program will be more harmonious with elements that affect an efficient construction program."—*By L. D. Blauvelt, State Highway Engineer.*

**Washington**—"The policy of letting contracts in the late fall or early spring has been pursued for some time in so far as the same is consistent with conditions and with the availability of funds. The funds for highway work in this state are provided through legislative appropriation. In order to take full advantage of the funds available in the matching of federal aid we are at this time awaiting on federal aid before letting any considerable amount for the next season.—*By James Allen, Superintendent of Highways.*

## Contract Let for Tunnel Work on Skagit River Development

After several months of delay, waiting for lower prices, the Seattle Board of Public Works has let the contract for the Gorge Creek tunnel of the Skagit River development. The successful contractor is R. O. Storrie and Co., San Francisco, that firm's bid being $2,203,865. The Puget Sound Bridge & Dredging Co. was next lowest and Grant Smith & Co., both of Seattle, third.

The Gorge Creek project involves about a mile of open-cut excavation, a main tunnel two miles long, and the construction of a surge tank and riser necessitating the excavation of about 10,000 cu.yd. of material.

## London Subway Extensions Planned

*London Correspondence*

The London Underground Railways have submitted to the Cabinet their application involving £8,000,000 new capital for the immediate carrying out of their extension plans. These plans include the extensions of several of the existing subways, the linking up of others and the enlarging of the oldest "tube" so as to accommodate the standard subway rolling stock. Parliamentary powers for these projects have already been obtained, full plans of the operations have been prepared and much of the preliminary work is in hand. The enlarging on the old City and South London "tube" is not to interfere with subway operations, so that work will be done between midnight and 4 or 5 a. m. At the estimated rate of progress of one foot per hour, this project will take two years to complete and will cost £2,000,000.

## Reduced Salary Scale for Navy's Technical Personnel

Reductions in pay approximating 10 per cent have been applied to the technical service of the Navy, as well as to other civilian employees in the Naval establishment. Some of the items recommended by the Navy wage board and approved by the Secretary of the Navy for the technical service are as follows:

Steel superintendents, $10,000 per year; melt-shop superintendents, $5,000; machine-shop superintendents, $5,000; heat-treatment superintendents, $5,000; forge superintendents, $5,000; senior educational advisers, $6,500; plant engineers, $5,000; powder experts, $7,500; assistant to powder experts, $3,000.

In addition, numerous technical positions are rated on a per diem basis. Civil-engineering aids are to receive from $12.08 to $8.72, specification aids $9.04 structural aids from $10.96 to $7.60 and technical aids $7.68. Construction inspectors are scheduled at from $9.44 to $4.88, and creosote inspectors at $6.40. Naval construction inspectors are to receive $10.56 while their assistants are rated at $6.88.

Structural steel inspectors are to receive from $8.32 to $6.40 and timber inspectors from $8.32 to $5.68. The title of surveyor has been abolished and these positions re-rated as instrument men; the salary scale ranges from $8.24 to $5.36.

In the drafting service some of the new rates per day are: Chief draftsman, $13.20 to $14; draftsman, grade A, $6.80 to $7.60; draftsman, grade C, $4.48; copyist draftsman, $4.16.

## To Study Paving Brick Standards

Elimination of excess varieties and styles in paving brick is to be considered at a meeting Nov. 15 in Washington under the auspices of the Secretary of Commerce. The meeting is to be open to all interested. A preliminary survey of tthe situation is being made by a committee of paving brick manufacturers and a report will be submitted setting forth the facts as to the volume of the manufacture in the various sizes and styles of bricks now in use.

## Colorado River Hearing Planned

It is announced from Washington that the Secretary of the Interior and the Director of the Reclamation Service expect to hold a hearing in San Diego, Cal., on Dec. 1, in regard to the Colorado River problems. At this hearing the report of the Reclamation Service, in which has been assembled all available data bearing on the Colorado River, will be considered and the general question of the development of the river for irrigation, power, and flood prevention purposes will be taken up.

## Back to Atlantic City

For many years the American Society for Testing Materials held its annual meetings at Atlantic City in June. In 1920, however, the rising cost of living at that resort led to holding the meeting at its minor rival sea-shore city, Asbury Park, and the experiment was repeated this year. The attractions of Atlantic City, however, still linger in the minds of the members, far by popular vote, confirmed by the executive committee, that place is selected for next June's meeting. Of the 502 votes cast, 229 were for Atlantic City, 135 for Asbury Park, and 49 for Chicago. The referendum also has led to a consideration of a plan for holding the annual meetings in the different places in succeeding years.

## Complete Bar Survey at Entrance to San Francisco Bay

The survey of the bar just outside the entrance to San Francisco harbor has been completed under the direction of the Engineer Corps, U. S. A. and the report and recommendations of Colonel Herbert Deakyne Engineer Corps, U. S. A., who is stationed at San Francisco, have been submitted to Washington headquarters together with tabulated soundings and maps.

It is understood that Colonel Deakyne's recommendations include an estimate of the amount of work that should be done and its cost.

Of the two best channels in the approach to the Golden Gate from the sea, the so-called Bonita channel has ample depth but follows the rugged and somewhat irregular shoreline to the north, while the route directly across the bar in midstream is not deep enough for the largest ships. Improvement has been urged by the bar pilots association, by shipping interests and by the navy department, and it is believed that a channel 45 to 50 ft. deep and one-half mile wide could be constructed with sea-going dredges at comparatively low cost which, when constructed, would probably retain approximately the original dimensions.

## Forestry Investigation Continued

The committee on forestry policy of the Chamber of Commerce of the United States will hold its hearings in New Orleans Nov. 14, 15 and 16 as a continuation of its investigation of forestry conditions throughout the country. This committee was appointed to recommend to the United States Chamber a national forestry policy. Similar hearings have been held throughout the Middle West and Pacific Coast states.

## Irrigation District Wins in Court

The Kennewick Irrigation District, at Prosser, Wash., has won a victory in the Benton County Court throngh a decision, rendered by Judge Mills, sustaining the irrigation district's claim that the need of water for irrigation purposes is superior to the requirements of a flour mill, electric plant and other private interests involved, for which reason he granted an order of necessity and permitted condemnation of the Prosser Falls dam. About 35,000 acres of irrigable land will be benefited by the proposed ditch. Compromise negotiations now under way contemplate preserving ample power to operate the flour mill and electric power plant.

## Two-Day Discussion on Joint Committee on Concrete Report

Two days, with three sessions each day, will be devoted to a discussion of the report of the Joint Committee on Concrete and Reinforced Concrete by the American Society of Civil Engineers, on Dec. 7 and 8, in the Engineering Societies Building, New York City. Portions of the report, which consists of tentative specifications for concrete and reinforced concrete, will be discussed as follows

Dec. 7, 9 a. m. Chapter IX. Waterproofing and Protective Treatment.
Chapter X. Surface Finish.
2 p. m. Chapter VI. Depositing Concrete.
Chapter VII. Forms.
Chapter VIII. Details of Construction.
8 p. m. Chapter XI. Design
Dec. 8, 9 a. m. Continuation of discussion of Chapter VIII and X.
2 p. m. General discussion of the Tentative Specifications for Concrete and Reinforced concrete and of the scope of the Joint Committee's work.
8 p. m. Chapter III. Quality of Concrete.
Chapter IV. Materials.
Chapter V. Proportioning and Mixing Concrete.

## Cleveland Adopts Manager Plan

Early returns indicate the adoption of the city-manager plan at Cleveland, Ohio, Nov. 8, by a large popular majority. The manager will be appointed by a city council of 25 members, elected from four districts on the proportional representation plan, to take office Jan. 1, 1924.

## I. C. C. Reports Tentative Value of Rock Island

The final value of the property of the Chicago, Rock Island and Pacific Railroad, devoted to common carrier purposes, on lines wholly owned and used by the company, has been found to be $251,809,983 in the tentative valuation report which just has been issued by the Interstate Commerce Commission. The value of the property used but not owned by the parent company was found to be $70,467,613. In addition, the company owns and has under lease property valued at $252,937.

The cost of reproduction (new) on the lines wholly owned and used by the parent company was found to be $250,697,172. The cost of reproduction (less depreciation) is reported as being $197,090,275.

The outstanding capitalization of the company, at the time of the valuation, was found to be $307,287,422.50. Information of the same character for the affiliated lines of the Rock Island system is shown in the accompanying table.

| Name of Road | Final Value | Cost of Reproduction New | Cost of Reproduction Less Depreciation | Outstanding Capitalization |
|---|---|---|---|---|
| Keokuk & Des Moines Ry. Co. | $3,464,958 | $3,269,803 | $2,592,509 | $6,875,000 00 |
| Choctaw, Oklahoma & Gulf Railroad Co. | 35,500,000 | 39,406,828 | 30,800,082 | 31,692,981 93 |
| Rock Island, Arkansas & Louisiana R. R. Co. | 10,750,000 | 11,781,218 | 9,884,803 | 15,214,321 73 |
| St. Paul & Kansas City Short Line R.R. Co. | 8,400,000 | 7,933,931 | 6,967,280 | 12,679,044 63 |
| Rock Island & Dardanelle Ry. Co. | 215,000 | 230,800 | 198,549 | 200,000 00 |
| Rock Island, Stuttgart & Southern Ry. Co. | 213,000 | 217,976 | 169,052 | 490,266 22 |
| Rock Island Memphis Terminal Ry. Co. | 700,000 | 261,871 | 261,871 | 1,438,459 94 |
| Peoria and Bureau Valley R.R. Co. | 1,650,000 | 1,607,220 | 1,318,717 | 1,500,000 00 |
| White & Black River Valley Railway | 700,000 | 787,355 | 630,714 | 1,000,000 00 |
| Chicago, Rock Island & Pacific R.R. Co., (Iowa Co.) | 23,250 | 19,194 | 14,732 | 227,500 00 |
| Chicago, Rock Island & Gulf Ry. Co. | 13,833,406 | 14,960,839 | 11,974,731 | 17,248,372 60 |
| Morris Terminal Railway Co. | 48,750 | 59,908 | 42,902 | 52,207 39 |

## Tulsa Gets Report on Gravity Water Supply From Ozark

For an estimated cost of $6,800,000, Tulsa, Okla., can get a 25-m.g.d. gravity water supply from Spavinaw Creek in the Ozark foothills, according to a report presented Oct. 24 to the Non-Partizan Water Commission by J. D. Trammell and W. R. Holway, consulting engineers. The plan calls for a 55-ft. dam on Spavinaw Creek impounding 16 billion gallons, or more than a year's supply, and a 55-mile conduit—28 miles of 60-in., 27 miles of 48-in.—conducting the water by gravity to a point five miles from Tulsa, where a high pressure pumping station would lift the water 300 ft. through a 30-in. cast-iron pipe to a high pressure distribution reservoir holding 30 days' supply on the edge of the city 4½ miles distant. At this reservoir the water would be aerated and chlorinated.

The estimated costs are: Dam, $1,132,000; conduits and right-of-way, $4,065,150; tunnel, $225,000; reservoir and pump station, $458,000; distribution mains, $541,000; engineering and supervision, $321,057; administration, $57,793.

The water commission has issued a call for a bond election to be held Nov. 29. The engineers are of the opinion the work can be completed within two years.

## Engineer on Louisiana Board of Health Urged

The Louisiana Engineering Society is urging an amendment to a bill for the reorganization of the Louisiana State Board of Health so that one of the members will be an engineer. The bill now provides for a board of eight members, of whom five must be physicians, one a dentist, one a pharmacist, and one an educator. The existing board is composed of five physicians. Support for the proposed amendment is being given by the local press.

## Minneapolis Regulates Vehicles

The city council of Minneapolis, on Sept. 9 passed an ordinance regulating the weight, width, height, and length of vehicles operating on the city streets. An unusual provision, according to information received from Ellis R. Dutton, assistant city engineer, is that the city engineer is authorized to restrict the use of streets for a period not exceeding 90 days when, in his judgment, any surface is being unduly damaged by vehicular use. This provision was included in the ordinance as a result of the destruction of certain dirt streets by a trucking and grading company engaged in making excavations and hauling the waste material. A contributory cause was the excessive truck loads hauled over paved streets, amounting, sometimes, to 20 tons or more.

The ordinance follows the uniform vehicle law and provides the following restrictions on vehicles: Maximum width, 96 in.; maximum height, 12 ft. 6 in.; maximum length, 30 ft. for a single vehicle and 85 ft. for a tractor-trailer combination. The gross load is fixed at 28,000 lb., the load per axle at 22,400 lb. and the weight per inch width of tire at 800 lb.

## Unconventionality in Society Meeting Notices

They do things differently in Oregon. Here is one of the unconventional meeting notices issued by C. P. Keyser, secretary of the Portland Section, Am. Soc. C. E.:

"*Tandem aliquando*, and 'It's a long time,' since we had an old time technical meeting. We slipped, and are 168 hours late this month, but overhangs are pretty well cleaned up, and a *pleasant little* SOIRÉE is indicated.

UNIVERSITY CLUB, FRIDAY, OCT. 28, 8 P.M.

"The story relates to the great slide at Cascade Locks, and will be presented by no less a *raconteur* than our Sam Murray. Sam is incidentally a bridge engineer with a license, and is properly poking into the Bridge of the Gods. He has gone into this thing; dug in, actually looking for water, and what he found will surprise you. Discussion will follow, headed by at least three experts in the shifting of Oregon scenery—Williams, the geologist, Newell, loaded with antediluvian and other data pertaining, and Clarke, some checker in his own right.

"If you FEEL on the subject of LICENSE, wag, bristle, or yelp, or I will have to tell Humphrey that you seem to be satisfied with your collar.

"Looking forward to next month, we are to have another love feast with the contractors, but that will be different, perhaps irregular."

# Engineering Societies

## Calendar

### Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, New York City, Nov. 8-19.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

**The Brooklyn (N. Y.) Engineers' Club** made an inspection trip, Oct. 29, of the new piers at Stapleton, S. I.

**The Engineers' Club of Philadelphia, (Pa.),** announces the following speakers for its luncheon meetings: Nov. 15, "Humor in Business; A Cheerful Talk" by Albert B. Kelly; Nov. 22, "Accomplishments Under the Federal Water Power Act," O. C. Merrill; Nov. 29, "The Kansas City Board of Public Welfare—An Interesting Experiment in Civic Democracy," Jacob Billikopf.

**The Texas Section, Am. Soc. C. E.,** at its annual meeting, Oct. 28, elected the following officers: President, Col. E. B. Cushing; first vice-president, E. E. Sands; second vice-president, Major W. J. Powell; secretary-treasurer, E. N. Noyes.

**The Engineers' Club of Trenton, N. J.,** at its meeting Oct. 27 was addressed by Thomas H. Wiggin on, "Two Years' Experiences in China," illustrated with lantern slides. At the Nov. 10 meeting Robert Fleming will speak on "Building Codes," with particular reference to the proposed new building code for Trenton.

**The Houston (Tex.) Engineers' Club,** at its luncheon meeting, Oct. 18, was addressed by Thomas H. Ball, president of the Houston Harbor Board on "The Houston Ship Channel and Its Future." The following officers have been elected by the club: President, E. G. Maclay; first vice-president, E. M. Wise; second vice-president, R. J. Cummins; third vice-president, W. H. Mead; and secretary-treasurer, A. J. Banta.

**American Public Health Association, Sanitary Engineering Section.**—The first session of this section in conjunction with the fiftieth annual convention of the association, to be held Tuesday afternoon, Nov. 15, will be devoted to an address by the chairman, S. A. Greeley, Chicago, and to business matters. On the afternoon of Nov. 16 the section is invited to meet jointly with the American Society of Civil Engineers, at the United Engineering Societies Building, New York City, for a discussion of stream pollution and sewage disposal. At later sessions there will be committee reports and discussions on water supply and purification, sewerage and sewage disposal, garbage and refuse disposal, the milk supply, zoning and allied subjects. The meeting of this and other sections, and the general headquarters, will be at the Hotel Astor, New York City.

**The Western Society of Engineers'** November program, beginning Nov. 7, includes the following papers: "Illiana Harbor" by Col. W. V. Judson, U. S. Engineers; "Layout and Design of the Modern Industrial Plant" by Frank D. Chase; "Engineering Features of Chicago's New Gas Plant" by J. I. Thompson, chief engineer, the Koppers Co., and an "Experience Night" at which R. W. Hunt, P. W. Gates, H. C. Gardner and W. L. Abbott will give 15-min. talks on personal engineering experiences. In addition the Young Men's Forum has scheduled Saturday afternoon talks on "Business Management" and "Organization." On Nov. 5 a plan for a 10-weeks' course on public speaking will be perfected.

# Personal Notes

EDWARD S. NETTLETON, acting city engineer of New Haven, Conn., has been appointed city engineer.

G. R. ABNEY has been appointed highway engineer of Angelina County, Tex., with headquarters at Lufkin.

ARTHUR L. WALKER, professor of metallurgy in the School of Mines, Engineering and Chemistry of Columbia University, has been elected a member of the board of Engineering Foundation, which is organizing industrial research on a nationwide scale. Prof. Walker, internationally famous as inventor and teacher, succeeds Dr. Joseph W. Richards of Lehigh University, eminent metallurgist, who died recently.

J. P. WEHRUNG has been appointed district engineer for the Falls County Road District No. 5, with headquarters at Chilton, Tex.

CLARENCE B. HOOVER has been appointed superintendent of waterworks and sewers, Columbus, Ohio, to fill the vacancy caused some months ago by Jerry O'Shaughnessy. Mr. Hoover was graduated from Ohio State University in 1903 and has been connected with the public works of Columbus since 1904, having long been in charge of the sewage-works and recently having been engineer in charge of important water-works extensions. He is a brother of Charles B. Hoover, chemist of the Columbus water purification plant.

PROF. C. J. TILDEN, who has been director of the Highway and Highway Transport Education Committee, Washington, D. C., since Dec. 1920, has returned to Yale University, to resume his duties as professor of engineering mechanics.

WALTER MOORE, JR., has resigned as promotional engineer with the Portland Cement Association to become manager of the Southern California chapter of the Associated General Contractors of America. He was formerly district engineer for the Los Angeles County Road Department.

ROBERT L. E. WARD, formerly with the Weiland Engineering Co.

Canon City, Col., has been appointed city engineer of Canon City.

E. P. WATSON, JR., has been appointed chief engineer for the highway commission of Imperial County, Cal.

E. L. DALTON of Dallas, Tex., has been appointed supervising engineer for water-works improvements at Ferris, Tex., and for street improvements at Mexia, Tex.

D. L. STRUTHERS, formerly of Wilmington, N. C., has been appointed highway engineer for Gaston County, with headquarters in Gastonia, N. C.

LT.-COL. FRANK B. KING, during the war in command of the 112th Engineers in France, is in charge of water and sewer extension work at Duncan, Okla., for V. V. Long & Co., consulting engineers.

GEORGE F. PORTER, chief engineer, Canadian Bridge Co., Ltd., Walkerville, Ont., has received the honorary degree of Doctor of Laws from McGill University.

A. W. K. BILLINGS has returned from Barcelona, Spain, to act as construction manager for the English and Canadian interests controlling large public utility companies in Mexico, Brazil and Spain, and as vice-president of the Canadian Engineering Agency, Inc., New York City. During the war Mr. Billings was in charge in Europe of naval aviation construction work ashore. He was promoted to the rank of Commander in the Naval Reserve and was awarded the Navy Cross and the Legion of Honor.

COL. C. S. COE, formerly engineer with the Florida East Coast Ry., has been appointed city manager of Miami, Fla.

ARTHUR H. BLANCHARD, professor of highway engineering and highway transport at the University of Michigan, has received notice from Paris of his appointment as representative of the executive bureau of the Association Internationale Permanente Des Congres De La Route to select the United States reporters on seven topics in the fields of highway engineering and highway transport to be discussed at the fourth International Road Congress to be held in Spain in 1923.

## OBITUARY

RALPH E. ROBSON, associated with the engineering firm of Cope, Rand, Means & Co. of San Francisco, was killed recently in an automobile accident while driving over work on which he was engaged in northern California. Mr. Robson, gained an enviable reputation for his service as an engineer officer in the American Expeditionary Force having been decorated by the Belgian government for his work in that country. Mr. Robson left the service with the rank of major.

FRANCIS L. DORMANT, formerly city engineer of Houston, Tex., and recently city engineer of Palestine, Tex., died in Houston, Oct. 12.

GEORGE R. HENDERSON, consulting engineer, died in Philadelphia, Pa., Oct. 20. He was born in Philadelphia in 1861 and began his career in the Pennsylvania R.R. shops at West Philadelphia and Altoona. He was later associated with the Norfolk & Western Ry. and the Santa Fe System, the Schenectady Locomotive Works, and the Baldwin Locomotive Works. In 1915 he began a consulting practice in Philadelphia. He acted as consulting engineer for railroads in Brazil, the Philippine Islands, and several in the United States.

A. T. BROOKINS, for 25 years junior engineer in charge of harbor inspection work for the Corps of Engineers, U. S. A. in Grand Rapids, Mich., died Oct. 13. He was born in Shoreham, Vt., 1869, and was a graduate of the civil engineering department of the University of Vermont.

WILLIAM H. RONEY, contractor, bridge, structural and fire-proofing engineer, died Oct. 16 in Alhambra, Cal. He was born in Warren County, Ill., 1857. His first position was bookkeeper and draftsman for Wuichet & Co., sheet metal works, Dayton, Ohio, and later he was draftsman and sales engineer for the Columbia Bridge Co. at Dayton. In 1889 he became engineer, and later shop manager, with the Lane Bridge & Iron Works, Chicago. In 1897 he engaged in preliminary tests and development of reinforced hollow tile construction for E. V. Johnson at Chicago. In 1898 he was experimental engineer for John S. Metcalf & Co., Chicago; James L. Record of Minneapolis, and E. V. Johnson, Chicago, on fireproof construction for grain elevators. In 1899 he entered private work as an engineer and contractor. He also was consulting engineer for the National Fireproofing Co., and planned its first testing laboratory at Chicago. In 1912 he wrote the "Collation of Tests of the Resisting Qualities of Terra Cotta Structural and Fire-proof Material," which was published by the above company.

## BUSINESS NOTES

J. C. TOWNLEY, formerly manager of the Pittsburgh office of the Cement-Gun Co., Inc., sailed for Holland Oct. 15, where he will become general manager of the International Cement-Gun Co., Utrecht, Holland, organized to handle for the Cement-Gun Co., Inc., its foreign business, with the exception of Canada, Mexico and Cuba.

THE CONSOLIDATED EXPANDED METAL COMPANIES, Braddock, Pa., announce the opening of a direct factory branch office and Eastern distributing warehouse in New York City, under the direction of Thomas R. Herbst, Jr., who during the past seven years has established and operated similar distributing stations for the company in Philadelphia and Pittsburgh.

ALAN A. WOOD, for a number of years connected in an engineering and sales capacity with the Providence plant of the Builders Iron Foundry and the Diamond Machine Co., associated companies, is now sales manager of the Philadelphia district, with office in Philadelphia.

E. G. LEWIS, formerly Central sales manager of the Bucyrus Co., with headquarters at Chicago has been appointed Eastern sales manager in charge of the New York office. M. J. Woodhull will succeed him at Chicago, and E. R. Weber has been appointed Northern Sales manager at Minneapolis to succeed J. N. Gawthrop, who will become associated with Mr. Lewis at New York.

## EQUIPMENT AND MATERIALS

### Swing Bridge Operated by Gasoline Engine

Across the Wilmington River in Chatham County, Ga., there is a steel swing span of a length of 229 ft. 10 in., a height of 22 ft. between the center lines of the truss chords, and a width of roadway of 20 ft. between the center lines of trusses, which is operated by a 6-hp. gasoline engine manufactured by the Gray Motor Corporation at Detroit, Mich. The total weight which is swung is 166 tons and the time to swing the span through an arc of 90 degrees is about two minutes. The gasoline engine is of the marine type with two cycles.

### Self-Winding Electric Cable Reel

A reel on which an electric cable can be wound and unwound and locked in any position, after the manner of an ordinary window shade, is being sold by the Wayne Engineering & Equipment Co., London, Eng. The reel is 14½ x 4 in. in size and has a standard by which it is attached to wall or ceiling. It holds 25 ft. of cable which can be unreeled as little or as much as is desired and so "spot" the attached lamp or tool wherever it is wanted.

### Steel Sections for Anchoring Shaft Hangers

For supplying anchorage for shaft hangers, piping on columns or walls, or anchoring machinery, such as electric motors, to concrete floors, the Midwest Steel & Supply Co., New York City, has developed a line of steel sections, chief among which are its ankerails—box rails, and "L" rails. The ankerails are continuous inserts made of rolled steel to be embedded in ceilings, walls, and columns of factories for the purpose of fastening shaft hangers, trolleys, pipes, cables, etc. They also serve as reinforcing bars for the reinforced-concrete members in which they are embedded. With a box rail embedded in the concrete it is possible to hang shafting at most any place simply by inserting a bolt into the desired point, turning about 90 deg. and pulling down the bolt until the grooves in the head fit over the vertical ribs of the rail. In contrast to the box rail, the "L" rail is a solid steel bar so placed in the concrete beams and girders that suitably-formed bolts can be easily attached to it by moving the concrete covering at such points. The anchorage of the "L" rail is provided by the ordinary stirrups.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Trade Revival Seen in Federal Reserve Board Report

The cut in the discount rate of Federal Reserve banks, the activity of the War Finance Corporation in behalf of cattle and sheep raisers, a general improvement in the live-stock situation, the rapid marketing of agricultural products which carried along a stimulus in other important lines of industry and trade, are only a few of the conditions indicating a trade revival, according to prominent government officials and the recent report of the Federal Reserve Board.

In its report the Federal Reserve Board asserts that "Improved collections and reduction of outstanding loan accounts have followed in the strain of this renewed activity. The beginnings of improvement are noticeable, even in portions of the country, such as some of the southern and southwestern districts where credit conditions have been more serious than generally."

Some distinct and encouraging elements in the general business situation, the Federal Reserve Board finds to be: (1) The outlook in the textile industries is good; (2) there has been a more active demand for raw wool, especially of the medium grades; (3) a more active disposition than has been noted for weeks in the buying of cotton is present; (4) increase in both production and unfilled orders in the iron and steel trade; (5) improvement in the production and sale of non-ferrous metals; (6) increase in bituminous coal production and (7) activity in the lumber industry.

## Production and Shipping Costs of Southern Pine

Since the first of this year the cost of manufacturing among the Southern Pine mills has decreased approximately 50 per cent. The cost per thousand feet, b. m., of logs, excluding the stumpage, and the milling cost is now $10.88 as against $21.88 for December, 1920, according to a cost statement recently issued by the Southern Pine Association. Including shipping, selling and depreciation, though excluding any interest on invested capital, the total cost now stands at $21.65 as against $37.27 for December of last year. The figure arrived at for December is taken from the reports received from 78 mills representing a total cut of 182,000,000 ft.b.m., and that for August of this year from the reports of 89 mills with an aggregate production of 305,000,000 ft.b.m.

## Steel Exports Recover Slightly

Exports of iron and steel from the United States during September totalled 95,169 tons, compared with 75,827 tons in August, says a recent announcement from the U. S. Department of Commerce. The former figure, however, represents but 23 per cent of the tonnage exported during the corresponding month of 1920. Steel rails formed the largest export item, and more than half of the rails were exported to China.

## Trend of Business

**Stock Market**—Oil stocks still command principal interest. Market generally reflects improving business and industrial affairs.

**Bond Market**—Heavy oversubscription for the new Treasury certificates and the reduction in the Federal Reserve rediscount rate to 4½ per cent have brought on a strong rise. Advancing bond prices with declining interest rates, result in rush to buy stronger issues at rising prices. New issues light, with municipals leading. Industrials and public utilities share in the rise, with the railroad list leading.

**Money**—Lowering the interest rate by about 1 per cent on the new Treasury certificates have made the money market easier and boomed the bond market. Call money plentiful.

**Foreign Exchange**—Further weakness in the German mark (par 23.8 cents; present .35 cents), not reflected in other exchanges. Sterling strong around $3.94, with exchanges on Paris, Rome and Amsterdam rising.

**Retail Food Prices Declined** in nine of eleven American cities from Sept. 15 to Oct. 15. The decreases were: Milwaukee, 3 per cent; Chicago, Detroit and Indianapolis, 2; Peoria and St. Louis, 1; Newark, 0.1; Bridgeport and Minneapolis, 0.4. No change in Columbus, and an advance of 1 per cent in Mobile. As compared with average retail cost in 1913, the increases on Oct. 15, 1921, were 54 per cent for Detroit; 50@53 for Chicago, St. Louis, Milwaukee and Newark; 47 for Indianapolis and Minneapolis.

**Wholesale Prices** in September still held the Bureau of Labor Statistics Index of 152 for all commodities, as in August, as against 242 in September, 1920.

**Cost of Living** in 32 American cities declined 1.7 per cent from May to September, 1921, and 18.1 since June, 1920. The average declines since 1913 are: Food, 53.1 per cent; clothing, 92.1 per cent; housing, 60; fuel and light, 80.7; furniture and furnishings, 124.7; miscellaneous, 107.8, making a total of 77.3, according to the Bureau of Labor Statistics.

**Iron and Steel Workers** in 106 establishments numbered 106,690 in September, as against 183,873 one year ago, and the respective payrolls were $14,288,398 and $4,131,241.

## Unemployment Relief Plans Being Carried Forward

### Iowa Contractors Meet with A. G. C. Officers—Canadian Government Makes Program Known

Contractors from all parts of Iowa and representative of all classes of construction met in Des Moines recently to listen to various officers of he Associated General Constractors of America and to form some sort of an organization to stimulate construction as an aid to employment. The meeting was under the auspices of the Iowa Street and Highway Service Bureau and that organization, subsequent to the meeting with the A. G. C. officers, has bent every effort to induce city officials and state department to let public work soon. The mayor of Des Moines has called a committee to function along these lines, and from reports the contractors association is receiving from other cities of the state city officials are doing everything possible to relieve the unemployment situation in their respective localities.

Wide publicity has been given throughout the state to the results secured from the unemployment conference held by the contractors, and it is hoped that this interest may be translated into results.

Included among the speakers who addressed the Iowa Street and Highway Service Bureau and the other contractors were F. L. Cranford, G. A. Garber, and J. H. Ellison.

---

Acceptance of appointment as regional directors on behalf of the President's Conference on Unemployment have been received from thirteen men throughout the United States, according to word received from the U. S. Department of Commerce. These regional directors will keep the mayors in their respective cities informed of the work being carried on by the committee on civic and emergency measures in Washington and to act as a source of closer contact between the mayor's unemployment committees and the standing committee of the President's Conference.

The committee on civic and emergency measures is receiving almost daily reports from cities throughout the country on work being carried forward by local unemployment committees. Status of employment in 42 New York cities was included in a message recently received by the chairman of that committee from Governor Miller, of New York. Reports from many cities were to the effect that public works construction was being greatly stimulated as a means of unemployment relief.

---

Already considerable effective work has been done in Milwaukee, Wis., for the relief of the unemployed through the unemployment committee of the Milwaukee Association of Commerce. This committee consists of manufacturers, public officials, labor leaders, and contractors, and is presided over by a director of the General Contractors Association of Milwaukee—F. R. Bell.

The general committee has been subdivided into groups as follows: Public works, private industries, factories, and general welfare. The program that has been outlined has been practically identical with the one outlined at the President's Conference on Employment. So far over $2,000,000 worth of work which had been held in abeyance has been released and is now well under way, activity which is attributable to the effective work done by the unemployment committee.

After careful consideration, taking into account the experiences of the winter of 1920-21, the Canadian Government has determined upon a definite course of action in assisting municipalities in relieving the unemployment situation. The government considers that, inasmuch as unemployment is primarily a municipal question though one in which the province itself also shares, practically all of its assistance should be through municipalities. The government therefore proposes to participate in the cost of work provided by municipalities on the following basis:

(1) Municipality to bear the normal cost, that is to say the cost of carrying on the work in the normal working season; (2) estimate of normal cost to be approved by the federal government's engineers and the Department of Public Works; (3) that municipal, provincial and federal governments bear equally and jointly the actual cost over the estimated normal cost, thereby encouraging the creating of employment where possible; (4) That where work cannot be provided the federal government continue to refund one-third of the investment actually made by a municipality for unemployment relief, conditional upon the provinces participating on an equal basis.

## Plea For Disarmament From Building Materials Maker

A circular letter, sent out by the Charles Warner Co., Philadelphia, manufacturers and distributors of building materials, is to the effect that, if the American citizen is "wise he will pray that the spirit of forbearance rather than the spirit of might and force shall rule the hearts and minds of the conference members" attending the arms conference to open this week in Washington. The necessity of protecting American capital in European enterprises makes it incumbent upon the government, hints the circular, to forget Washington's warning about the dangers of entangling alliances abroad.

PUBLIC BOND SALES OF SEPTEMBER AND OCTOBER, 1921

| State | Purpose | Amount | Maturity | Rate per Cent | Sold for | Dated |
|---|---|---|---|---|---|---|
| Delaware | Highway | $ 500,000 | 1922-1961 | 4½ | 92.18 | Jan. 1, 1921 |
| Illinois | Highway | 5,000,000 | 1926-1935 | 4 | 94.02 | Nov. 1, 1921 |
| Oregon | Highway | 2,000,000 | 1931-1951 | 5 | 100.00 | June 1, 1921 |
| **County** | | | | | | |
| Brown, Wisc | Highway | 150,000 | 1941 | 5 | 99.05 | Oct. 1, 1921 |
| Crow Wing, Minn. | Road | 75,000 | | 5½ | 100.90 | |
| Newton, Ind. | Ditch | 171,000 | 1931 | 6 | 100.00 | Oct. 24, 1921 |
| Orleans, N. Y. | Highway | 35,000 | 1928 | 6 | 103.82 | Nov. 1, 1921 |
| Porter, Ind. | Road | 73,000 | 1922-1931 | 5 | 100.00 | Oct. 15, 1921 |
| Stevens, Minn. | Drainage | 29,916 | | 5½ | 100.50 | Oct. 1921 |
| Sumter, S. C. | Road, Bridge | 500,000 | 1926-1950 | 6 | 100.053 | July 1, 1920 |
| Washington, N. Y. | Highway Improvement | 285,000 | 1923-1942 | 5 | 102.899 | Nov. 1, 1921 |
| Wasser, Minn. | Ditch | 22,500 | 1927-1940 | 5½ | 100.46 | Oct. 1, 1921 |
| **Township** | | | | | | |
| Cambria, Cambria Co., Pa. | Road | 70,000 | $11,000–1927<br>15,000–1933<br>20,000–1939<br>24,000–1945 | 5½ | 101.107 | Aug. 1, 1921 |
| **Municipality** | | | | | | |
| Attleboro, Mass. | Street Improvement | 58,000 | 1922–1925<br>1926 | 5½ | 101.241 | Oct. 1, 1921 |
| Greenwich, Conn. | Sewage Disposal | 104,000 | 1922–1929 | 5½ | 101.07 | June 1, 1921 |
| Hammond, Ind. | Water Works | 375,000 | 1922–1926<br>1927–1951 | 6 | 105.348 | Oct. 15, 1921 |
| Lockland, Ohio | Street Improvement<br>Sewer | 5,000<br>5,000 | 1922–1931 | 6 | 100.111 | Aug. 1, 1921 |
| Los Angeles, Cal. | Harbor Improvements | 1,600,000 | 1922–1961 | 5½ | 102.54 | Nov. 1, 1921 |
| Minot, So. Dak. | Sewage Disposal | 10,000 | 1922–1940 | 4 | 100.00 | Apr. 1, 1920 |
| New Wilmington, Pa. | Paving | 13,900 | Due serially<br>Int. M. & S. | 6 | 100.00 | Sept. 26, 1921 |
| Randolph, Neb. | Paving | 20,000 | 1940 | 6 | 100.00 | Nov. 1, 1920 |
| St. John, Kan. | Paving<br>Internal Improvement | 80,000<br>74,741 | | 6 | 100.00 | Oct. 1920 |
| Smithfield, Utah | Water Works<br>Improvement | 35,000 | $2,000 (1926-30)<br>$2,500 (1931-40) | 6 | 100.00 | Sept. 1, 1921 |
| Walla Walla, Wash. | Water Extension | 500,000 | 1924–1931 | 6 | 101.17 | July 1, 1921 |
| Albany, N. Y. | Water System Improvem't<br>River Front Improvement | 100,000<br>40,000 | 1922–1941 | 5¼ | 101.11 | Oct. 11, 1921 |
| Catahoula Parish Road Dist., La. | Roads | 690,000 | 1921–1960 | 5 | 100.00 | Feb. 1, 1920 |
| Center, Col. | Water Works | 30,000 | 1936 | 6 | 91.55 | Sept. 1, 1921 |
| Chico, Calif. | Street Paving | 19,261 | 1921–1936 | 7 | 100.00 | Aug. 24, 1921 |

## Close Bidding on Texas Road Job

The contract for building the Bankhead Highway, 102.69 miles long and extending across the Texas Counties of Howard, Martin, Midland and Ector, was awarded recently to the Womack Construction Co., McKinney, Texas, with the understanding that the road be completed within 18 months. Ten contractors submitted bids ranging between $759,231.36 and $823,085.13, the successful bidder submitting the former bid, which does not include 10 per cent for engineering and contingencies. The engineer's estimate, excluding the 10 per cent addition, was $764,730.63.

The highway will be 16 ft. wide on a 24-ft. roadbed, with an 8-in. gravel surface. Gravel will be obtained from a 25-acre pit, owned jointly by the counties, and located at Big Springs. The contractor will install and operate the loading plant and ship the gravel to points of delivery.

The accompanying tabulation gives the range of unit bids:

| Item | Unit | Total for the Four Counties | Range in Unit Prices Low | High |
|---|---|---|---|---|
| Earth excavation | Cu.Yd. | $129,477.40 | $0.12 | $0.24 |
| Borrow excavation | Cu.Yd. | 224,697.70 | .11 | .19 |
| Loose rock excavation | Cu.Yd. | 3,552.20 | .30 | 1.00 |
| Solid rock excavation | Cu.Yd. | 10,839.70 | 1.00 | 1.75 |
| Overhaul | 100 Ft. | 144,620.36 | .02 | .06 |
| Road-grader work | 100 Ft. | 3,096.49 | 4.70 | 11.00 |
| Gravel, f.o.b. delivery point | Cu.Yd. | 206,363.58 | 1.17 | 2.63 |
| Gravel hauled and placed 1st ½ | Cu.Yd. | 206,363.58 | .40 | .60 |
| Gravel hauled add ½ | Cu.Yd. | 1,131,982.95 | .06 | .09 |
| Reinforcing steel | Lbs. | 240,157.00 | .05 | .07 |
| Structural exc. (dry) | Cu.Yd. | 2,648.00 | .35 | 1.15 |
| Concrete 1:2:4 in place | Cu.Yd. | 2,297.19 | 19.50 | 28.50 |
| Concrete 1:2½:5 in place | Cu.Yd. | 233.01 | 18.75 | 28.50 |
| Concrete 1:3:6 in place | Cu.Yd. | 4.80 | 18.00 | 27.00 |
| Rolling | Per Hr. | 2,360.00 | 1.50 | 4.50 |
| Water hauled 1st mile | M.Gal. | 926.50 | 1.75 | 5.50 |
| Water hauled add mile | M.Gal. | 1,340.10 | .50 | 3.50 |
| Wooden guard fence | Lin.Ft. | 1,000.00 | .40 | .85 |

## Building Trades Unionists Gain In Numbers

There has been an increase in the membership of the international unions which form the building trades of 63,000 within the past year, according to a recent report of the secretary-treasurer of the building trades department of the American Federation of Labor. There is now in good standing an average membership of 866,735 as against 803,920 for last year. The greatest gains have been in the following trades: united brotherhood of carpenters and joiners, electrical workers of America, brotherhood of painters, decorators and paperhangers.

## Southern Pacific Places Large Rail Order

Announcement was recently made by the Southern Pacific R. R. that it had placed with the Tennessee Coal and Iron Co. an order for 44,600 tons of steel rails for 1922 delivery. This is one of the largest single orders for rail placed with the Steel Corporation within recent months.

## Railroads Preferred Borrowers

According to a report made at the recent meeting of the Investment Bankers Association of America, New Orleans, La., notwithstanding the fact that the railroads of the United States during the last twelve months have been in such serious financial condition due to the impairment of earning power, a tribute to the attitude of the investor toward railroads is found in the fact that the railroad corporations have been

the preferred borrowers. The railroads have borrowed money at about three-quarters of 1 per cent cheaper than any one else.

In other words, the railroad securities which have gone to the public since the first of the year have averaged about 6.5 per cent yield, public utility securities have yielded about 7½ per cent, industrials about 7⅞ per cent, and foreign governments about 8¼ per cent.

Upon the theory that it might undermine credit, the convention was urged by Pierpont Davis of the National City Bank of New York, through the committee on railroad securities, to recommend that the Interstate Commerce Commission continue 6 per cent as the statutory or suitable rate of return for railroad earnings. The 6 per cent statutory definition expires March 1, 1922.

## Average Earnings of Factory Employees Increases

The average earnings of New York State factory workers increased 17c. from July to August, says a recent issue of the *Labor Market Bulletin* published from the office of the chief statistician of the New York State Department of Labor. The higher average of earning of factory workers in August is accounted for for the most part by the increased working time. Another factor was the retention in some industries that were still on the decline of the higher paid and more important employees, while the lower paid and less skilled employees were laid off. Improved demand, partly seasonal, was the reason for the increased working time in many factories.

The average weekly earnings of factory workers have decreased $3.28 from August, 1920.

# Weekly Construction Market

This limited price list is published weekly for the purpose of giving current prices on the principal construction materials and noting important price changes on the less important materials. Moreover, only the chief cities are quoted. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.88 | $4.00 | $4.00 | $2.88 | $3.10 | $3.75 | $3.70 | $4.00 | $4.00 |
| Structural rivets, 100 lb | 3.70 | 5.25 | 5.50 | 3.68 | 4.15 | 4.25 | 5.50 | 4.50 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.78 | 3.20 | 3.50 | 2.78 | 3.18 | 3.57½ | +2.90 | 3.75 | —3.25 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | 52.65–5% | 45% | 54½% | 58.9–5% | 38% | 51.8% | +50% | —6% |
| Cast-iron pipe, 6in. and over, ton | +47.30@48.30 | 40.50 | 54.30 | 42.60@44.10 | 47.80 | 52.00 | 50.00 | 53.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | 2.40 | 2.60 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | +3.12 |
| Gravel, ¾ in., cu.yd | —1.75 | 2.00 | 2.25 | 1.65 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.25 | 1.35 | 2.25 | 1.65 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.25 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 45.00 | 38.00 | +37.00 | 48.00 | 36.00 | 50.00 | +31.00 | 24.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | 27.50 | 21.00 |
| Lime common, lump, per bbl | 3.69 | 1.60 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 2.75 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | 11.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | — 10 | .124 | .0821 | .092 | .09 | .12½ | .10 | 08@.29 |
| Hollow partition tile 4x12x12, block | —.11120 | —.10 | .124 | .0657 | .092 | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal | —.72 | .85 | .93 | —.74 | +.80 | —.90 | .83 | .79 | —.85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75@.80 | .35 | ..... | .72½ | .50 | .50@.55 | .75 | .50@.60 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or —. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, or, means a range of 15 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside, Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5¼ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding. brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

## Changes Since Last Week

Structural steel shapes, plates and bars are still quoted at the Pittsburgh mills at $1.50@$1.65 per 100 lb., the lower figure applying mostly to the larger tonnages; small tonnages selling at $1.60@$1.65. Mill shipments of structural shapes are quoted in Denver at $3.05 and in New York at $1.88@$2.03; bars at $1.80@$1.88. Reinforcing bars have advanced 55c. in San Francisco and declined 50c. per 100 lb. at Montreal warehouses. An increase of one per cent is reported in black steel pipe discounts in Montreal and a decrease of 5 per cent in Seattle. New York quotes cast-iron pipe at $47.30@$48.30 as against $45.30 per ton, and gravel at $1.75 as compared with $2 per cu.yd. formerly.

Increased demand for steel products and other construction materials is marked by advances in price quotations, while decreases are effected in many instances to stimulate buying. Lumber prices, particularly, have shown this tendency to stiffen with increasing demand.

Longleaf yellow pine is quoted in Dallas at $37 as against $35, and in San Francisco at $31 as compared with $29 per M ft., previously. Seattle reports an advance of 50c. per M ft. in Douglas fir, 1 in. rough, 10 in. x 16 ft. Common birch, base size, is quoted in San Francisco at $15.50 per M ft. The market on hollow tile is reported very unsettled in Atlanta, with both building and partition tile quoted at 10c. as against 14c. per block. New York quotes hollow partition tile at 11.12c. as compared with 11.37c. per block formerly.

Linseed oil has dropped 1c. in New York, 2c. in Denver, 5c. in Montreal and 6c. per gal. in Chicago. Minneapolis reports an advance of 4c. per gal. in 5 bbl. lots.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 87 — NEW YORK, NOVEMBER 17, 1921 — Number 20

## The Disarmament Proposals

It was a stroke worthy of a nation with disinterested motives to propose, in the opening address of the conference on the limitation of armaments, the scrapping of 66 capital ships. The boldness of the proposal and the challenge it gives to the intentions of other nations is an augury of a successful outcome of the conference in Washington. The start is a good one—worthy of a nation with America's peace traditions. It will hearten all who pray for a successful outcome of the negotiations.

## Common Sense Versus Vaporings

REFERENCE was made in these columns last week to the addresses being made by Mr. Rowntree. One of these was delivered at a dinner, of over 1,000 covers, of the Academy of Social Science of New York. On the same program was Hugh Frayne, general organizer of the American Federation of Labor, who was expected to give labor's viewpoint on the elimination or mitigation of industrial unrest. It was an occasion for solid thought. Mr. Rowntree stuck to common sense. He was definite. His subject had a solid appeal. Here was a great occasion for the federation to appeal to an influential group interested in working toward a sound solution of the labor problem. Yet Mr. Frayne indulged in generalities. His speech was of the spread-eagle variety that would make a hit at a union picnic. There was no substance; nothing concrete. The sad part is not that this is an isolated case of lack of judgment in suiting the theme to the audience, but is typical of the fighting policy of the federation which excludes, apparently the development of policies that are economically defensible and that would win public support for organized labor. So long as the federation continues under its present unstatesman-like leadership, it cannot expect to regain or improve on the ground lost in recent years.

## Double Side-Slab Roads

THE use of two side-slabs of concrete to replace a considerable mileage of old waterbound macadam in New York offers a method, where funds are limited, of securing a wide paved road at the cost of a comparatively narrow one-slab concrete road. Little criticism can be made of the design except on the count of increased maintenance. It gives a road with plenty of turnout room and, in case of need, for three-way traffic. It keeps the normal two lines of traffic well separated, and therefore increases the degree of safety. Maintenance will be increased. The center strip of penetration macadam, in the New York practice, breaks down sooner than the concrete, and particularly at the edges requires rather constant repairing. In rebuttal it may be said, however, that the narrow concrete slabs will probably develop fewer cracks than will a single slab 18 to 20 ft. wide, and that the reduction in crack-filling will counterbalance in part at least the extra cost of repairs on the penetration macadam. A final thought to be kept in mind is that the parallel slab road is a reconstruction design. Its fitness and its cheapness as a main road structure result largely from the fact that an old macadam pavement is in place as a foundation for the concrete slabs and for the macadam center strip.

## Intimidation Enjoined

TWO recently issued injunctions against strikers emphasize a solid point of view toward the conduct of strikes. The one was at Raleigh, N. C., in connection with a strike in the printing trade, the other in the milk strike at New York City. The purport of the injunctions is the same—that no means may be used by the strikers to annoy or threaten those who remain at or return to work. There is left to them only strictly peaceful means of procedure. By detailed statement all the usual methods of bringing pressure on loyal employees or strike breakers are enjoined. The North Carolina court, for example, as two of the specific prohibitions, forbids the strikers, (1) "From following after the complaining employees (the injuction was sought by the employees who continued working) or any other employees of the printing companies for the purpose of worrying, harassing or disturbing them, or for the purpose of talking to them on the subject of their employment if said employees shall notify the defendants that they do not want to be talked to on this subject. (2) From using any threats, gestures, or engaging in any conduct of any kind calculated to disturb, annoy or put in fear any of the complainants herein." The New York decision is equally specific. Heretofore, "peaceful" picketing has been held legal. The intent of these injunctions evidently, is to prevent so-called "peaceful" picketing from becoming a means of intimidation. If the North Carolina and New York views as to the proper limits of methods of strikebreaking become general, the only means left to strikers to gain their point would be the obvious conferences with employers, the inconvenience and loss to owners resulting from the stoppage, the presentation of their case to the public through various channels of publicity, and the use of various official agencies for mediation. This is as it should be, and is demanded by our constitutional guarantees. The wonder is that such sweeping prohibitions of all means of instilling fear in the minds of those who work have not become general before.

## Maintaining Worker's Standards

RESISTANCE to accepting lower standards—or to what are believed to be lower standards of living—is bound to be strong. This has been forcefully illustrated during this period of depression. Men applying for work at agencies frequently go away without taking jobs, though many are available, because they refuse to accept the lower wage scale now prevalent to do work that they consider of a lower order, or to work under less favorable conditions. This desire to maintain a higher standard is laudable, but in times like the pres-

ent, men must temporarily take what they can get, trusting to better times to permit them to return to their former standards. Another phase of this unwillingness to change standards was illustrated this summer on the construction work on the Catskill aqueduct. It was difficult to maintain full forces due to the unwillingness of men to work in isolated places. It is quite likely that with the curtailment of immigration this difficulty of filling forces on isolated jobs is likely to become widespread. The obvious effect will be to force a higher wage scale on the remote works.

## Pit-Run Gravel Concrete Roads

PIT-RUN gravel mixtures have demonstrated their utility for concrete road construction to the satisfaction of the Iowa Highway Commission. This is a conclusion of immense importance to all in the states of the Mississippi Valley, and in all other states where the prevailing gravels have a sand content exceeding 30 to 40 per cent. In these states practically all the gravel deposits south of the Wisconsin drift area run small both in pebble content and in the size of the pebbles. A screened mixture from any of these gravels is excessively costly because of the great wastage of sand in screening. If screened materials in arbitrary proportions are rigidly demanded the coarse aggregate at least has to be imported, and importation cannot meet the demand both because means of transportation are not sufficient and because consumption in the few states having materials to export limits very narrowly the surplus available for a foreign market. All states are building roads, each to about the limit of capacity of mercantile producers to furnish materials, so that none can materially aid another which lacks materials.

These facts must be kept in mind in passing comment on a practice which by most highway engineers has come to be regarded as dangerous. It must also be remembered that the pit-run gravel concrete roads of Iowa are being constructed with a care and under a control by the laboratory which was not dreamed of when the pit-run gravel concrete roads which have so disastrously gone to pieces in New York and other Eastern states were built. The impulse to criticize is modified as this care in controlling the construction is comprehended and as the vital fact is realized that concrete roads in Iowa would cost more in many cases and could not be built in some cases unless excess-sand aggregates could be utilized.

## Cleveland Leads Big Cities in Adopting City-Manager Plan

OPPONENTS of the city-manager plan who have been confronted with proof that it has been a marked success where tried have urged that it might do for small cities but would never work for large ones. This argument has been persisted in nothwithstanding the fact that four cities with over 100,000 population have prospered under city managers for considerable periods: Akron, Ohio, with 208,000 population; Dayton, Ohio, 153,000; Grand Rapids, Mich., 138,000; Norfolk, Va., 116,000. Such reasoning did not deter the voters of Cleveland, with its population of 797,000, from adopting the manager plan by a decisive vote on Nov. 8.

It should be noted that the amendments to the Cleveland charter meet one of the most valid of the arguments brought against the commission-manager plan for a large city, which is that a commission or council of only five members is not truly representative. This charge was met several years ago by Richard S. Childs and other advocates of commission-manager government by proposing that the larger cities should be divided into "wieldy districts," the number of districts depending upon the total size of the city and other local conditions, each district to be represented on the commission. Not only has this plan been adopted at Cleveland, but also proportional representation, after Jan. 1, 1924, by which the Council will consist of 25 members, chosen by proportional representation from four districts.

The extension of the city-manager plan to a city rapidly approaching a million people promises much in terms of municipal efficiency and of opportunity to engineers—the latter because better city government means the employment of more engineers, under improved conditions, even if the manager himself be not an engineer. It may also be noted in passing that a large percentage of the two hundred or more city managerships already in existence are filled by engineers.

In both opportunity and emolument the city managership of Cleveland should and probably will be the most important appointive municipal executive in the United States. To the highest type of men the opportunity will outweigh the emolument, whatever the latter may be.

The citizens of Cleveland should not rest content with the mere adoption of the city-manager plan, for that is only the beginning of what must be done to reap all its possible benefits. No matter how excellent the machinery of government provided in moments or days of zeal the people of any city must choose fit men to select its chief operator, to determine the policies he is to execute and to see that those policies are carried out; otherwise inefficiency and disaster will come soon or late—generally soon. True as all this is, it is no argument against adopting the best possible machinery of government yet devised—and this, for the city of today, provides for a chief engineer who goes under the name of city manager, whether he be an engineer in fact or merely in executive efficiency.

## Specifying Concrete Proportions

IN THE discussion of the Progress Report of the Joint Committee on Concrete and Reinforced Concrete before the American Society of Civil Engineers on Dec. 7 and 8 no subject will receive more attention than the alternate provisions for proportioning. That clause which requires concrete of a given strength and workability and permits the contractor to produce such concrete as he pleases will be especially attacked by the contracting fraternity as unfair and unworkable, or at least tending toward an added expense without compensating improvements in quality. There is a fair question whether the committee has not gone ahead of the state of the art in this clause.

The technic of concrete manufacture has progressed remarkably in the past few years. Cement has been improved and standardized, aggregate selection and grading have approached a scientific basis, proportioning is no longer by rule-of-thumb and mixing and placing are regulated by proved rules. The variations in strength from batch to batch of the best concrete are measurably less than they were a decade ago in some of those structures whose present appearance is beginning to worry engineers. Indeed on some recent jobs where most attention has been paid to the production of the concrete, predicted strengths have been reached with

startling regularity. Study and experimentation are beginning to show in the improvement of the uniformity of the product.

With all this, however, concrete must continue to be a field made product, with all the deficiencies that involves. Its very formation is a chemical action that is not too well understood, unknown factors still affect its strength and the human element, always uncertain, enters largely into its makeup. In spite, therefore, of the great mprovements in the art of making concrete it is hardly fair for the engineer to require the contractor to take all of the responsibility for the strength of the concrete, unless he is prepared to make that required strength far enough below what he may reasonably expect as an average to take care of the inevitable variations that will occur, which obviously would be uneconomical.

Two practical questions also suggest themselves. Is the individual specimen test a complete indication of the strength of the mass and what is to be done about the concrete in the structure the test pieces for which show a strength deficiency at the end of say a 28-day period? It is well known that most concrete cut from structures shows a higher strength than the test pieces poured of the same concrete simultaneously with the placing. Different conditions of curing, the added pressure of the superposed concrete in the structure, the blending of successive batches, all have something to do with this. It would hardly be practicable to order the removal of concrete once placed because of a small reduction from the prescribed strength and it would be most difficult to set a limit of tolerance because of the unknown coefficient of superiority of the structural over the test concrete Furthermore, few structures are of such a nature that concrete placed a month ago can be removed today, without wrecking the structure.

The criticized clause, it will be noted, is merely an alternate. The engineer who employs it in a specification is apt to store up for himself a great deal of trouble. In the first place he must give up a great portion of his powers of supervision, for he cannot well say that the contractor must produce concrete of a certain strength and then tell him how he is to get that strength. Therefore any regulations as to proportions, quality of material, amount of water, time of mixing—all of which influence strength—must be left out of the specification. Will the engineer be willing to relinquish so much of his authority? Or to subject himself to the possibility of a high bid on the one hand from the good contractor who wants to take care of all possibilities or of a deficient structure which must be removed if the contract is let to one who is willing to take a chance?

## Constructive Progress in New Highway Act

OF GREATER importance than the appropriation of $75,000,000 of government funds for road construction now and next year, as provided for in the Federal-Aid Highway Act which President Harding signed last week, is the assurance of the adoption, by the states, of sounder policies of highway location, financing, construction and maintenance than has existed in the past. To be sure, the additional funds are urgently needed in several of the states where the availability of state money has been contingent upon new federal-aid appropriations. This situation was brought out in several of the replies to *Engineering News-Record's* inquiry among state highway engineers as to policy regarding fall lettings.

Among the outstanding principles of logical highway administration which have been written into the new law are these: The designation of a system of highways comprising 7 per cent of the mileage of each state; the obligation of matching federal money with state funds under the direct control of the state highway department; the recognition of the need for maintenance and the provision of funds therefor; the centralization of control over road construction in the state rather than in its lesser political subdivisions; relief to the so-called public land states, assuring to them a more equitable distribution of federal funds; insistence upon roads of adequate width—18 ft., except in special cases. The establishment of such general principles marks a great forward step in highway administration and, as Senator Townsend has pointed out, precludes the probability of federal appropriations for road construction becoming subject to the "pork-barrel" charges which have been made against the government's river and harbor expenditures.

Perhaps the bitterest fight on any single feature of the new measure centered on the proposal of a federal highway commission to administer the work in place of the Secretary of Agriculture, through the U. S. Bureau of Public Roads. The commission plan was defeated and control will rest with the bureau which, during recent years, has demonstrated its ability to administer the work.

The passage of the bill, too, probably marks the end of the propaganda for a federal-built and maintained "national highway system." The federal-aid plan has come off victorious.

In the apportionment of federal aid to the states the former principle of a division on the basis of population, area, and mileage is followed, the only new feature being the stipulation that no state shall receive less than one-half of 1 per cent of the total funds, which, in the present case, amounts to $365,625. This provision increases the amounts formerly received by four of the smaller states, Delaware, New Hampshire, Rhode Island, and Vermont. The 7-per-cent road system which each state must select is divided into two classes—interstate and intercounty highways. The former comprises three-sevenths of the system and may receieve 60 per cent of the state's allotment of federal aid. The intercounty highways, constituting the remaining four-sevenths of the system selected, will receive the remainder of the state's allotment.

Coming at a time when unemployment is one of the country's pressing problems, the Federal Highway Act offers a substantial measure of relief by making possible the continuation of the highway programs of the states. It has been estimated that federal-aid road construction is giving employment to 250,000 men either directly or in the production and transportation of materials. Without a new distribution of federal funds, many of the state highway departments would have been forced to curtail, or in some cases to halt, their road-construction programs. These contingencies, happily, have been avoided.

The thought should be emphasized, too, that the appropriation allows highway development to proceed without chaotic interruption. In any enterprise as large as our highway-building program continuity of policy and work is necessary if efficiency is to be maintained.

*Practical Hints on Operation and Maintenance*

# Tractor Grading Outfits

*THIS article contains suggestions for selecting, operating and maintaining tractor grading equipment. These suggestions are a summary of the best experience of users and manufacturers. The information is of particular value now when the change from teams to tractors is gathering headway. Modern tractor grading outfits are not a collection of odd machines, but a co-ordinated train of machinery and economy can be secured only by exercising skill in selection, operation and maintenance.* —EDITOR.

TRACTORS are used in earth moving to haul wagons and cars for transporting excavated materials and to operate excavating machines, like scrapers and graders, which are actuated by traction. The usual forms of tractor grading outfits are (1) tractors and elevating graders in which case wagons move the excavated material (2) tractors and wheel scrapers (3) tractors and blade graders and (4) tractors and special earth-moving appliances such as land levelers and bulldozers. Ordinarily, blade grader outfits are used for light grading or for finishing rough grading which has been done with elevating graders or wheel scrapers. For heavy grading, contractors east and south of Illinois favor wheel scrapers, while north and west they prefer elevating graders. The land leveler is a development of the Far West. It is a large wheel-scraper type of machine originally employed to level land for irrigation but now used generally in grading operations of other kinds. The bulldozer, a scraper blade attached to and pushed by the tractor, is a special device for grading fills. The primary function of all these combination outfits is to move earth.

A secondary use of tractors in grading is to prepare the ground for earth moving. Clearing and grubbing, and, in hard ground, plowing or scarifying, are important tractor operations. Under certain conditions these secondary uses have to be considered very carefully in selecting tractor grading equipment.

## Selecting Equipment

There are certain considerations in selecting equipment which apply to all grading operations. They may be set down in the form of rules as follows:

1. Select equipment for its general serviceability. This rule applies particularly to tractors. The variety of duties, from stump-pulling to hauling empty wagons, which they have to perform requires all-around efficiency.

2. Standardize in type and make of equipment. This secures uniformity which simplifies operation and maintenance.

3. Select equipment of ample power and strength. Ability to master an occasional particularly steep or slippery or rough grade, or, without help, to do some especially hard digging, is often required.

With these general considerations in mind, the problem of tractor selection is to determine the kind of tractor and the sizes of tractors which are most efficient for earth grading. At best the hauling conditions are difficult. There are loose soil, soft ground, rough and steep roads and, often, little room for turning and maneuvering. Experience indicates that a gasoline tractor with crawler traction, best meets these conditions.

In general the gas engine has the same advantages for tractors that it has for motor trucks. Multiple cylinders give a compact high-power unit. It is self-contained in respect to fuel supply and operates equally well in all positions of the frame resulting from tilting on rough roads.

Crawler tractions, because of their large area of contact with the ground and the succession of gripping treads, give great pulling power in loose soil. Their wide distribution of the load reduces the danger of miring in soft ground. The long flexible treads ride easily over the bumps and depressions of rough excavated earth. The possibility of operating the treads separately, forward or in reverse, enables sharp, quick turns to be made. Their small vertical height keeps the center of gravity close to the ground and permits longitudinal or transverse tilting without dangerous loss of stability.

Two sizes of tractors, 25 and 40 hp., will meet the requirements of most grading operations. In grading, the small tractor—10-hp. to 12 hp.—is frequently a useful supplementary machine. It will handle a plow, one wagon, a small blade grader or a single fresno or wheel scraper. Its proper function is road conditioning and performing light earth moving where the 25-hp. tractor cannot be given full load.

## Working Capacities

Manufacturers indicate the sizes of their product in different ways but horsepower, based on drawbar pull at a definite road speed, is perhaps the most simple method for the contractor. On this basis, the two sizes of tractors for heavy grading correspond approximately to 25 hp. and 40 hp. at a working speed of 3 miles per hour. The capacities of these sizes, measured in equipment operated, are about as follows:

A 25-hp. tractor will operate two or three self-loading wheel scrapers or an 8- to 10-ft. blade grader or it will haul two 3½- to 4-cu.yd. wagons. The 40-hp. tractor will operate the largest elevating grader on low gear, from 1½ to 2 miles per hour, and in some work, including casting on direct, on direct drive at 3 miles per hour. It will handle six self-loading wheel scrapers or a 12-ft. blade grader, or, sometimes, two 8-ft. graders. On low gear both sizes will handle their loads on grades up to 30 per cent. Either will make a complete turn within an ordinary roadway.

In selecting grading equipment—graders, scrapers and wagons—it is best to choose machines which are especially designed for tractor operation. Ordinarily, two or more machines are hauled in train. Therefore, special couplings, stronger draft gear and a stronger running gear as a whole, are required. Tractor operation is more intense than team operation, that is, the speed is faster and the machines are kept more steadily

at hard work. Equipment designed for team operation, and wagons particularly, ordinarily must be provided with supplemental draft gear to be safely operated, especially in train, by tractors.

Tractor grading equipment is usually installed by the manufacturer. A service man sets up the machine and puts it in operation. With a trained operator to receive the equipment there are no difficulties in installation.

The factors chiefly to be considered in tractor operation are: Skilled operators; speed of operation, road conditioning, crew distribution, overloading and job planning.

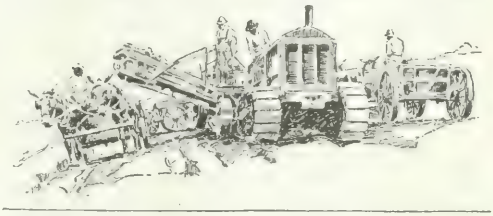
The fundamental requirement for success in operating tractors for grading is trained operators. Economy in wages should not tempt the contractor to employ untrained men. The trained driver will secure enough better service from his tractor and reduce repairs enough to make his higher wages an economy. He will do this by intelligently alternating speed and tractive power to suit the conditions, by pure skill in driving, by keeping his machine tuned up and by anticipating replacements due to wear and making them before a breakdown stops operation.

Speed of operation is a function of the working conditions. For example, if all the equipment including wagons is operated by tractors it is possible to maintain a higher normal rate of travel than where the wagons are hauled by teams. The speed naturally also varies with the character of the roads and with the loads. Tractors of the latest model are usually equipped with three speeds and optional combinations can be provided. A 40-hp. tractor has normally 1½, 3 and 5 miles per hour gear speeds but to meet special conditions a low gear of from 1½ to 2 miles and a direct drive of 2½ miles per hour are available. Older models generally had lower speeds, as 1½ miles per hour on low gear and 2 miles per hour on direct drive.

In actual operations the speeds are alternated as the load demands, as is indicated by the accompanying dynamometer graph of a typical wheel-scraper opera-

tion. In this instance a 25-hp. tractor was operating a train of three 4-wheel 1-cu.yd. scrapers in a medium damp clay soil. As indicated, the scrapers are loaded one at a time at low gear, or 1½ miles per hour. Then the tractor is shifted to direct drive, 3 miles per hour, which is maintained while the loads are hauled to the dump. With the scrapers unloaded the speed is changed to high gear, about 5 miles per hour, for the return trip. The lower line of the diagram shows the drawbar pull at all points of the haul. The time required is indicated by the upper line of the diagram. In operating other kinds of excavators, the diagram of drawbar pull will be different than that shown, but in all cases there is alternation of the speed with the load and here is where the skill of the operator assists in keeping the efficiency high.

Neglect to keep the haulageway in reasonably good condition results in loss of work and increases the wear of tractors. Crawler tractions have a surprising ability to negotiate bad roads but they exert their best power and speed on good roads. Road conditioning is, therefore, important in tractor grading operations. An occasional smoothing cut with a blade grader and particularly a skimming cut, immediately after rain, to

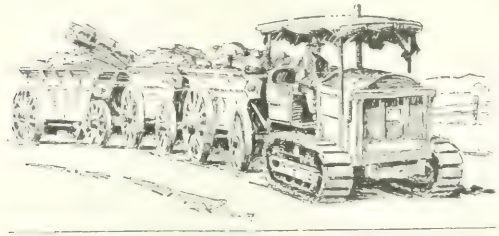


remove the top mud, keeps the road in shape to get speed and pull from the tractor and the cost is small compared with the gain. Good road conditions cut down the road trip time. Fig. 1 shows a round trip time of about 6 min. for about a 1,000-ft. total haul. This is good time over average roads. In continuous operation the lost time factor to be added is about 15 per cent of 1½ hr. per 8-hr. day.

One man operates the tractor under all conditions. Crew distribution, therefore, becomes a real problem only in connection with the grading units, and here choice of practice is called for only in manning wheel-scraper outfits. One scraper man usually loads the train of scrapers, one scraper after another, as each arrives at the point of cut. Some operators advocate a variation of this practice. They employ a separate operator for each scraper. The advantages, they claim, are that the scrapers are kept in better running order; a larger load is taken and a more even cut is made; the time of getting ready for work in the morning is reduced; the work is more active because the men do not become so tired and there is always extra help for an emergency.

Precaution against overloading is important. On whatever speed—low, direct or high—the tractor is operated, there should always be a reasonable margin of reserve power. An advantage of having experienced operators is that they will not fail to notice when the tractor is overloaded. There are circumstances in which the returns from the work performed under overload may be thought to exceed the cost of increased wear and depreciation, but this advantage is always secured at the risk of increased danger of breakage. It is safe to assume that overloading is never really desirable.

More careful planning of the whole operation is required in tractor grading, because all units work faster than in team grading and commonly they work in trains. This calls for more accurate scheduling of movements to prevent interference, particularly if several excavating units are distributing onto the same fill. There should be closer co-ordination of both equipment units and operating processes because interruptions of full output are more costly. Better living and working conditions are required to hold the trained operators who replace the teamsters and roustabouts of a team outfit.



On the other hand, the crews, and the accommodations and supplies for teams, are reduced, and generally the job housing and living problem is simplified.

Maintenance begins with the careful inspection of the tractor when it is received. *Inspection thereafter should be made at stated intervals as daily, weekly and monthly.* These inspections have two purposes, one is to determine the condition of the machine in respect to wear and needed replacement and the other is to perform the work required periodically to keep it in good operating condition. It is in this periodical inspection and constant maintenance that the trained operator demonstrates his value. With an outfit of five to seven tractors a high class mechanic, in addition to the operator, is a profitable investment.

Special provisions for making major repairs, beyond replacements, are not necessary except possibly in isolated or very large plant operations. Ordinarily also, a large stock of spare parts is not necessary. Large manufacturers of tractors and grading equipment provide service stations at most centers of tractor operations from which replacement parts can be secured in a short time and good maintenance inspection can anticipate needed renewals in ample time to have the parts on hand. Standardized equipment considerably simplifies the problem of replacements.

### Depreciation and Plant Requirements

Different contractors use different methods of estimating the working life of a tractor and for computing its depreciation. Much depends upon the character of the work, the character of the operation and maintenance, and contingencies which can be classified as pure accidents. Tractors are better built now than ever before, and based upon the performance of earlier built machines, it is safe to assume that a 40-hp. tractor will have a life of 1,000 working days, and at the end of that time, through reasonable care and prompt replacements, the tractor will still be capable of some further service.

Grading equipment, ordinarily assumed to have a depreciation of from 20 to 33⅓ per cent, will have a greater depreciation if operated by tractors. Manufacturers of road machinery are, however, constantly strengthening their equipment to meet the extra demands of tractor operation and this, of course, means longer life and less depreciation as time goes on.

The plant required for a tractor grading job depends upon the volume and character of the materials; the depth and relative locations of cuts and fills; the length of haul, and the period allowed for completion. General directions involve so many qualifications that they are of little service. Two examples of actual operations, both well outfitted as the performances obtained have demonstrated, are therefore presented. One is a mixed team and tractor road grading operation and one is a completely motorized heavy land grading operation. Neither represents the ultimate development in tractor grading, nor the most completely equipped operation, but both represent reasonably good practice and performance.

*Wheel Scraper Outfit.*—On a five-mile road grading job in Kentucky the contract called for 35,000 cu.yd. of earthwork, twenty concrete culverts and 2½ acres of clearing and grubbing. The route winds among hills with few level stretches and with grades of from 2 to 6 per cent. The soil is limestone clay free from rocks. The free haul is 500 ft. with an overhaul of about 13,000 ft. on 5,000 cu.yd. A combined team and tractor outfit was selected as being most flexible, the teams and slip scrapers being used on short hauls and tractors and 4-wheel scrapers on hauls of 150 ft. and greater. Table I lists the equipment and organization.

The power units consist of two 25-hp. tractors hauling two scrapers each. Six men are employed as operators; two on the tractors and one on each of the four

TABLE I—EQUIPMENT AND ORGANIZATION FOR TRACTOR GRADING ON HIGHWAY CONSTRUCTION

| Equipment | Organization |
|---|---|
| 2 5-ton tractors | 1 contractor |
| 1 plow | 2 tractor operators |
| 4 four-wheel scrapers | 4 scraper operators |
| 1 8-ft. blade grader | 4 mule team drivers with teams |
| 4 No. 2 slip scrapers | 1 dump man |
| 1 Dodge touring car | 1 roustabout |
| 1 motor truck | 1 man for clearing right-of-way |
| 1 concrete mixer (1 bag) | 1 loader (for teams) |
| 75 ft. of ⅝ in. chain, small tools | 1 truck driver |
| | 1 concrete mixer foreman |
| | 5 laborers on mixer |

scrapers. On hauls of around 600 ft. one power outfit loads at 360 ft. and the other at 660 ft. from the fill, to prevent delays. On longer hauls this is unnecessary. The road is about 24 ft. wide, which gives ample room for passing at any point and the tractors turn the scrapers easily within this radius, and when necessary can turn within 18 or 20 ft. The teams, besides being used for short hauls, are found particularly useful in smoothing out the road ahead of the wheel scrapers.

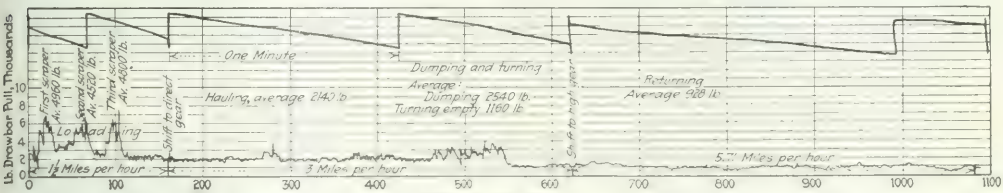
Working up and down a 6 per cent grade that was to be cut to 5 per cent, on an overhaul of about 1,300 ft. one outfit averaged about 120 cu.yd. a day, and the two outfits about 240 cu.yd. On another hill, of 5 per cent grade, around 200 cu.yd. was averaged with each outfit, on a 600-ft. haul, and both outfits gave 400 cu.yd. per 10-hr. day.

*Elevating Grader Outfit.*—Table II gives the tractor-elevating grader performance and cost for a period of nine days on a land development operation requiring heavy grading for streets. This record indicates (1) with a 40-hp. tractor hauling the largest size elevating grader, the maximum volume of dirt can be cut per day even if the work is on steep grades; (2) with several 25-hp. tractors each hauling two 3½- or 4-yd. dump wagons, the maximum output of the grader can be

TABLE II—TRACTOR ELEVATING GRADER COST AND PERFORMANCE ON A LAND-GRADING JOB

| | Quantities | | | Costs—Total | Costs—Per Yd. |
|---|---|---|---|---|---|
| Total yards dirt removed | 7,500 | | | | |
| Distance hauled—ft | 1,800 | | | | |
| Distance hauled—miles | .335 | | | | |
| Total yards—miles | 2,300 | | | | |
| Total hours on field | 79 | 15% | | | |
| Total hours actually worked | 63 | | | | |
| Yards per hour on field | 96.2 | | | | |
| Yards per hr. actual working time | 120 | | | | |
| Yards—miles per hr. on field | 2.91 | | | | |
| Yards—miles per hr. actual working time | 3.65 | | | | |
| Gal. gasoline for hauling | 945 | @ .25 per gal. | | $236.25 | $ 0310 |
| Gal. gasoline on elevating grader | 334 | | | 83.50 | .0110 |
| Total gas used | 1,279 | | | 319.75 | .0420 |
| Motor oil for hauling | 18 | @ 1.10 per gal. | | 19.80 | .0026 |
| Motor oil for grader | 16 | | | 17.60 | .0023 |
| Motor oil for total | 34 | | | 37.40 | .0049 |
| Trans. oil for hauling | 6.75 | | | 7.43 | .0010 |
| Trans. oil for grader | 4 | | | 4.40 | .0006 |
| Trans. oil total | 10.75 | | | 11.83 | .0016 |
| Grease used for hauling—lb. | 158 | @ .10 per lb. | | 15.80 | .0021 |
| Grease used for grader—lb. | 70 | | | 7.00 | .0009 |
| Grease used, total | 228 | | | 22.80 | .0030 |
| Hauling operators | 4 | @ $35 per wk. | | 210.00 | .0276 |
| Grader tractor operator | 1 | @ 57 per wk. | | 52.50 | .0068 |
| Dump | 1 | @ 35 per wk. | | 52.50 | .0068 |
| Dump men | 5 | @ 3.75 per day | | 169.00 | .0222 |
| Foreman | 1 | @ 40.00 per wk. | | 60.00 | .0079 |
| Wagon repair man | 1 | @ 35.00 per wk. | | 52.50 | .0068 |
| Grader operator | 1 | @ 4.00 per day | | 36.00 | .0047 |
| Grader operator helper | 1 | @ 3.75 per day | | 33.75 | .0045 |
| Freight one way* | | | | 350.00 | .0460 |
| Ford car* | 1 rental | @ 14c per mi. | | 175.00 | .0233 |
| Camp* | 1 rented tent | | | 150.00 | .0198 |
| Board | 15 | @ $1 per day | | 135.00 | .0178 |
| Depreciation for 9 days on 1—10 tractor @ 25% per annum based on 200 working days per year | | | | 73.50 | .0097 |
| Depreciation for 9 days on five-ton tractors @ 25% per annum based on 200 working days per year | | | | 240.00 | .0316 |
| Depreciation on grader at $1,900 cost price @ 20% per annum | | | | 17.00 | .0022 |
| Interest for 9 days on investment of $25,400 @ 8% per annum | | | | 50.00 | .0066 |
| Total cost | | | | $2,247.78 | $ .295 |
| Hauling cost only | | | | $1,450.78 | $ .1920 |
| Elevating grader costs | | | | $632.50 | $ .083 |

* The propriety of these charges is doubtful—the camp and Ford car are exhibition expenses and the total freight should not be charged against nine days' operation.




GRAPH OF DRAW-BAR PULL OF 25-HP. TRACTOR OPERATING THREE FOUR-WHEEL SCRAPERS

moved; (3) that tractors can handle the wagons on the dump, spreading the dirt evenly and making a perfect fill; (4) that a bulldozer attachment consisting of a stout 7-ft. blade mounted on the front end of the 25-hp. tractor reduces time and labor on the dump and in filling in around bridges, culverts, etc., and (5) with a completely motorized outfit, no teams are necessary, the labor of many men is saved, and a volume of work is accomplished which is beyond the capacity of teams.

## Train Ferry for the English Channel

A train ferry service between England and France, which was established during the war to facilitate transportation by eliminating the transhipment of freight on each side of the channel, is to be started again for freight service, especially for fruit and vegetables from southern France. Box cars loaded at different points are to be assembled in trains which will run to Calais, the train ferry conveying them to Richborough, where they will be landed and forwarded by rail to London.

## Report on Large Power Development at Umatilla Rapids

WITH the aid of the states of Washington and Oregon, the Umatilla Rapids Power Site Association of Pendleton, Ore., has recently completed a preliminary report on the plan to develop a large block of power on the Columbia River at Umatilla Rapids, 180 miles east of Portland, Ore. The report was made by the engineering firm of Lewis & Clark, Portland. Some of the chief features of the report are summarized in the following paragraphs:

Both rail and water transportation are available at the site which is within 200 miles of all the principal cities of the Northwest. Markets for the power nearer at hand are suggested in (1) the 270,000 acres of arid land within 45 miles of the site which could be irrigated by pumping, (2) the manufacture of nitrates and phosphates for use as fertilizer and (3) railway electrification.

If private capital cannot be interested in the project before the passage by Congress of the McNary bill, it is hoped that when the bill has been passed, the U. S. Reclamation Service will undertake the Umatilla Rapids development.

Foundation conditions are believed to be satisfactory. At low water bedrock is exposed or is visible for the entire length of the proposed dam except in a narrow section which is approximately 30 ft. deep. It is proposed to construct a 30-ft. dam with an open spillway 1,800 ft. long and a closed spillway 1,400 ft. in length controlled by removable gates, the structure to develop a head of 27 to 33 ft. at all stages of the river. 125,000 continuous horsepower could be developed at low water, 300,000 hp. for eleven months of the year and a total of 500,000 hp. during the irrigation season, the larger power during the irrigation season making it possible to carry the irrigation load without interfering with the sale of power which would be developed for continuous industrial uses.

The cost estimates allow $9,000,000 for the dam, navigation locks, railway relocation, overflowed lands, etc. In addition to that the power development costs would range from about $16,000,000 for 180,000 hp. to $32,000,000 for 500,000 hp. On the basis of construction by the U. S. Reclamation Service with interest at 5 per cent and operating without direct profit the annual cost per horsepower at the switchboard, including all fixed and operating charges, is estimated to be, on the basis of a 300,000 hp. development, $11.40 for primary power, and $6.85 for secondary power. The power cost would be slightly less on the larger power development plan and somewhat more under the minimum development plan.

# New York Develops Double-Slab Concrete Roads

## Parallel Concrete Slabs Separated by Macadam Give Three-Way Road at Cost of Single Two-Way Slab

RECENT reconstruction of waterbound macadam roads in New York has developed a double-slab concrete road section which automobile and truck drivers are greeting with favor. It is also proving to be a section which stands up under traffic without excessive maintenance charges on the macadam strip which separates the two concrete slabs. In regard to cost, a 24-ft. paved highway is being secured at about the price of a 20-ft. single-slab concrete road. Inspection of a number of sections from Rochester east to Albany and south to Poughkeepsie disclosed in every instance an easy riding road of handsome appearance.

FIG. 1. OLD WATERBOUND MACADAM BEFORE RECONSTRUCTION

FIG. 2 OLD ROAD, FIG. 1, RECONSTRUCTED WITH DOUBLE-SLAB CONCRETE PAVEMENT

The double-slab concrete road is only one of several types of concrete reconstruction sections with which old macadam, badly damaged by modern motor traffic, is being replaced. Typical illustrations of the old road conditions and the reconstructed highway are given by Figs. 1 and 2. This particular road is near Albany. The cross-section and reinforcement details shown by Fig. 4 are those of a road south of Rhinebeck, N. Y. Examination of this section, with a statement of the modifications employed on other roads, will give a clear idea of the double-slab practice being followed.

In the section shown by Fig. 4, the old macadam is excavated rather deeply and out to the ditch edges. The center strip of macadam is new construction in its entirety. It is 6 ft. wide and the side slabs are 9 ft. wide; these widths are now standard, but some of the older improvements have 8-ft. and 8½-ft. concrete slabs which have proved somewhat too narrow.

Returning to the excavation, the fact to be remembered is that the operation is always one of reconstruction, and to provide an emplacement for the concrete slabs and to build up the separating macadam are different problems in nearly every case. Where the old macadam is narrow, the sub-base has to be extended with new broken stone or slag. Often the concrete slabs are placed virtually on top of the old road, which is merely scarified and the sharp crown flattened by shifting the excess material to the edges. In other instances, emplacements for the slabs are excavated and the center strip is left undisturbed and is merely surfaced with macadam.

The concrete slabs are invariably reinforced, but practice in designing reinforcement varies somewhat with the preferences of the different division engineers. Two broad types, mesh reinforcement and bar reinforcement, are employed and the general character of each is fairly indicated by Fig. 4. Practice in mesh reinforcing ranges from 32 lb. to 60 lb. per square. When bar reinforcement is employed it seldom is lighter than 60 lb. A distinctive feature of this reinforcement is the bent bars placed at the four corners of each 33-ft. slab. These are ½ or ⅝ in. bars 8 or 10 ft. long bent at a 90° angle at the center and laid directly on the wires or bars.

To keep a way open for traffic, one slab at a time is constructed. This is required by the specifications. No more than one half of the road can be obstructed

FIG. 3 CONSTRUCTION OUTFIT FOR DOUBLE-SLAB CONCRETE ROAD

by plant or operations. Ordinarily the full width is scarified and regraded; then one slab is built; then the second slab and finally the center strip of macadam. A typical construction outfit is shown by Fig. 3. On work inspected near Rochester, N. Y., a slab 8½ ft. wide, 6 in. and 8½ in. thick, was being completed at an average rate of 450 ft. a day with a gang of 18 to 20 men, charging with wheelbarrows and finishing with strikeboard.

roller and belt. The bidding price for 0.8 miles was $22,600, or $28,250 a mile. In another division the bidding price for 1½ miles of 9 — 6 — 9 ft. road was $54,000 or $36,000 a mile.

Recapitulated briefly, the advantages of the double-slab design are: It leaves one half of the road clear for traffic during construction; it gives a wide hard road at no greater cost than a narrower single slab design; it provides distinct routes for right and left traffic and thus contributes toward safety of travel; it is smooth riding and attractive in appearance. It's disadvantages are that the narrow slabs concentrate wear and the penetration macadam separating strip requires considerable maintenance.

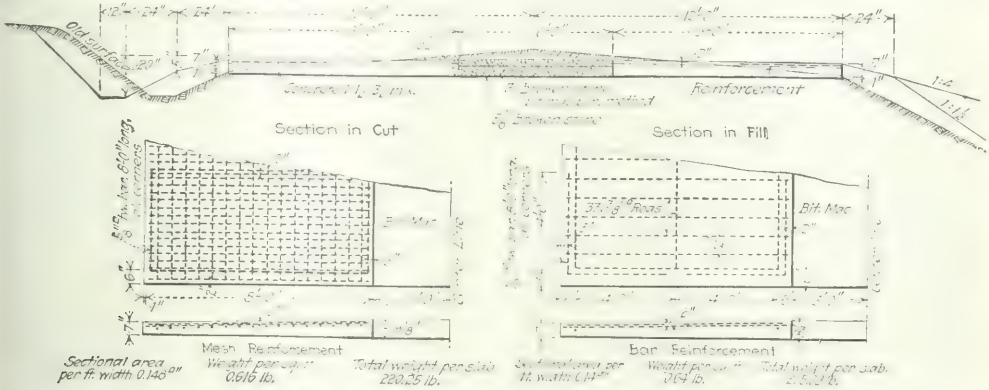



FIG. 4. CROSS-SECTION AND REINFORCEMENT DETAILS OF DOUBLE-SLAB CONCRETE ROAD

### St. Louis Suburban and Rapid Transit Plans

A downtown suburban terminal station for steam railways at St. Louis, Mo., and a combined elevated and subway rapid-transit line for street and interurban electric cars have been proposed by the Department of Public Utilities in order to meet the needs of suburban and local traffic. The union station is distant from the business district and the report states that its main-line traffic is so heavy as to cause suburban trains to be held outside frequently for 10 or 15 minutes before tracks are available. A 16-track station at the southeast corner of Market and Twelfth Sts. is proposed, having its floor 17 ft. below street level. Increased suburban train service is recommended, as well as a belt line service around the city and connection with East St. Louis, as the heavy traffic with the latter city is now accommodated mainly by street and interurban electric lines.

For the rapid transit electric service it is proposed that the Hodiamont line, which has private right-of-way, should be elevated on a solid fill between concrete retaining walls from Maple Ave. to Spring Ave. At the latter point the line would pass into a subway ending in a loop under Lucas, Morgan and Sixth streets and Broadway. Both suburban and interurban lines could use this route, the interurban cars making only few stops. These improvements in local traffic accommodation are outlined in a report by James A. Hooke, director, and Charles S. Butts, engineer, of the Department of Public Utilities.

## New Street Signs for San Francisco Cost $18 in Place

SAN FRANCISCO has adopted a new standard street sign, installation of which is to begin at once. The first signs are being put in in the downtown section and the work is to be continued toward the outlying districts. The type selected, as shown in the accompanying picture, consists of two metal plates set at right angles and fixed to a 3-in. standard pipe support 9 ft. above ground. The bottom of the pipe is imbedded in concrete foundation, and is set 30 to 36 in. back from the face of the curb on the extension of the property line. The first installation will consist of one sign

NEW SAN FRANCISCO STREET SIGN

on each street intersection. Later a second sign on the corner diagonally across, is to be added.

The name plates are 5 x 22 in., made of 16 gage galvanized iron with 3-in. letters milled in the plate. The plates are surrounded by ½ x 1-in. iron channels. Both plates and frames are finished in baked enamel, the lettering and border being of a dark blue color and the background lemon yellow. Posts are painted black 6 ft. from the ground and the remainder of the post is yellow to match the frames. The cost of each sign erected and painted is approximately $18.

# Building a Sheet Pile Cofferdam in a 28-ft. Tide

## Trestle With Timber Sheeting Used in Construction of Courtney Bay Dry Dock at St. John, New Brunswick

By H. E. Huestis
Engineer, Quebec, Canada

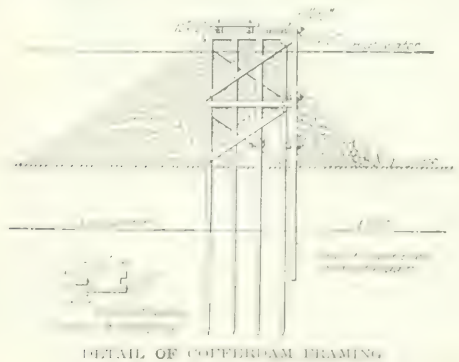
IN CONNECTION with the 1,150-ft. dry dock being constructed at Courtney Bay, St. John, New Brunswick, under the direction of the St. John Dry Dock & Ship Building Co., it was necessary to excavate an entrance channel 250 ft. wide and approximately 500 ft. long, or to such a distance from the return walls of the dock as to remove all rock to an elevation of — 32, or 32 ft. below low water. There is a tide of nearly 30 ft. here so the cofferdam offered considerable difficulty.

PLAN SHOWING COFFERDAM FOR COURTNEY BAY DRY DOCK

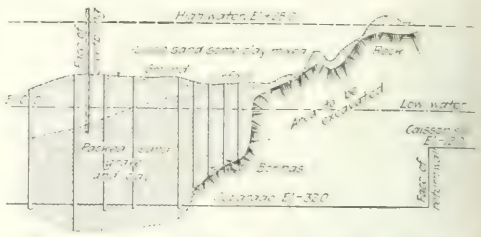
The Bedford Construction Co., at the time, July, 1919, were excavating the prism of the dock, and associated with James B. Craven, New York, took a further contract to remove the material in the entrance channel. This material was estimated to be 140,000 cu.yd. of rock and 110,000 cu.yd. of overlying sand, clay, etc., and as the excavation was a continuation of the dock, seaward or westerly, although at a 12-ft. lower level, it was decided that by the erection of a cofferdam, the material could be removed by steam shovels in the dry.

Plans were prepared using steel sheet piling driven to an elevation of — 33, with a timber sheeting from the ground surface, + 10 to + 32, the joint, at the ground line between the steel and timber sheeting, to be of concrete. On account of the excessive cost of steel sheeting, and for various other causes, this plan was not deemed practicable and the writer was asked to submit other plans.

Two sets of plans were prepared and submitted. One consisted of a double row of timber sheeting, with puddle between, and the other, a single sheeting driven on the outside face of a trestle. As the latter was some $70,000 cheaper, and as the writer anticipated no appreciable leakage from the ground surface to high-water mark, the company decided on the cheaper one.



DETAIL OF COFFERDAM FRAMING




SECTION SHOWING MATERIAL OVERLYING ROCK

A most complete set of borings, every 25 ft. over the whole area and to a distance of 900 ft. west from the dock return walls, taken by the Department of Public Works, showed a stratum of clay varying from 5 to 15 ft., overlying and practically following the dip of the rock and although loose sand and gravel was shown underneath this clay stratum, yet at Sta. 9 + 00 west the clay bed dipped to El. — 33.

Due to this condition, the writer believed that it would not be necessary to drive sheeting to El. — 32, the level to which the rock should be excavated, but that timber sheeting driven to just penetrate but not pierce the clay bed, and the exercising of the company's right, by a clause in their contract, whereby the dredges could not work within Sta. 12 + 00, would thus keep the clay stratum unbroken, and acting as an impervious blanket, permit steam shovels to take out the material in the dry. The actual conditions worked out as anticipated.

TRESTLE CONSTRUCTED; DRIVING SHEETING ON FACE

The maximum high water at Courtney Bay is + 28.4 the average being + 24, and as the ground surface elevation of the entrance channel is about + 10, twice a day this flat is dry, which facilitated both the erection of the cofferdam and the subsequent dewatering and pumping.

A four pile driven trestle, bents 10 ft. c. to c. was erected, at an average distance of 150 ft. outside the area to be excavated, to which were bolted three double rows of 10 x 10 wales, between which was driven 6 x 10, 12 and 14-in. tongue and grooved British Columbia fir, in lengths varying from 34 to 44 ft. To save timber, which costs from $65 to $85 per thousand ft. b.m., each piece had two grooves, 1½ x 1½ in., and before

NORTHWEST CORNER AT LOW WATER, SHOWING OPENING AT BOTTOM

driving, a splice 3 x 1½ in. was nailed in one groove, thus forming the tongue.

Each sheet pile was pointed at the end, and by means of a screw jack, clamped to a pair of wales, it was forced into its companion tongue. Driven by a steam pile hammer to the desired distance, this gave a practically watertight joint. The average penetration was 16 ft., the cutoff being made at El. + 32, which was considered high enough to take care of waves or wind spray.

The work on the trestle was commenced in August, 1919, and sheeting completed at the end of the following November. Previous to the completion, an opening 20 ft. wide was made in the face, to take care of the rise and fall of tide, and before closure a 15-in. pipe and valve were installed, to let out at low water any water that might make during tides.

To add to the stability of the cofferdam, material was dumped inside and outside the face of the sheeting. Clay was to be used, but having in view the experience of the Boston cofferdam, clay was first tried out on the approach trestle, with the result that with the rise and fall of the tide, the clay sloughed to such an extent, that full bents were carried away. Clay was accordingly dumped around the toe only, and the balance of the fill was made up with rock and overburden. In all some 35,000 cu.yd. of rock and 42,000 cu.yd. of clay and overburden were placed around the cofferdam.

Closure was made at the end of December, and with the exception of the southeast corner, where loose rock was struck, the cofferdam was a complete success.

As there was no immediate need of the cofferdam during the winter months, owing to the fact that the 15-in. pipe, assisted at times by an 8-in. pump, could cope with all leakage, nothing further was done until June, 1920.

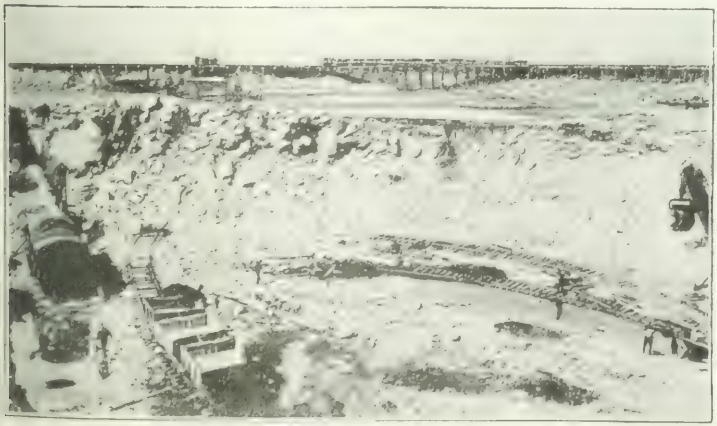
In the meantime it was learned that the loose rock at the southeast corner was the result of an exhibition shot, touched off by the Honorable Minister of Public Works, at the inauguration of the St. John dry dock, some years previous. It was shot but never moved, and being afterwards filled in, gave no indication of what was actually struck. Exhibition shots are "no bon."

In June by finding solid rock in the southeast corner, and trenching to follow it, a cutoff was built and apart from some water which still came in at high water, no further trouble was experienced. An 8-in. pump working from 8 to 12 hours a day took care of all the water both on the ground surface level and the level of the pit excavation.

INSIDE VIEW BEFORE EXCAVATION COMMENCED

The first big shot in the submarine area was May 12 and by December, 1920, some 125,000 cu.yd. of rock and 80,000 cu.yd. of overlying material had been removed. It was quite feasible to remove the balance, but as the St. John Dry Dock Co. had not completed all preparations for the construction of their caisson, as an extra precaution it was mutually agreed that this material should be left. At the present time these caisson walls are being constructed by the St. John Dry Dock Co. and it is to be hoped that they will be expeditiously carried out, as the cofferdam was not intended for more than two seasons.

The conditions at Courtney Bay were unique in their way, inasmuch as steam shovels were excavating below the



INSIDE THE COFFERDAM, SHOVELS WORKING AT EL. -4?

bottom of the sheeting, or under an extreme head of 62 ft., at high water, and this stratum of clay acted in every sense as a lower level cofferdam. There was absolutely no indication of water coming in at the face of the cut.

In addition to acting as a cofferdam, the trestle was used as a means of receiving all freight and coal, and also as an approach to a dump for the shipways embankment, over 200,000 cu.yd. of material from the prism of the dock being carried over it.

The total cost of material, construction and maintenance of the cofferdam, during excavation, was a little over $1 per cu.yd. of submarine rock removed.

# Locomotive Track Scale Shows Load on Each Wheel

## Platform of 450-Ton Scale Carries Portable 25-Ton Scales Which Register Weight on Individual Wheels

By Carl C. Bailey
Baldwin Locomotive Works, Philadelphia, Pa.

A NEW LOCOMOTIVE weighing plant of high load capacity at the Baldwin Locomotive Works, Eddystone, Pa., has the special feature of a scale platform wide enough to carry portable scales for taking the load on each individual wheel. The large scale is composed of six sections, each designed for a theoretical concentrated load of 150 tons, making a total of 900 tons, with a working capacity of 450 tons. Fig. 1 shows an engine on the scale platform, with the individual scales adjusted to its wheels. Fig. 2 is a cross-section of the plant.

Weighing locomotives at the Baldwin works has been done hitherto by taking the total weight on a track

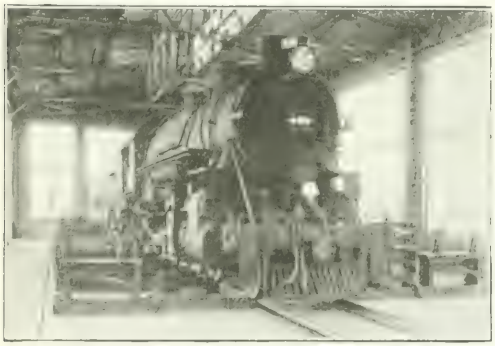


FIG. 1. LOCOMOTIVE ON TRACK SCALE WITH INDIVIDUAL SCALES UNDER THE WHEELS

scale and then moving the engine to a track having concrete foundations wide enough to allow of placing an individual scale under each wheel. It was difficult, however, to obtain any degree of accuracy in comparing the total weight on the platform with the sum of the weights of the individual scales. After investigations as to the weight of the largest locomotive which it would be practical to build, it was decided to construct a scale of 450 tons working capacity and with a platform of such width as to permit placing individual scales under the wheels. In this way all weights would be determined with the engine in one position.

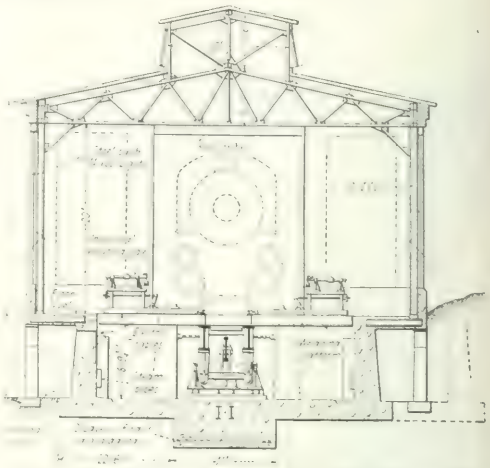



FIG. 2. SECTION OF LOCOMOTIVE WEIGHING PLANT

At the new plant, the scale platform is 100 x 27½ ft., and the 110-ft. pit is extended 5 ft. under the floor at each end. This end arrangement is to enable the load to pass over the main bearing pivots of the end section before it rests on the scale proper, thus alleviating the impact on the knife edges, increasing the life of the mechanism and resulting in more accurate weight. The design and arrangement of parts are shown in Fig. 3.

In considering the stresses recommended by the scale specifications of the American Railway Association and the U. S. Bureau of Standards, it was found that under maximum loading the longer extension levers, if designed by the given fiber stresses for the tension side in transverse bending, would deflect much more than permissible for this class of work. By designing the longer levers with regard to deflection as well as fiber stress, these latter stresses were much reduced. To conform to these specifications, the designers were confronted with the problems of producing a knife edge in the main levers which would be of sufficient length to take a loading not to exceed 7,000 lb. per lineal inch, and of supporting it in a substantial manner to secure an even distribution of the load.

These knife edges, 22 in. long, are made of a special oil-hardened alloy steel which has an elastic limit of not less than 160,000 lb. and a tensile strength of not less than 200,000 lb. All other knife edges and bearing steel meet the same requirements. The entire surfaces of all pivots and bearings are machined, hardened and ground and set in machined ways. Bearing steels for fulcrum stands are set in removable blocks. The knife edges are so constructed as to have continuous contact with their bearings and the only bow loops are those for counter-balancing or back-balancing the weigh beam.

Each of the twelve cast steel main levers weighs approximately 1,075 lb. and has one end resting upon a fulcrum stand, the other end being suspended by a stirrup. From these levers the massive cast steel yokes that carry the platform are suspended by two heavy machine steel stirrups, as shown by Fig. 3. The bedplate supporting the main and the extension lever fulcrum stands is a single casting secured to the foundation by independent anchor bolts in order to facilitate accuracy in leveling up on a concrete foundation. There

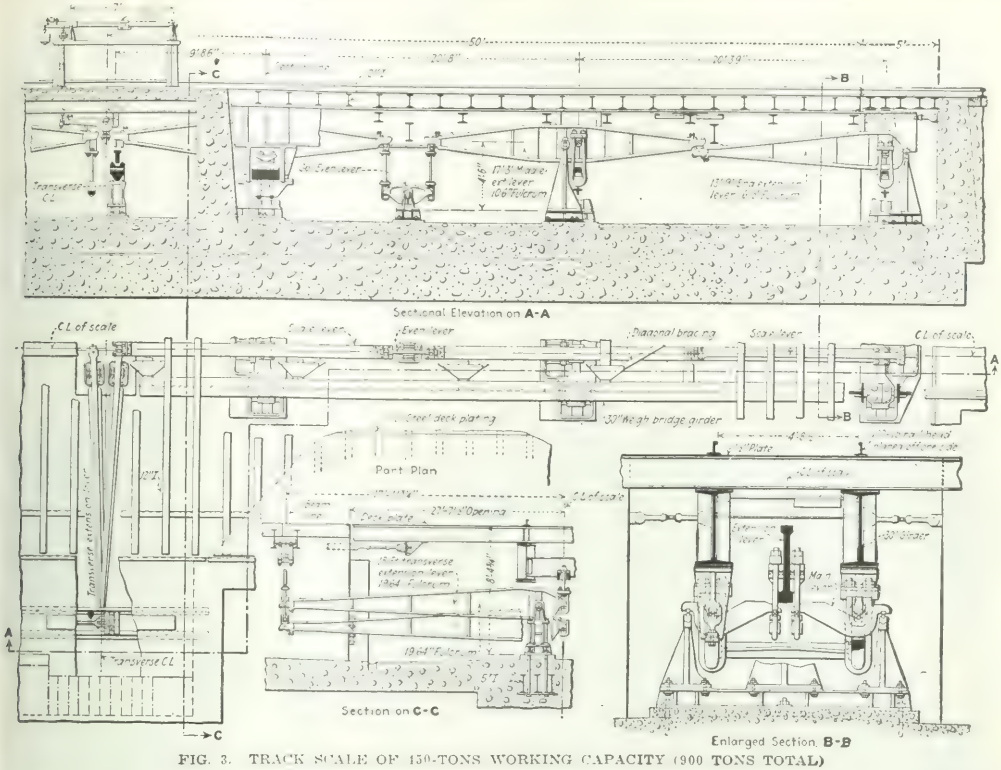



FIG. 3. TRACK SCALE OF 150-TONS WORKING CAPACITY (900 TONS TOTAL)

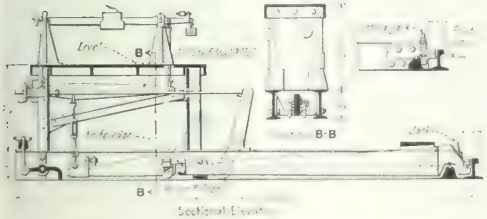



FIG. 4. PORTABLE SCALE FOR TAKING LOADS ON INDIVIDUAL WHEELS

are ten bedplates; one for each scale section, two for the even levers that connect the inner sections and two for the transverse extension levers. These last four are of cast steel because the stress is practically direct tension. All contact points of metal against metal are machine finished.

The connection between the middle extension lever and the transverse extension, shown in Fig. 3, is accomplished by means of two machine steel stirrups passing over bearing blocks which engage the butt pivot of the transverse lever and the end pivot of the middle extension lever. These stirrups are then connected by a 2-in. plate which permits vertical adjustment. The connection between the middle extension lever and the 3-ft. even lever consists of two similar stirrups that pass over the bearing blocks which engage the end pivot of the middle extension lever and the end pivot of the even lever. These stirrups are connected by two 1½-in. plates and two draw bars. To resist the upward pull, the fulcrums of the even levers and extension levers are anchored to the sub-bases by cast-steel inverted stirrups, each held by two 1¼-in. anchor bolts. In the upper part of these stirrups are bearing blocks engaging the fulcrum knife edges.

The connection between the transverse extension lever and the lever under the weigh beam is arranged to permit one lever to be leveled independent of the other, to allow swiveling to match the different angles at which the levers hang and to give vertical adjustment to the levers in unison. In design and manufacture, great care was exercised in locating all pivots practically on the neutral axis of the section, in order to obtain an even distribution of the weights about the pivot line. On the platform scale the weigh beam is graduated by 5,000-lb. increments to 895,000 lb., an auxiliary beam of 5,000 lb. capacity graduated to 50-lb. increments brings up the total capacity to 900,000 lb.

## New 785-Mile Trip is Longest Train Run in Britain

The longest British railway run is the new 785-mile 22-hour trip between Penzance at the southwest corner of England and Aberdeen on the northeast coast of Scotland. Through day cars are run, dining cars are attached at convenient times and sleeping cars are attached in the evening. The route is over six different lines and serves a number of important cities. This service is operated daily in each direction.

# Sand Box Employed in Teaching Topographic Mapping

## University of Illinois Adopts Plan Which Clearly Indicates to Student Interdependence of Various Steps Taken

By W. H. Rayner and J. R. Stubbins
Assistant Professor of Surveying Instructor in Surveying
University of Illinois

ONE of the greatest difficulties which attends instruction in topographic surveying is to secure the proper conception in the student's mind of the interdependence of the various steps to be taken in the execution of such a survey. It was primarily an attempt to meet this difficulty which led to the adoption, at the University of Illinois, of the device to be described herein. This original purpose has been adequately fulfilled, and a number of other advantages have resulted.

The use of models for instructional purposes and for studying layout schemes of various sorts is common practice and the value of this aid to instruction was fully demonstrated in the late war. Much use was made of the sand-box, the puff-board, and the relief map in the different branches of the service. It is believed, however, that the application of the use of the sand-box to instruction in the design and execution of accurate topographical surveys is new and of peculiar value.

The general features of the scheme may be stated briefly as follows: A landscape which includes the more common topographical features is modeled accurately to scale in the sand-box; a set of field notes for a complete transit-stadia survey of this area, is derived from the sand-box landscape by methods to be explained later; the students are then assembled around the box and each man acts as the recorder of a transit-stadia survey party. The instructor acts as the instrument man, calls off the notes just as they would be called off by a transitman in the field. By proper methods the students reduce these notes for plotting, and, finally the survey is plotted and the map finished according to standard practice. This scheme, of course, is designed not to take the place of the field work but to prepare the student to undertake his field work with greater intelligence and better judgment. This training, therefore, saves much time and results in greatly accelerated learning on the student's part while in the field.

The materials used in the construction of the sand-box landscape are: 1 box, 6 ft. x 8 ft. x 10 in.; ¾ cu.yd. of fine sand; 2 cu.ft. of pulverized shale; 2 sets of symbols for houses, water-tanks, bridges, etc., secured from the U. S. Disciplinary Barracks at Fort Leavenworth, Kan.; sponges for trees, and other symbols as desired.

Some practice may be necessary before the uninitiated will secure good results in modeling, but a high degree of skill is not at all necessary. The sand and shale are placed in the box, thoroughly mixed and moistened. The sand will remain moist for two or three days but all modeling should be done on the first day. The model is constructed according to the general plan selected, care being taken to keep the features and shapes consistent with the scales chosen. It has been found desirable to double the vertical scale so as to give a more impressionistic view of the relief. Perhaps the trees, houses and bridges will not be exactly to scale, but the impression will be very good nevertheless. A good effect for underbrush may be secured by dropping lumps of wet sand on the finished surface. Pieces of sponge stained green make good tree symbols and light-brown plasticene strips may be used for roads, etc. Any degree of elaboration may be used in the embellishment of the model. A view of the box as now in use at the University of Illinois is shown in Fig. 1.

FIG. 1. SAND-BOX GIVES VIVID PICTURE OF TOPOGRAPHIC FEATURES

From this point the procedure is as follows: The instructor chooses a purpose for the survey of this area, and for the survey here described it is assumed that a transit tape traverse is best for the horizontal

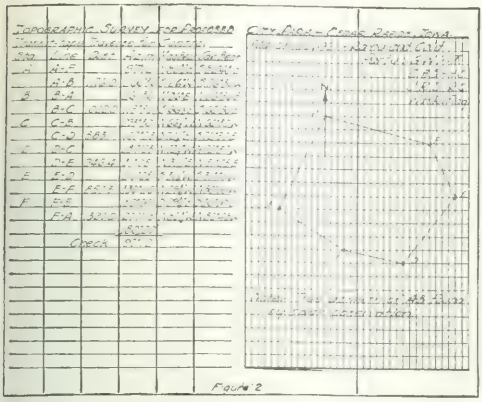


FIG. 2. HORIZONTAL CONTROL OF SURVEY

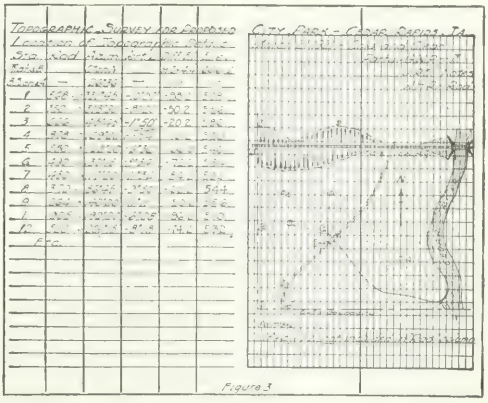


FIG. 3. SAMPLE PAGE OF STADIA NOTES

control. The traverse stations are selected according to good field practice and their locations are marked by small flags, consisting of bits of white cloth glued to toothpicks or matches. The side shots for the location of contour points and details are then selected and marked by small bits of paper on which are printed identification numbers and which are held in place by ordinary pins. Special care is taken to place these points so as to completely control the drainage net and principal ground forms with the fewest possible points.

These points are then located by co-ordinate measurements from the sides of the sand-box and are plotted on the instructor's map, on which the sand-box edges (co-ordinate axes) have previously been plotted to a reduced scale. The scales now in use are as follows: On the sand box the horizontal scale is 1:400, and the vertical scale is 1:200, on the map the scale is 1:2400 and the contour interval is 10 ft.

The elevation of the river bed on the bottom of the box is then assumed and the differences in elevation between it and all traverse and detail points are observed directly on the sand-box by means of an engineer's level and rod. These values are enlarged in the proper ratio and the relative elevations of the points are entered on the instructor's map.

Next the azimuths and lengths of the traverse courses are carefully measured on the instructor's map with a Colby protractor and scale, and the results recorded in good note-book form. These measurements should be made with great care for the accuracy of the students' maps, to be made later, will depend on these notes. The latitudes and departures of the traverse are computed and adjusted if necessary to give a degree of accuracy consistent with the purpose of the survey and scale of the resulting map. This completes the reduction of the horizontal control to notebook form. (Fig. 2.)

The vertical control may be given to the students in the form of a set of differential level notes or if desired the elevations of the traverse stations may be given to the students outright. The side shots for the location of contours, points and details are determined by azimuths and distances, scaled in a manner similar to that used in locating the traverse stations.

These measurements furnish the horizontal distances and differences in elevation of all the detail points and it remains to compute a vertical angle and a rod reading which, if taken in the field, will yield these distances when reduced. This is best done by means of a stadia slide rule. A sample page of stadia notes is shown in Fig. 3, the inclined figures being those which are to be read to the students. The instructor's map is now contoured, finished, traced and used by the instructor to check the students' plotting and sketching.

It is now possible to place before a class of students the project of making a complete topographic survey and map which very closely approximates actual field conditions. They are given only the purpose of the survey. In consultation with the instructor they decide on the scale of map, and contour interval. With these conditions established, they decide on the instruments, methods, checks, allowable errors, personnel and organization of the party for each part of the work. While looking at the landscape model, they imagine a transit set up in the field. The instructor gives the readings as they would be taken in actual work and the class records these notes in proper form. An excellent opportunity is given the instructor at this point to indicate the principles which govern the selection of detail points and to point out the best methods of procedure.

Each student now reduces his notes, plots the points and constructs a map in the usual manner, except that in sketching the contours he has an actual situation before him to interpret, both by means of his plotted points and by inspection of the real configurations of the landscape. Sometimes the students are asked to exchange note-books so that one man plots another man's notes and consequently gains a comprehension of the uselessness of vague notes. The map is inked in colors, using the usual symbols and a report is prepared which approximates the report of a similar survey in the field.

The use of this device is established and justified because it possesses these advantages: (1) The work is independent of field weather conditions; (2) it enables the student to see the relation of each step to the entire project; (3) it enables the student to see the significance of controlling points, and of ridge and valley lines; (4) it gives a clear and comprehensive conception of the factors which govern the choice of instruments, methods, and personnel; (5) it emphasizes the importance of good note-keeping and affords excellent practice in this regard; and (6) it enlists the student's interest quite as much as the out-of-door work.

# Practical Use of Excess Sand in Concrete Mixtures

## Tests Prove Pit-Run Gravel Suitable for Concrete Pavements—Iowa Practice in Proportioning Mixes of Varying Sand Content

By R. W. Crum
Engineer of Materials and Tests, Iowa Highway Commission, Ames, Iowa

APPROXIMATELY 187 miles of single-course concrete pavement were constructed in Iowa in 1920 and 1921. In 122 miles of this pavement, unusual concrete mixtures were used; the aggregates contained from 50 to 80 per cent sand instead of the 33 to 40 per cent which is common. To keep the quality constant, additional cement was used in the mixtures rich in sand. Judging from tests made daily during construction, and from observation of pavement in service up to one year, the quality has been consistently maintained although the mixtures range from a 1:2:3½ by volume to 1:2½:1 by volume.

In 35.43 miles of road, unscreened pit-run gravel was the aggregate. *The tests show that this road is as good in every way as those in which screened aggregate was used.* If the constituent particles are good and the material is clean, we conclude that, when properly handled, pit-run gravel is suitable for use in paving.

The advantages in the use of pit-run gravels and of mixtures rich in sand have been: First, reduced cost, and, second, ability to carry on projects not otherwise possible. A conservative estimate of the saving in the cost of the two years' work, is $144,000. At least 35 miles of pavement were completed, which would not have been built under other circumstances.

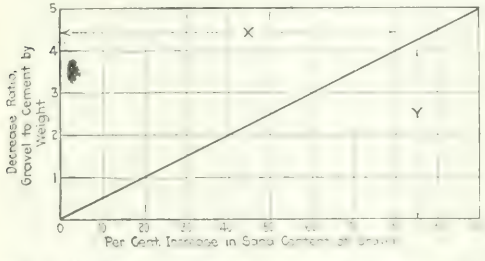



FIG. 1. DIAGRAM FOR PROPORTIONING CONCRETE MIXTURES OF VARYING SAND CONTENT

The method by which mixtures of varying sand content are proportioned, has been worked out by the Engineering Experiment Station of the Iowa State College from the results of some five years of experimental work. This method depends only upon the ratio of sand to total aggregate by weight. In the use of pit-run gravel, field control is very easily maintained since simple determinations of the percentage of sand in the gravel and the weight per cubic foot of the aggregate can be easily and often made.

Figure 1 is the basic diagram for proportioning mixes of varying sand content. To use this diagram the procedure is as follows. First assume a mixture known to be satisfactory, then: (1) Reduce the proportion of the standard mix to the basis of weight. (2) Determine from Fig. 1 the decrease in parts of aggregate corresponding to the increase in the percentage of sand in the aggregate and change the proportions accordingly. The formula for computing item 2 (Fig. 1) is:

$$\tan a = \frac{4.0}{80} = 0.05, \text{ and } y = x \tan a = 0.05\,x$$

*Example*: Assume that an aggregate containing 42 per cent sand, and weighing 112 lb. per cubic foot, makes a satisfactory concrete in the proportion of 1:4½ loose volume. What proportion should be used in a similar gravel containing 75 per cent of sand and weighing 107 lb. per cubic foot?

Assume that 94 lb. of cement equals 1 cu.ft. Then 1 cu.ft. of cement to 4.5 cu.ft. of aggregate equals 94 lb. cement to 4.5 x 112 lb. gravel, equals 1 lb. cement to $\frac{4.5 \times 112}{94}$. Therefore the proportion by weight is 1 to 5.36.

The increase in the percentage of sand is 33. From the diagram, the corresponding decrease in parts of aggregate is 1.6. Therefore, the proportion to use for the gravel containing 75 per cent of sand should be 1 to (5.36-1.6) or 1 to 3.76.

If it is desired to measure the materials by volume instead of by weight change the above weight relation to a loose volume proportion as follows:

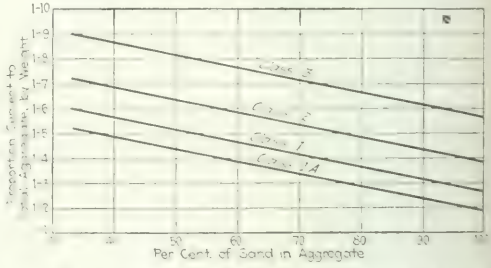



FIG. 2. MIXTURES OF VARYING SAND CONTENT FOR CLASSES OF CONCRETE IN COMMON USE

Weight per cubic foot of cement, 94 lb.; weight per cubic foot of gravel, 107.0 lb.; 1 lb. cement to 3.76 lb. gravel equals 94 lb. cement to 354 lb. gravel, equals $\frac{94}{94}$ cu.ft. cement to $\frac{354}{107}$ cu.ft. gravel, equals 1 to 3.30 by loose volume.

Fig. 2 is a working diagram for several classes of concrete in use by the Iowa Highway Commission. Class IA is the one in present use for single course concrete pavement.

Two 6 x 12-in. cylinders for crushing tests, and two 8 x 8 x 5-in. blocks for wear tests were made each day from concrete going into the roads. These specimens were cured and stored in a manner similar to the conditions of curing in the pavement. At the same time, the cement was removed by washing from a sample of concrete from the same batch, and a sieve analysis was run upon the aggregate. These data represent 46.17 miles of pavement built in 1920, and divided as follows:

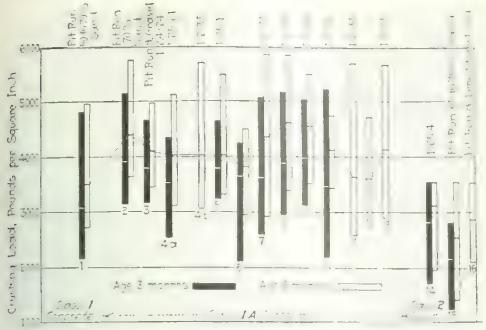


FIG. 3. STRENGTH TESTS OF FIELD SPECIMENS OF PAVEMENT CONCRETE

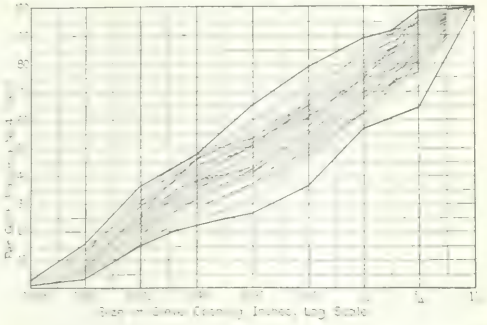


FIG. 4. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 1

| | |
|---|---|
| Single course concrete, pit-run gravel | 5.52 miles |
| Single course concrete, screened aggregate | 8.04 miles |
| Single course concrete, screened aggregate, 1:2:3.5 by volume | 21.81 miles |
| Base course for brick, pit-run gravel | 5.12 miles |
| Base course for brick, screened aggregate, 1:2:3.5 | 5.38 miles |

It is to be expected of specimens made in this way, under field conditions, that there will be considerable variation in individual results. However, if a considerable number of specimens are used it is reasonable to expect that the average will be representative of the strength of the concrete, and that the variation in the individual results will give some measure of the comparative uniformity on different jobs. Of course many variables enter into the control of strength and uniformity. No attempt has been made to study the effect of the various conditions. We have drawn only one conclusion and we believe that to be substantiated.

*We believe that it is entirely possible to design and construct pavements using pit-run gravel, or high ratios of sand to coarse aggregate, equivalent to pavement made from the common arbitrary mixtures such as 1:2:3.5, provided the same standards of supervision and inspection are maintained.*

*Crushing Tests.*—Results of tests at the age of three and six months on concrete single-course pavement are shown by Fig. 3. The three months' specimens were made late in the fall and when studied with respect to weather conditions show a decided tendency toward decrease in strength as the days upon which they were made grew colder. Taking into account the varying conditions as to source of materials and methods of operation it would appear that there is no greater variation in strength between the high sand ratios and the 1:2:3.5 mixes or between screened and unscreened mixes, than there is between any two of the 1:2:3.5 mixes. Project 1 is class 1 concrete and 14, 15 and 16 are base concrete, while all of the others are class 1A concrete (Fig. 2). In view of this difference the average for No. 1 is not inconsistent.

*Sieve Analysis.*—Other qualities being equal, the principal objection to the use of pit-run gravel has been the fancied lack of uniformity in the resulting concrete. It is true that these experiments show that there is a great opportunity for improvement in the uniformity of concrete mixes, but, it is rather surprising to note that the mixtures of screened aggregates are no better in this respect than pit-run gravel mixtures, and often not so good when the pit-run gravel is handled in the most advantageous manner. Figs. 4, 5 and 6 show the sieve analyses (upon four typical projects) made daily upon samples of concrete from which the cement had been removed by washing. Fig. 4 refers to project No. 1 in Fig. 3 and is the worst example of variation in the pit-run gravel mixes. In this case the material was hauled direct from the pit to the road and strung along the subgrade. This method of handling pit-run gravel is the worst possible and should not be permitted. In order to compensate for the variation in sand content, three different mixes were used on this job.

Fig. 5 refers to project No. 2, a pit-run gravel job in which the material was properly handled. The gravel was piled by the excavating machinery in a large stock pile containing more than 1,000 cu.yd. of material. Gravel taken from this stock pile and measured in industrial railway batch-boxes showed such uniformity of

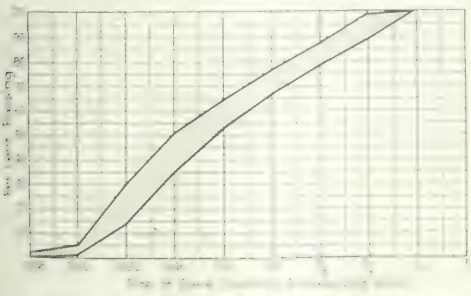


FIG. 5. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 2

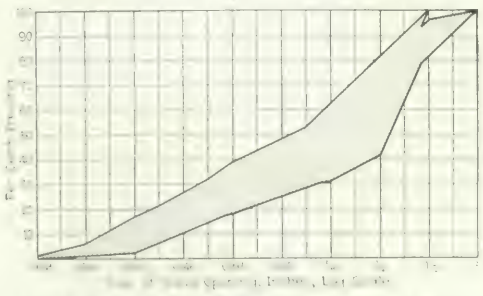


FIG. 6. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 8

the sand content that for the entire project of eleven miles there was no occasion to change the proportions. The sieve analyses on the samples taken from the mixer corroborate this uniformity. This is the best example of the use of pit-run, but is much more nearly typical of the results being secured than is Fig. 4, which refers to obsolete methods of handling.

Fig. 6 refers to project No. 8 and is typical of the results secured with screened aggregates. It is neither the worst nor the best case noted in 1920.

A study of these data further substantiates our opinion that it is possible to make concrete with as uniform composition from unscreened as from screened aggregates. However, all gravel deposits are not suitable for use as unscreened gravel. In practice, before the use of pit-run gravel is authorized, the Highway Commission engineers assure themselves by thorough investigation that the deposit is capable of producing reasonably uniform and high quality material. These 1920 observations with respect to sieve analyses are also corroborated by similar data accumulated in 1921, in the construction of 140 miles of pavement.

TABLE I WEAR TESTS OF CONCRETE TAKEN FROM PAVEMENT CONSTRUCTED IN 1920

Age of Specimens about six months

| Project Number | No. Specimens Tested | Wear in Inches | Project Number | No. Specimens Tested | Wear in Inches |
|---|---|---|---|---|---|
| 1 | 64 | 0.40 | 7 | 28 | 0.43 |
| 2 | 22 | 0.47 | 8 | 12 | 0.45 |
| 3 | 16 | 0.45 | 9 | 18 | 0.39 |
| 4a | 26 | 0.37 | 10 | 33 | 0.42 |
| 4b | 28 | 0.51 | 11 | 32 | 0.41 |
| 5 | 41 | 0.46 | 12 | 21 | 0.39 |
| 6 | 6 | 0.43 | | | |

*Wear Tests.*—The results of wear tests are given in Table I. The specimens were tested in a Talbot-Jones rattler, according to the method used by the Structural Materials Research Laboratory at Lewis Institute. The result of this test is reported in inches of wear, which is the average depth worn off of the specimen. Inspection of these data corroborates the general conclusion that there is a reasonable uniformity in results on the various jobs. Such a wide variation in conditions is represented that no refined comparisons can be made on the basis of the average depth of wear. Visual examination of the blocks is more illuminating. While the average depth of wear is very nearly the same for the different mixtures, it is seen that those concretes having a high ratio of sand to coarse aggregate, show a much more uniform wear than those concretes containing more coarse aggregate. The exact significance of this test with respect to the durability of the pavement has not been defined and thus far we have only used these tests as corroborative of our general conclusion with respect to the use of heavily sanded mixtures.

Fig. 7 shows the appearance, after the wear test, of specimens from five jobs typical of the two classes of proportions.

In view of the experience recorded, the Iowa Highway Commission has based the standard specifications for single-course concrete upon the assumption that, it is possible so to design and construct concrete pavements with varying cement, sand, and coarse aggregate contents, that the results will be in as close agreement as may be expected from the arbitrary mixtures in common use. Furthermore, the more heavily sanded mixtures have at least two quite important advantages:

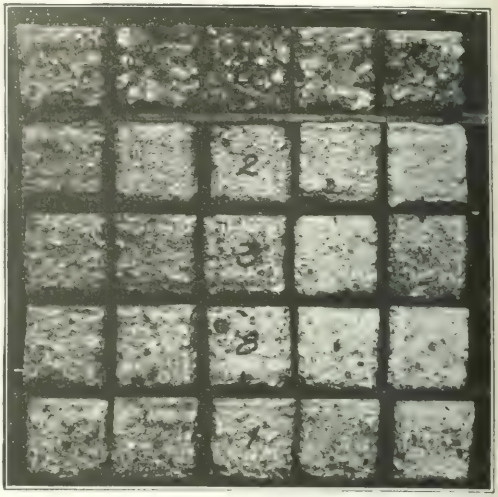



FIG. 7. TYPICAL APPEARANCE OF SPECIMENS SUBJECTED TO TALBOT-JONES WEAR TEST

1. It is quite generally accepted that if the voids in the coarse aggregate are more than filled by the cement and sand mortar, the internal grading of the coarse aggregate will have little effect upon the strength of the concrete. Such being the case with the mixtures under discussion makes it possible to use certain aggregates which might not be suitable for use in the more common mixes.

2. In proportioning mixes of high sand to coarse aggregate ratio, the amount of the cement should be based upon the maximum amount of sand to be expected, then, when the amount of sand at times becomes less, the high ratio of cement to sand will more than compensate for the variation. For instance if the proportion be based upon 70 per cent sand and the percentage of sand falls to 60, the mix would have more cement than the 60 per cent of sand requires, and the variation would not be at the expense of the strength of the concrete. As shown by the sieve analyses, considerable variation is to be expected. Mixes, such as the usual 1:2:4, which are intended just to fill the voids in the coarse aggregate do not provide any such factor of safety and most of the variation is, therefore, more serious.

A most important factor in the successful use of unusual and varying mixes is the careful and accurate control of all of the details of construction. This requires two full time inspectors upon the job in addition to the inspection and tests made upon each unit of shipment by the material inspection force. One inspector is constantly on duty at the measuring and proportioning station and the other supervises the placing and curing of the concrete.

## Exports of Road-Making Equipment

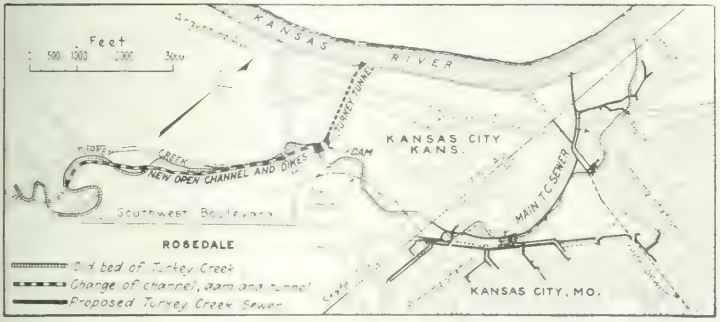
Road-making machinery to the value of $73,108 was exported during September. This shows a slight increase over exports of September of 1920 when the value of such machinery exported was given as $67,160. The figures are those compiled by the Department of Commerce.

# Turkey Creek Sewer One of the Largest Yet Built

## Relation of Sewer to Other Features, Contractual and Engineering, in Flood Control Problem of Kansas City—Design Data Given of 17 x 18-Ft. Double-Box Section Under Pressure

By Alfred D. Ludlow
Chief Engineer, Kansas City, Mo.

THE Turkey Creek sewer is the last step in a large flood protection scheme in Kansas City, Mo., which includes the Kaw River levees and the Turkey Creek tunnel. After many years of agitation the flood protection problem is well on the way toward solution. The engineering features consist mainly of diversion and sewer structures to carry off flood waters originating on the Turkey Creek drainage area, but not until these were constructed could the back water from the Kaw River be kept out of the lower parts of the city. The political boundary situation was involved almost inextricably because of the winding of the stream across state and municipal boundaries, to say nothing of the necessity of adjudicating and assessing benefits so that adequate funds could be raised. In this article the political boundary situation is outlined briefly, the engineering problem is stated and the design of the Turkey Creek sewer, which is one of the largest capacity structures of its kind yet built, is described.




TURKEY CREEK SEWER DRAINAGE DISTRICT

In 1903 Kansas City was visited by a disastrous flood which inundated a large area on both sides of the state line and caused damage estimated as high as $22,000,000. The damage was caused mainly by the waters of the Kaw or Kansas River, which flows into the Missouri River at the intersection of the Missouri and Kansas state line with the latter stream. As a result of this flood, and another of much smaller magnitude in 1904, the Kaw Valley Drainage Board was created by the Kansas Legislature and a drainage district formed in Wyandotte County, Kan., to pay for widening, dredging and diking the river. This work has been practically completed and the lands which were flooded in 1903 are now believed to be safe from a flood of even greater magnitude, except at the mouth of Turkey Creek, across which the dike could not be constructed until the creek was diverted.

Turkey Creek, which heads in Johnson County, Kan., a few miles south and west of Kansas City, Mo., and drains an area of about 25 miles, enters Missouri near the intersection of 30th St. (produced) and the state line, flows in a northerly direction and crosses the line into Kansas again at a point just south of 19th St. in Kansas City, Mo., and about 100 ft. from the Kaw River, into which it empties. In ordinary times the flow in Turkey Creek is very small except for the sewage which it receives from Rosedale and Kansas City, Mo., for which it serves as an outlet for a number of sewers, the largest of which is the O.K. Creek sewer in Kansas City, Mo., which is a double-box reinforced-concrete sewer each side of which is 16 ft. in height by 15 ft. 8 in. in width at the outlet and which has a capacity of 7,436 cubic feet per second.

Due to encroachment on the channel of Turkey Creek by various property owners and railroads, and the construction of several pile piers in the stream, the channel has been so restricted that it cannot carry off the water in times of excessive rains. This has caused the flooding every few years of a considerable area of business and residence property along the Southwest Boulevard in Kansas City, Mo., near the state line. To relieve this condition a diversion tunnel has recently been completed under Greystone Heights in Kansas City, Kan., and the entire flow of the creek turned through the tunnel, leaving only the portion of the creek north of Mill St., in Rosedale, to be taken care of to make possible the construction of the dike across the mouth of the creek. Previous to June, 1916, at which time the writer was appointed engineer of sewers of Kansas City, Mo., contracts had been entered into with various railroad companies and the Kansas City Stock Yards Co., whereby these companies had contributed to the cost of construction of the Turkey Creek tunnel in proportion to the area of their lands that would be reclaimed by the construction of the Turkey Creek sewer, and Kansas City, Mo., had agreed to complete the construction of the sewer within two years after the completion of the tunnel.

Soon after taking charge of the department the writer began studying the Turkey Creek sewer problem. Considerable time had been devoted to this problem by other engineers and a contract had been entered into with the Kaw Valley Drainage Board providing for the construction of the sewer with an outlet into the Kaw River at the mouth of Turkey Creek. The route of the sewer, as shown on the plan attached to the contract with the Kaw Valley Drainage Board, followed very closely the route of Turkey Creek from 25th St. to the Kaw River and for a considerable portion of the distance between 23d St., and the Kaw River followed the route of the proposed 23d St. viaduct, now under construction. This route was several hundred feet longer than the route finally adopted and the difficulties of construction were much greater on account of the necessity of taking care of the flow of the creek which, north

of 25th St., served as an outlet to the Kaw River for the O.K. Creek sewer previously mentioned, and also on account of the sewer being for several hundred feet under the 23d St. viaduct, which it was expected would be completed before the sewer was constructed. Finally, a more favorable contract with the Kaw Valley Drainage Board was obtained which permitted the construction of the sewer on the route shown on the accompanying general plan. A contract had also been entered into with Rosedale, Kan., whereby it had agreed to extend the construction of the proposed sewer west of the state line and remodel a portion of its sewer system to conform to the work to be done by Kansas City, Missouri.

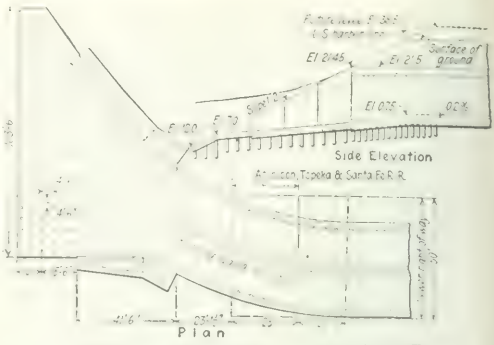
Since the land along the route of the sewer and for a considerable distance on each side is below the elevation of extreme high water in the Kaw River it was necessary to design the main sewer as a pressure sewer and to construct, or reconstruct, the various laterals so that they would act as pressure sewers or go through a pumping station where in times of high water in the river the laterals could be shut off from the main sewer by means of sluice gates and the storm water and sanitary sewage be pumped into the main sewer.

The contract between Rosedale, Kan., and Kansas City, Mo., previously referred to, provided that all lands below El. 40, Kansas City, Mo., datum should be protected from overflow. This necessitated the closing of all openings into the lateral sewers below that elevation or diverting the sewers through several pumping stations.

The elevation of the levee at the mouth of the sewer at the present time is 32 but it is proposed to raise it to 38.5 as soon as the necessary funds are available.

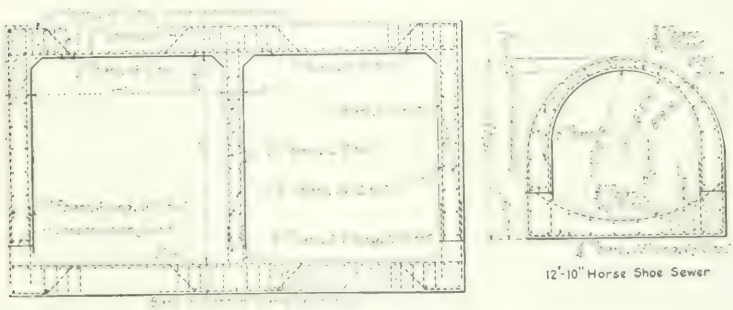
The main sewer, from its outlet to a point just south of 25th St., where the O.K. Creek extension comes in, a distance of 1,860 ft., will be a double reinforced-concrete box each unit of which will be 17 ft. wide and 18 ft. high. From this point south the main sewer will have a horseshoe section, there being 2,340 ft. of 12-ft. 10-in., 1,384 ft. of 11-ft. 4-in. and 1,017 ft. of 7-ft., or a total length of the main sewer of 6,600 ft. There will also be 28,000 ft. of laterals and connections ranging in size from an 8-in. vitrified pipe to a double 15-ft.-8-in. by 16-ft. reinforced-concrete box sewer.

The entire length of the main sewer and a considerable portion of the larger laterals will be under existing railroad tracks or so located that tracks may be constructed over them at any point. For this reason it was thought necessary to provide for a railroad loading at all points. The following data were used in making the design:



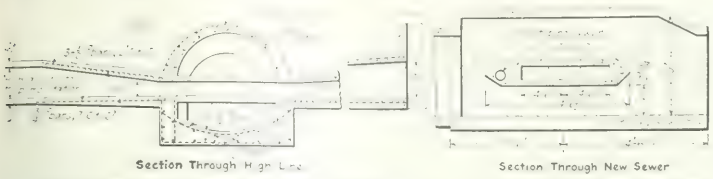

OUTFALL STRUCTURE AT KANSAS RIVER

*Design Assumptions for Double-Box Section.*—The top and bottom were each assumed to act as a continuous beam of two spans. Earth was taken at 100 lb. per cubic foot and concrete at 150 lb. For live load a Cooper's class E-60 engine was used. The depth of fill over the top of sewer was assumed to be 12 ft. For the live load a transverse distribution at a slope of ¼ to 1 was assumed. The unit live load was obtained by use of the formula $W_L = \frac{12{,}000}{8 + \frac{H}{2}}$, $H$ being 12 ft., as stated above. The final unit loadings were as follows: earth 1,200 lb. per square foot; concrete, 450 lb., live load, 860 lb.; total, 2,510 lb. The moment factor used was 1/10; unit fiber stresses, $f_c =$ 650 lb. and $f_s =$ 16,000 lb. Side walls were computed as a simple beam using the above loading and assuming the horizontal pressure to be one-third of the vertical. The moment factor used was ⅓. The center wall was designed as a simple column. The effect of bursting pressure due to a head of water 15 ft. above the top of the sewer was considered for all parts of the structure and steel placed in the outer plane of the side walls to care for this internal pressure. Shear was duly considered and stirrups provided where needed. The box section of the main sewer will have a foundation of clean fine sand and it is believed no foundation piles will be needed except for the outfall structure. Preliminary excavations made to a depth considerably below the proposed bottom of the sewer and just inside of the levee showed that this sand carries no water whatever. Subsequent construction bore out this observation. The horseshoe-shaped section of the main sewer, being for nearly its entire length in the bed of Turkey Creek, and also the extreme east end of the O.K. Creek sewer extension, will require pile foundations.




SECTIONS OF DOUBLE BOX AND HORSE SHOE SEWERS

Openings are provided through the middle wall of the double-box sections to equalize the flow in the two chambers at the time of storms. As the bottom of the




INTERNAL SEWER CROSSING AT ROANOKE ROAD AND SOUTHWEST BOULEVARD

openings are 5½ and 6 ft. above the flow line of the sewer no equalizing of the flow will take place until the sewer is running one-third full. Just below the junction of the 12-ft. horseshoe section with the double 17 x 18-ft. box section there are to be four 6 x 6-ft. openings through the middle wall, spaced 6 ft. apart. The openings at other points will be 5 x 6 ft., in groups of three. Openings 2 ft. wide by 6½ ft. high are also to be constructed in the middle wall opposite the pressure manholes so as to make it possible for anyone who is inspecting the sewer to pass from one chamber to the other.

At several points where lateral sewers cross Turkey Creek the barrel of the sewer will be reinforced to act as a beam and will be supported on concrete piers spaced from 14 to 16 ft. on centers.

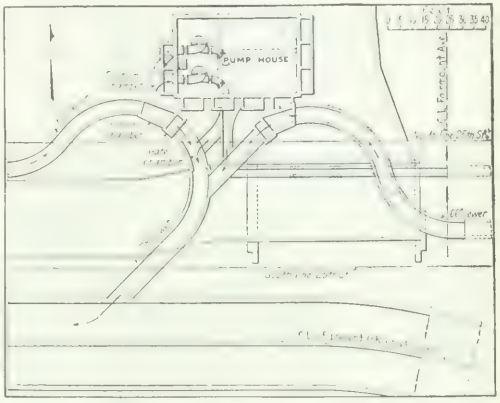
For the run-off factor the writer adopted the one deduced from his investigations in 1912 when designing the O.K. Creek sewer for the Kansas City Terminal Railway Co. (*Engineering Record*, Nov. 2, 1912, page 480.)

The main sewer, O.K. Creek sewer extension and Roanoke sewer were designed for a run-off of 1.5 in., with free discharge on actual grades. With the maximum flood in the river these sewers are good for a run-off of 1 in., using the hydraulic grades. Our investigations failed to reveal any time when the maximum rain has occurred at the time of extreme high water.

The stockyards sewer, which drains a very flat sandy area crossed by many railroad tracks ballasted with crushed rock and cinders, was designed for a run-off of 1 in. All small laterals were designed for a run-off of 2 in., which is the run-off used by Kansas City, Mo., for all short laterals. The total area tributary to the main sewer at the outfall is approximately 5,000 acres.

*Pumping Stations.*—Two pumping stations are to be installed to pump both sanitary sewage and storm water when the main sewer is under pressure or running so full as to cause backwater in the laterals and flood basements. One station will be located on the northwesterly side of the Southwest Boulevard near 28th St. The other station will be located on the north side of 25th St., immediately west of Turkey Creek. In the Southwest Boulevard station two 30-in. vertical, centrifugal pumps, having a capacity of 30,000 gal. per minute each against a maximum head of 30 ft., will handle storm water; one 10-in. centrifugal pump, having a capacity of 2,500 gal. per minute against a maximum head of 32 ft., will handle sanitary sewage. In the 25th St. station there will be two 30-in. vertical centrifugal pumps, having a capacity of 30,000 gal. per minute each against a head of 30 ft., and two 30-in. horizontal, centrifugal pumps having a capacity of 22,000 gal. per minute each against a head of 15 ft. All these pumps are of the volute, double-suction type, motor driven. Except the sump pumps and the sanitary pump in the Southwest Boulevard station, all units will be used only during times of high water in the Kaw River, into which the main sewer will discharge. This will be for only a short period of time each year and some years possibly not at all. The sanitary pump will be operated during times of high water and also during severe storms which will raise the elevation of the water in the main sewer to a point where it would back up in the sanitary sewers, although the water in the river might be below the pumping stage for the storm water pumps. This unit will be provided with an automatic float control and an electrically operated gong which will notify the watchman of the starting of the pump in order that he may close the gate valve on the sanitary sewer. The sluice gates, of which there will be two at the 25th St. station and one at the Southwest Boulevard station, will be operated through bevel gearing and shafting by 5-hp. motors.

A contract for the construction of the work was awarded in August, 1919, to Thomas Kelly & Sons, Inc.,




TWENTY-FIFTH STREET PUMPING STATION

of Winnipeg, Canada, for $2,453,750. As the work is to be paid for in special tax bills against all the taxable property in the drainage area, and there was some doubt as to the validity of the tax bills on account of a portion of the work being in Kansas, a friendly suit was brought to test the validity of the entire proceedings. A decision was rendered by the Supreme Court of Missouri upholding the validity of the proceedings in the summer of 1920 and construction work was started in October of that year.

## Chicago City Drawbridges

Fifty movable highway bridges are maintained by the city of Chicago, the different types being as follows: 24 trunnion bascule bridges, 12 center bearing swing bridges, 12 rolling lift bascule bridges, one vertical lift bridge and one pontoon bridge. Of the trunnion bascule bridges, 22 are of the type developed by the city and the others are of the Strauss and Page & Schnable types. The pontoon bridge is across the Calumet River at Torrence Ave.

# Concrete Grandstand Jacked Up to Allow Enlargement

## Seating Deck Raised 12 Ft. and Capacity Enlarged—Steel Distorted by Fire Straightened or Replaced

By E. Robinson
Engineer, Terry & Tench Co., Inc., New York, City

EARLY in the spring of 1917 there occurred a disastrous fire in the grandstand at the Belmont Park race track, Queens, Long Island, N. Y., which destroyed the entire roof and badly distorted the steel framing. The rear of the seating deck collapsed, together with portions of the mezzanine floor. Work on cleaning up the debris was started immediately after the fire, and a portion of the stand was arranged temporarily so that the spring meeting of 1917 opened according to schedule. Last fall it was decided to increase the seating capacity to 17,500, a feat accomplished in the following manner:

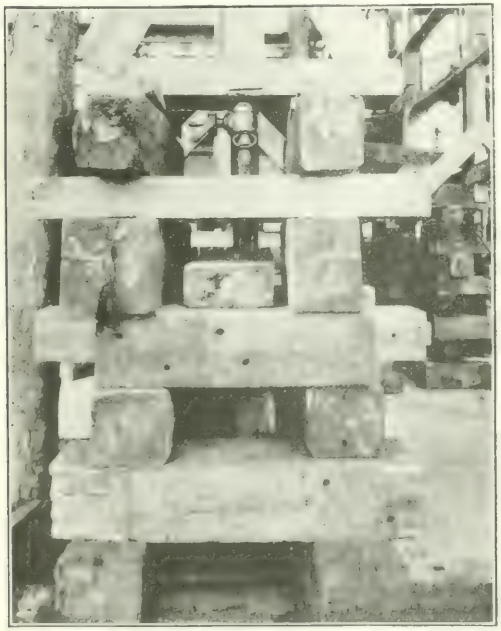
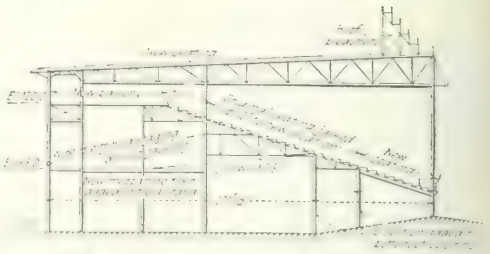


FIG. 1. METHOD OF JACKING AND CRIBBING SHOWING BOTTOM OF INVERTED T-SHORE

The old steel field stand, 125 ft. by 250 ft., which was situated about 250 ft. to the east of the grandstand, was taken down and joined onto the east end of the main grandstand at an angle of 10 deg., with a new connecting bay of 50 ft. inserted between the two stands. First about 25,000 sq.ft. of 3-in. concrete slab in the field stand was removed and all the steel framing marked with assembly marks upon the original erection plan. The original field rivets were burned and cut out and the steel taken down and thoroughly cleaned where rusted and given one good coat of red lead paint. Steel members which were found to be badly pitted were replaced with new material.

To line up the roof it was necessary to erect the old



Section through reconstructed Grand Stand

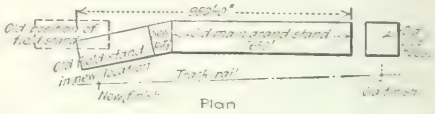



FIG. 2. PLAN AND ELEVATION OF RECONSTRUCTED GRANDSTAND

steel stand on concrete piers 6 ft. high and move up on the columns 6 ft. all the connections of the trusses carrying the seating deck. The roof of the old steel stand was carried out in front 21 ft. on a cantilever by adding new trusses and reinforcing others taking added stresses. It was found that the front columns were adequate to take the increased load, so replacement of those members was not necessary.

To add new seating in front of the existing seating area and to improve the line of vision in the combined stand it was found necessary to raise the existing seating area up a distance of 12 ft. above the original level. This was done by jacking and cribbing. The old grandstand was 650 ft. long and the seating area 52 ft. wide, being composed of steel trusses with a 3-in. concrete slab in steps of 1-ft. rise to 3-ft. tread, and weighing about 850 tons. This area was cut into three sections and jacked up to the new level by using fifty-seven ball-bearing screw jacks of a capacity of 15 tons each.

*Jacking Operations.*—The cribbing was built up around the jack with 10 x 10-in. timbers inverted to make a "T"-shore as shown in an accompanying photograph. The average distance jacked per day was about 12 in. When the staging had been raised a distance of 4 ft., a temporary shore was placed under the load and the cribbing was taken down. Then, after a 4-ft. piece had been spliced to the shore, the jacking operations were resumed until the next 4-ft. level was reached. Then again cribbing was taken down, the shore spliced, and the jack started from the base level. This method of changing shores was economical of cribbing and maintained the jack close to the ground. At each point where the shoring was spliced a longitudinal brace was placed consisting of two planks, each 2 x 10 in. in a "T" form and tied to the column with a sliding yoke brace. The columns were spaced 16 ft. 8 in. in a longitudinal direction.

Jacking of this large area of concrete surface 3 in. thick was accomplished without any damage to the concrete from cracking or from other causes, and progressed without any interruption or delay. Extreme care was taken that all parts jacked were kept in a level plane. Very little effort was necessary to operate the jacks.

When the jacking was first started the staging was

allowed to sag away from the columns about 1 in., being tied back securely to the rear of the stand with ⅜-in. wire cable and turnbuckles. This was done in order to clear the rivet heads of the columns, the cables being carefully watched and properly adjusted at all times. In addition to the back ties, the section being jacked was anchored at each end and crossbraced with ½-in. wire cable with turnbuckles. Each night before quitting time the load was released from all jacks by wooden wedges being driven hard up on top of the cribbing.

FIG. 3. ONE OF THE TWISTED STEEL COLUMNS WHICH WAS REPLACED

All through the stand were found steel members which were badly twisted and bent from the fire of 1917. All the old steelwork was carefully inspected. Top chords of trusses were buckled in places as much as 6 to 8 in. in sharp kinks, and columns which stood up and carried loads were found to have sharp buckles where the plates and angles bent together 5 in. out of line in a 2-ft. length of column. A large number of trusses were taken out and replaced, and where only top or bottom chords were damaged the load was taken off the truss was cut off the west end, moved along the roof and joined onto the east end of the bleachers, this bringing it on top of the new bay and a portion of the reconstructed steel span. The moving of these bleachers and the arranging of the east end of the grandstand into boxes and inclosures for members of the club were required by the reversing of the direction of running the races, so that now the inside of the track is to the left of the horses.

The work was under the personal direction of Maj. August Belmont, president, and Joseph E. Widener, of the Westchester Racing Association, and Charles W. Leavitt, architect. The American Bridge Co. fabricated the steel. The general contractors on the work were the Terry & Tench Co., Inc.

## Pure Iron in Early American Bridge

By D. M. Strickland
Research Dept., American Rolling Mill Co., Middletown, Ohio

In 1835 a wrought-iron arch bridge was erected between Brownsville and Bridgeport, Pa., near Pittsburgh, which has remained in service to the present day. It is in excellent condition from a corrosion-resistance standpoint. A local history published in 1903 by a Mr. Hart not only gives its date of construction as cited but also states that it is the first structural iron bridge built in America. The bridge is of special interest for this reason. The fact that the iron has withstood the corrosive elements for more than 85 years has attracted much attention and led to a chemical investigation of it.

Recently the author had the opportunity to analyze a sample taken from this structure and found the old iron

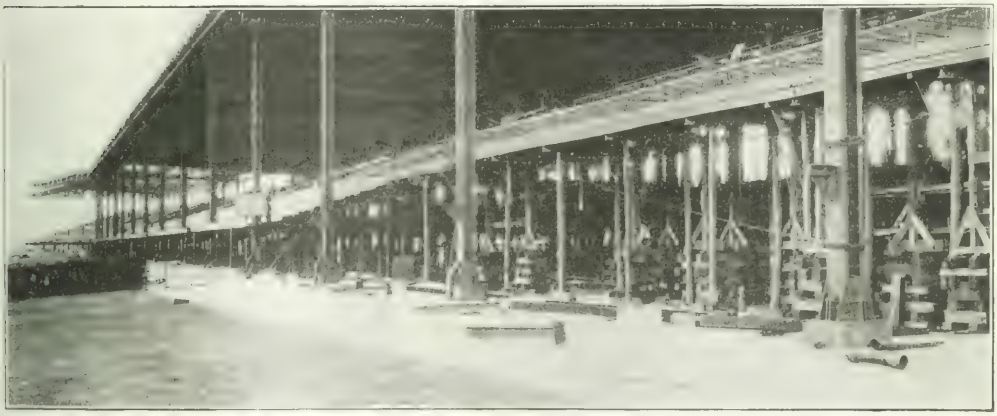


FIG. 4. SEATING AREA JACKED AT FULL HEIGHT—PART OF STEEL FOR ADDITIONAL SEATING AREA IN PLACE

and new material used. All punching was done on the job from plain material cut to fit. Columns which were badly kinked were cut out at the underside of the roof connection and just above the mezzanine floor, and new sections of a length of 20 ft. were spliced in.

In providing for the increased seating capacity ten new ramps were constructed. These ramps were 16 ft. wide and about 50 ft. long running from the center of the seating area to the rear. On the roof there was originally located a steel and concrete frame bleacher stand 600 ft. long. A length of this span 200 ft. long

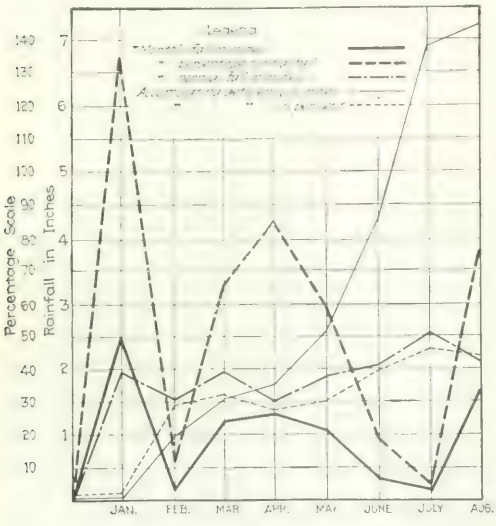
to be nearly as pure as the rust-resisting, commercially pure iron manufactured in openhearth furnaces at the present day. The analysis showed Si 0.05 per cent, S 0.025, P 0.200, C 0.037, Mn 0.003, Cu trace, N 0.006 per cent. This is a truly remarkable purity, considering the older inadequate manufacturing methods and lack of metallurgical and chemical control.

The iron of this historic bridge was manufactured in the town itself. It was made in the plant of John Snowden, an immigrant from England. His first forge and mill were built in 1824.

## The Drought in the British Isles

(London Correspondence)

FROM the beginning of February to the end of September there were over 170 rainless days in England, and the country had received less than 60 per cent of its normal rainfall. In London only 8.32 in. of rain fell between Jan. 1 and Aug. 31, which is only 56 per cent of the average rainfall. The monthly falls in London, with their percentages of the normal, are shown by the chart. Indeed, so severe has been




RAINFALL AT LONDON, ENGLAND, IN 1921

the drought that England has this year bordered on the conditions found in semi-arid lands where the normal annual rainfall is between 10 and 20 in. These conditions have, however, not been uniform throughout the British Isles. In Scotland, the rainfall has kept around the normal, and, at the end of September, Scotland had an excess of 1.5 in. Ireland finished up in September 4.5 in. short, while England was nearly 9 in. below the normal fall.

Should England receive its normal fall during October, November and December, the economy measures put into operation in London and the other large cities will still be necessary.

In London, where the water supply is derived from the Thames, its tributary the Lea and a number of deep chalk wells, the Thames Conservancy and the Metropolitan Water Board have been hard put to it to ensure adequate supplies from the Thames and its reaches without involving any hazard to navigation. The Metropolitan Water Board has economized to the extent of 20 m. Imp. g.d., but appeals to the public are still being made and prosecutions and fines follow water waste, such as watering gardens or washing down automobiles with hose.

Construction has been begun on a new reservoir for London to hold 7,500,000,000 Imp. gal., but owing to the war and to government control this project had to be postponed. It was due for completion last year and will now be ready by 1923. London will be short of water until the Thames is replenished, since this river is its chief source of supply and long and heavy falls are necessary before the river returns to normal condition.

The other large cities have suffered to a greater or less extent. Those cities in northern England, such as Manchester and Newcastle, have been short but not to the same extent as the south of England where the drought has been most serious. Manchester, for instance, which has the reputation of being the wettest town in England, derives its supply from Thirlmere in the English Lake district. The dam here conserves 8,000,000,000 Imp. gal. of water for conveyance to Manchester about 90 miles away.

The Liverpool supply is obtained from Lake Uyrnwy in Wales, 68 miles away, and here the shortage has been badly felt, for Cardiff up to Aug. 31 had only 15.41 in. of rain, which is 57 per cent of the normal.

The Midlands are supplied from valleys in the Peak District of Derbyshire, except Birmingham, which obtains its water from the Elan valley in south Wales. Several cities have been very badly hit by the drought. In Bath, for instance, the springs are only giving 742 Imp. gal. a minute, against a normal of 1,300 gal. Here the water supply is cut off for 16 hours out of the 24 so as to conserve the springs as far as possible. The Revesby reservoir which supplies Boston is dry, and 22,000 Imp. gal. of drinking water are daily distributed in the streets at a cost of £200 per week. Many other cities, Brighton for instance, have their supplies cut off for 12 hours every day.

### Survey of Underground Supplies

A geological survey has just been made of the underground water supplies of the counties of Buckinghamshire and Hertfordshire which afford much of the well water for London. In these counties the supplies derived from superficial gravels, and sandy beds of the lower tertiaries, are really insignificant, the main source being the chalk which has only one rival in Britain, that being the new red sandstone in the Midlands. The chalk formation here, while it may be regarded as homogeneous, from the point of view of water supply, possesses local differences which give rise to a certain amount of distinction between waters of the upper, middle and lower chalks. The results of this survey have shown that the water is derived from the joints and bedding planes rather than from the chalk mass, and that boring saturated chalk is of little use for pumping where there is an absence of fissures. A new survey is investigating this point and should be of great assistance to engineers in estimating the proportion of rainfall which can be expected to accumulate in any specific catchment area.

Such an unusual occurrence in Britain as a drought has prompted the Ministry of Health to collect particulars of the supplies of potable water in England and Wales, and to call attention to the advisability of taking advantage of the drought to ascertain the minimum available resources under exceptional weather conditions.

The drought has served to stimulate interest in water supply, in which branch development is badly behindhand. Had reliable data been available before the present drought it would have saved considerable sums of money which have been spent on elaborate supply schemes which have not been justified by results.

## Combating Electrolysis in Water Pipe Systems

IN A paper entitled "Discussion of the Causes and Prevention of Electrolysis Troubles in Underground Pipe Structures" presented at the recent convention of the California Section, American Water Works Association, E. B. Stewart reviewed experiences of the East Bay Water Co., of Oakland, Cal., for which company he is electrical engineer. The paper touches upon three methods ordinarily used in combating electrolysis namely, surface insulation, drainage systems and insulation joints. The first of these was not considered important. Extracts from the paper dealing with the other two methods follow:

A drainage system for conducting electricity away from pipes by connecting them to rails or negative buses can be used to advantage under certain conditions as a secondary means of lessening electrolysis, but the installation of such a system as a principal means of electrolysis mitigation in a large city is unwise. In suburban areas where the pipe networks are small, a limited drainage system may offer the best means of dealing with the electrolysis problem, provided there is no appreciable leakage of current from the rails at points remote from the power station.

If the drainage system is used where the pipe network is steadily increasing the load continually increases, more and heavier bonds become necessary, and the current in the pipe finally becomes so great that any further extension of drainage would be a menace to the system. The placing of additional bonds between pipes transfers the trouble from where it has been most evident to a new location where it may require some time to manifest itself anew. Hence the intervening lull creates a favorable impression and has made the drainage system popular.

### Danger of Bonding to Rails

Bonding to the rails at points remote from the power station should not be permitted. The disadvantage of such connections is illustrated by the following citation of experience in Oakland. At a point 2,900 ft. from the power house, indicating meter tests showed the pipe to be of positive potential to the rail and at the point where the pipe line crossed beneath the rails a connection was put in to lower this potential. In making the meter tests no account was taken of the potential of the rails with respect to the earth or to the likelihood of reversal of current flow from rails to the pipe during certain changes in the load distribution. The result was that while the bond between pipe and rail removed the discharge of current from the pipe to the rails, the pipe was still positive to the earth and a heavy discharge of current over the bond and into the earth took place, causing rapid deterioriation of the pipe near the point where the connection was made.

The safest and most economical plan for cases of this sort would be to enclose the pipe in a wooden conduit packed with insulating compound. This method is expensive, but serves the dual purpose of insulation at the point and reducing the amount of current that will accumulate on the pipe in outlying areas.

Pipes are often damaged on streets where there are no car tracks. In one case, where a number of services were found to be leaking, investigation showed that a cable conduit passed directly beneath them. The services were one-tenth of a volt positive to the cables. In this case the soil was wet clay and the nearness of the pipe to the conduit made up for the comparatively low potential. This illustrates the necessity for conducting tests between pipes and underground cable systems. In laying service pipes, cable conduits should be avoided even more than street car tracks. This is much more important in wet clay than in sandy soil.

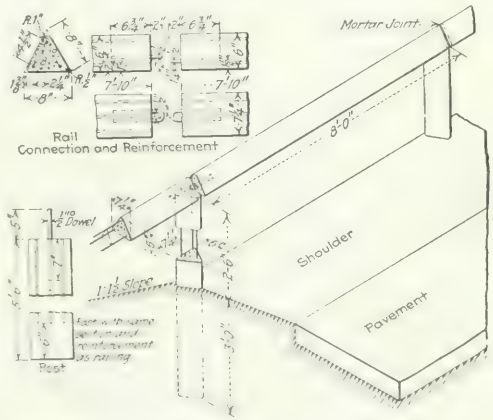
The most valuable means of mitigating electrolysis troubles lies in the proper use of insulating joints and the extensive use of such joints should be encouraged in new work and in making repairs. The objection to their use and the danger to be guarded against is a combination of conditions that will permit the current to shunt around the joint and cause destruction of the pipe on the positive side of the shunt. The kind of joints best suited to certain conditions, their spacing and complications arising from the nearness of other pipe systems not so insulated are all important factors that must be taken into consideration to secure adequate protection.

As a general rule, when a pipe line is laid with an insulating joint at every fourth or fifth length of pipe, the line has such a high electrical resistance that no measurable current will flow in it, even though considerable current is flowing parallel in the earth nearby. On wrought iron and steel pipes it has been found necessary to increase the efficiency of the joint by surrounding both joint and pipe with a wood box packed with insulating compound. The advisable length of such boxes will depend upon the resistance and amount of current in the earth. Although the box does not materially increase resistance, it gives a more even distribution of leakage current and is therefore a considerable advantage when the resistance of the surrounding soil is very low.

For the Oakland system the flanged type of insulating joints has been found the most desirable and economical for use on wrought iron and steel pipes. This joint is made up of a disc of red or gray fiber between the surfaces of the flanges, and washers of the same material under heads and nuts of the bolts. For pipe with bell-and-spigot joints a short wooden ring is used between the inside of the bell and the end of the spigot to prevent metallic contact and the joint is then calked with cement.

## Inexpensive Concrete Guard Rail

A REINFORCED concrete guard rail, which simplifies the problem of precasting and is easy to erect, is being employed this season by L. D. Brownell, division engineer, where wood guard rail has to be replaced in the Fourth Division, New York States Highways. The




REINFORCED CONCRETE GUARD RAIL, N. Y. STATE HIGHWAYS

post and rail are of the same section, as is indicated by the illustration, so that a single V-trough mold serves for both. In casting the rail, the stirrups, which hook over the dowel pin in the post, are given sufficient length to take up slight variations in spacing the posts. A mortar joint, carefully pointed, protects the metal parts of the connection and gives the rail a neat paneled appearance. As installed this year the railing has cost about a dollar a lineal foot.

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## A Comprehensive Treatise on Columns

REVIEWED BY FRANCIS P. WHITMER
Consulting Engineer, New York City

COLUMNS. A Treatise on the Strength and Design of Compression Members—By E. H. Salmon, D. Sc. (Engineering) London, Assoc. M. Inst. C. E. From a Thesis Approved for the Degree of Doctor of Science (Engineering), in the University of London. London: Henry Frowde and Hodder & Stoughton. Cloth; 6 x 9 in., pp. 279, illustrated. 31 6 net, postage 1s. extra.

This remarkably comprehensive treatise, comprehensive in the historical, theoretical and experimental aspects, is divided into three parts: a 16-page bibliography, and sections devoted to the "analytical" and "synthetical" aspects of the subject.

The bibliography covers nearly 400 references, arranged chronologically, to work of European and American investigators over a period from 1729 to 1920. It is so complete that the omission of Prof. S. W. Robinson's paper, "Strength of Wrought-Iron Bridge Members," (Van Nostrand Science Series, 1882) attracts notice. This valuable little work develops a general method for the solution of problems in combined bending and direct stress, solving a number of special cases, only two of which are presented by Dr. Salmon.

Chapter I of Part II, "Analytical," develops a series of general expressions for a flexed column, which are applied first to a round-ended "ideal column" and then in turn to round-ended columns with initial curvature, initial eccentricity and variable modulus of elasticity, finally combining all three conditions in what is termed an "ordinary column." A similar treatment is then accorded columns with end-fixing moments, with flat ends, and with one round end and one fixed end.

Chapter II, on "Lattice-Braced Columns," develops expressions for stresses in the flanges, taking into account various bending conditions introduced by the latticing. No expressions are derived for shearing forces which, at first, is rather surprising, until it is discovered that in the synthetical section the efforts of Engesser, Keelhof, Jansen and others to evaluate the shear are very fully presented, and followed by an interesting analysis by the author. A foot-note reference to this material, as given in Part III, would relieve some anxiety in the mind of the reader while perusing Chapter II.

The closing section of Part II, which presents two cases of columns with lateral loads, would have been improved by the inclusion of additional combinations of loading, such as are sometimes encountered in the design of heavy derrick booms and the like.

As a general comment, it may be said that the analytical work would have lost none of its practical value and its somewhat forbidding aspect would have been relieved if the analyses had generally terminated with the derivation of the maximum column deflection, instead of being developed into expressions for resultant fiber stress. Moreover, the practical value of many of the simplified expressions for fiber stress is lost by reason of the author's assumption of a minimum factor of safety of 4 as compared with the ultimate load given by Euler's formula. This factor is much higher than that corresponding to any of the formulas used in current American practice.

Part III, "Synthetical," comprises an exhaustive compilation of the theoretical and experimental work of the last two centuries, logically presented and ably discussed. Practically every known type of column formula and every reported column test receives attention. The many difficulties in the way of a practical formula with a purely theoretical basis are emphasized, and the conclusion is reached that some type of empiric formula in agreement with experiment is the best to adopt, preference being finally expressed for the Johnson parabola tangent to Euler's curve. Among matters demanding attention in future research is mentioned "the degree of imperfection common in practical direction-fixed ends," involving the problem of secondary stresses as affecting the deflection curve of columns in a framed structure, undoubtedly a vital obstacle to a satisfactory theoretical consideration of columns as encountered in practice.

The notation and the analytical methods employed in the book are very logical and clear. The typography and the figures are satisfying and quite free from important errors. On the whole, the book is perhaps the most complete work upon the subject of columns in all its aspects that has yet appeared, and seems to leave but little unsaid.

## Light on the Problem of Social Justice

THE UNSOLVED RIDDLE OF SOCIAL JUSTICE—By Stephen Leacock, B. A., Ph. D., Litt. D., F.R.S.C., Professor of Political Economy at McGill University, Montreal. New York and London: John Lane Company, Toronto: S. B. Gundy. Cloth; 5 x 7 in.; pp. 152; $1.25.

Unsolved though Prof. Leacock leaves the riddle of social justice at the close of his brilliant analysis, he does not fail to throw much bright light on its complexities and on the involved reactions that follow from any and all attempts at a solution that have ever yet been tried. Better yet, he offers concrete suggestions of wide appeal.

Skillfully the author shows the fallacies of the *laissez faire* and associated doctrines on the one hand and of socialism on the other. Either way lies disaster. High praise is given to Bellamy's "Looking Backward" as one of the best conceptions of the ideal socialistic state but it, like all other Utopias, will not stand the human work-a-day test. Progress lies along the line of still further social control, with opportunity opened to every child, employment aids for adults, an extension of the minimum wage and of shorter hours movements, and wise control of land speculation and other sorts of profiteering. Just how these principles and practices are to be extended the author cannot reasonably be expected to say in so short an essay and in view of all the uncertainties. In the main, progress must come through experience.

Those who do not know of Prof. Leacock's grasp of political economy and his literary ability can learn much of both to their profit from an hour or two spent in reading this stimulating volume.

## The F. A. E. Survey of Waste in Industry

WASTE IN INDUSTRY—By the Committee on Elimination of Waste In Industry of the Federated American Engineering Societies. Washington, D. C. New York: McGraw-Hill Book Co. Cloth; 6x 9 in.; pp. 409. $4.

To make in a short time a survey that might afford a stimulus to industrial and commercial leaders, labor organizations and government officials, to attack anew and vigorously the elimination of industrial wastes, was the first large proposal made to the American Engineering Council by Herbert Hoover when he become its chairman. The task was brought to a conclusion in five months, and the complete report appears under the title, "Waste in Industry."

In the original plan the survey of ten industries was contemplated. This number had to be reduced to six: Building construction, men's ready-made clothing, boot and shoe, printing, metal trades and textile. Studies in transportation and bituminous coal mining were made but were not completed in time to be included in the report; the same is true of a regional survey of the industries of the city of Worcester.

The material gathered is presented in three parts: (1) A summary of the detailed reports; (2) six chapters, each of which consists of the engineer's report on one industry; (3) seven chapters of general reports, dealing with unemployment, strikes and lockouts, legal machinery for adjusting disputes, industrial accidents, health of industrial workers, eye conservation, and purchasing and sales policies.

It was the expectation when the survey was undertaken that its results could be expressed in a relatively few figures which would indicate the magnitude of our industrial wastes, or at least those of the particular industries surveyed. In fact, the plan was based on the assumption that by taking representative plants the results could be multiplied by factors representing the proportion which the whole industry bore to the plants surveyed and totals thus arrived at with some show of justification. He who approaches the completed report in the expectation of finding these quantitative indexes will be disappointed. No such composite figures are presented.

This does not mean, however, that the report is without value. In fact, it has very decided value and should stimulate efforts in wide circles to reduce industrial waste. And this is true not only as applied to those engaged in the industries assayed but to all who have contact with industry of any kind.

The value lies in the presentation of a method of industrial assay that can be rather easily applied to any industry; in the qualitative conclusions, i.e., in the definite classification of wastes and indication of the corresponding methods of elimination; in the quantitative results in certain industries, which results in general terms are transferable to other industries; and finally, in the stimulating character of both the specific industry and the general reports.

The method of assay consisted in obtaining by personal investigation by competent specialists the answers to 260 leading questions, falling into 58 main topics, which in turn were classified under three main heads—wastes in organization, including the human factor; wastes through deficiencies in technical knowledge, which was taken to embrace the physical factors (plant, equipment, design, etc.); wastes in plant utilization, which was interpreted as covering operations. As to each question subject, also, it was determined what per cent of the waste was due to management, to labor and to outside contracts. Scales were set for the guidance of the inquirers, so that the procedure in all the studies was uniform. The method, while necessarily requiring knowledge and judgment in application, is relatively simple and would help any experienced executive to form a fairly reliable estimate of the extent of his wastes.

The character of the wastes disclosed are classified and discussed under four heads: (1) Low production caused by faulty management of materials, plant, equipment and men. (2) Interrupted production, caused by idle men, idle materials, idle plants and idle equipment. (3) Restricted production, intentionally caused by owners, management and labor. (4) Lost production caused by ill health, physical defects and industrial accidents. Under each of these heads there are quantitative citations of losses in given industries, the whole conveying a definite impression—even though composite loss figures are not arrived at—of very great waste in our industrial functioning. The industrial manager or worker must be hardened indeed who does not feel quickened by this picture of wastes and the consequent opportunity for savings to individuals and companies and to the whole community.

From the reports on specific industries the same sort of stimulus is derived. The major causes of wastes, are, in most of the reports, clearly disclosed and the corresponding remedies pointed out. Of particular interest to readers of *Engineering News-Record* will be Sanford E. Thompson's report on the building industry, a careful and illuminating inquiry into building wastes. (For abstract thereof see *Engineering News-Record*, July 28, 1921, p. 169.) Mr. Thompson also made the study of the shoe industry, which presents an equally interesting, but naturally materially different situation.

Of the general reports those on unemployment and on health of industrial workers make a strong appeal and will prove well worth the careful reading of those who are concerned with industrial functioning and desire to see its wastes cut down.

All in all, despite the failure to produce composite figures indicative of the magnitude of industrial wastes, either in industry as a whole or in particular branches, American Engineering Council has rendered through this study a valuable public service. The report holds much helpful information as to classes and causes of waste and method of study and elimination.

## Public Health Work in England

THE STORY OF ENGLISH PUBLIC HEALTH—By Sir Malcolm Morris, K. C. V. O.; President of the Institute of Hygiene; Fellow of the Royal Sanitary Institute. (English Public Health Series). New York: Funk & Wagnalls Co. Cloth, 5 x 8 in. pp. 166. $1.50.

Although going back to examples of the "scientific instinct" and of the "new humanity" in much earlier years the author confines himself chiefly to events of the last seventy-five years in this readable and inspiring sketch of the public health movement in Great Britain. The first and short-lived board of health was created in 1848, as a result of somewhat earlier investigations made by Edwin Chadwick and others. The work of this board and its successors, including particularly the Local Government Board and, of very recent origin, the Ministry of Health, is outlined, as are the activities of a number of leaders in public health work. The activities of local health authorities are also sketched. Stress is put upon the part played by sanitarians.

## The Thermal Properties of Concrete

STUDIES ON COOLING OF FRESH CONCRETE IN FREEZING WEATHER—By Tokujiro Yoshida. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 63; illustrated. 30c.

THE THERMAL CONDUCTIVITY AND DIFFUSIVITY OF CONCRETE—By A. P. Carman and R. A. Nelson. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 39; illustrated. 20c.

The two bulletins noted here are unrelated except that they represent somewhat allied experiments made in the same institution.

Prof. Yoshida's "Studies on Cooling of Fresh Concrete in Freezing Weather" is an elaborate investigation of the thermal properties of setting concrete, which includes the establishment of thermal constants, diffusivity, and the ratio of emissivity to the coefficient of thermal conductivity. These sound as though they required a highly scientific intelligence for their understanding. That is a fact. The bulletin is of much more value to the laboratory man and the physicist than it is to the expert concrete worker, although the latter is evidently in the mind of the author. What the author does is to establish the thermal constants of a setting concrete under varying conditions of deposition, mixture, protection, etc., and with them as a basis work out a number of curves by means of which, aided by some elaborate equations, one can ascertain the temperature of a concrete. Knowing the temperature which is required for removal of forms, that is, the strength which concrete will reach under certain temperatures, one can then proceed more inteiligently to the removal of forms. Unfortunately, the data are so elaborately stated that there is great doubt if they will ever be used, in their present form at least, by the actual concrete placer.

The Carman and Nelson investigation is frankly for the physicist, although the values which they determine are required in certain kinds of engineering studies. Their experiments establish certain values for thermal conductivity and thermal diffusivity, which constants have not hitherto been available.

## Equipment for Handling Materials

MATERIAL HANDLING CYCLOPEDIA—A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of Material Handling Machines Employed in Industry—Compiled and Edited by Roy V. Wright, Editor-in-Chief, Managing Editor, Railway Age, and Editor of the Railway Mechanical Engineer, Car Builders' Dictionary and Cyclopedia, and Locomotive Dictionary and Cyclopedia; John G. Little, Managing Editor, Railway Age and Robert C. Augur, Associate Editor. New York: Simmons-Boardman Publishing Co. Cloth; 8 x 12 in.; pp. 846; illustrated. Cloth, $10; leather, $15.

This volume is a super-catalog of materials handling equipment, with an extended glossary or list of definitions. It serves its purpose excellently in text and illustration. There are few devices that are not described or illustrated, and, with the glossary for detail, the user of handling machinery can locate such information he is likely to want. There is no critical discussion.

Part I, of about 140 pp., is composed of definitions presented after the manner of the various "Dictionaries" familiar to engineers and to railway men in particular. Part II is the body of the book, some 540 pp., and describes and illustrates in order hoisting machinery, package-handling conveyors and elevators, loose materials, conveyors and elevators, conveying machinery details, elevators, trackless transportation, industrial rail transportation and handling systems. With a final selected catalog section of about 100 pp., the purpose of the book as a gazetteer of handling equipment is well carried out.

## Concrete Ties

CONCRETE RAILWAY SLEEPERS: Notes compiled by the Technical Section, Indian Railway Board, with an Introductory Note by F. G. Royal-Dawson, M. Inst. C. E., late Chief Engineer with the Railway Board. Calcutta: Superintendent of Government Printing. Paper; 8 x 13 in.; pp. 88; folding plates and other illustrations. Rupees 3, annas 4.

Single-piece ties and ties composed of pairs of rectangular blocks and circular bowls are represented in this publication in a miscellaneous collection of designs tried in numerous countries. Most of the experiments noted have been on a small scale. Much of the information is old, and collected from other publications. Further, it deals more with description than with records of service. Nevertheless, the monograph is of value in bringing together a mass of information for reference and study. One of the interesting features relates to designs for Indian railways. Owing to the extensive use of pots and bowls of cast iron and steel for ties in India it is natural to find similar designs in concrete. Actual experience, however, has been limited. Large drawings are given of some of these designs. No summaries or conclusions are presented, but it is evident that a concrete tie satisfactory for main track service has yet to be developed.

## More New England Rainfall Statistics

In the September Journal of the New England Water Works Association (Tremont Temple, Boston, Mass.; 75c.), X. H. Goodnough, chief engineer, Massachusetts Department of Health, presents New England rainfall statistics for the years 1913 to 1920, supplementary to those given in his paper in the Journal for September, 1915, which came down to the close of 1912. Many new stations have been added since 1912 and some overlooked long-time records have also been included. Data for adjacent parts of Canada and New York are given. Monthly and yearly totals are given by years and averages by months and by years. Elevations of stations are given.

## A Pictorial Industrial Magazine

*Industry Illustrated*, an 11 x 14-in. monthly magazine, has been launched (10c. a number or $1 a year; Engineering Magazine Co., New York City). The editor is John H. Van Deventer, formerly of the *American Machinist*. The reading pages consist almost wholly of halftones, with some text in large type. Among the articles in the first issue are "Inventors Who Have Made It Pay" and "The Passing of the Roustabout; The Mechanics of Moving Materials."

## Power Map of New York Available

The United States Geological Survey has issued a large-scale map of the State of New York showing upon it all of the hydro-electric and steam-electric power stations, and the main transmission lines in the state (Washington, D. C.; 50c.). It is a clear and explicit map, and should be useful to many.

## Fire Protection in Electrical Stations

Thirty-five pages of the October Quarterly of the National Fire Protection Association (87 Milk St., Boston, Mass.) are devoted to an article on Fire Prevention in Electric Power Stations from the Operator's Point of View, by F. A. Allner, general superintendent, Pennsylvania Water & Power Co.

# PUBLICATIONS RECEIVED

ACCIDENT BULLETIN NO. 78 AND 79: Collisions, Derailments, and Other Accidents Resulting in Injury to Persons, Equipment, or Roadbed, Arising from the Operation of Steam Roads Used in Interstate Commerce. (1) October-December, 1920, and Year 1920. (2) January-March, 1921. Bureau of Statistics, Washington, D. C. Paper; 9 x 11 in.; pp. 94 and 190. 5c. per copy or 15c. per year from Superintendent of Documents.

AMERICAN SOCIETY OF CIVIL ENGINEERS: Index to Transactions, Volumes I to LXXXIII (1867 to 1920). Prepared Under the Direction of the Committee on Publications by Elbert M. Chandler, Acting Secretary. New York: The Society. Paper; 6 x 9 in.; pp. 272.
Papers are entered under (1) topics and (2) authors, in each case alphabetically by titles. Well done and useful.

THE AUTOMOBILE INDUSTRY AND ITS FUTURE—By Leonard P. Ayres, Vice-President, the Cleveland Trust Company, Cleveland, Ohio: The Company. Paper; 6 x 9 in.; pp. 32.
An interesting, painstaking analytical study of wide appeal.

BUILDING OFFICIALS CONFERENCE: Proceedings of the Seventh Annual Meeting, April 27-30, 1921. Springfield, Mass.: Fred W. Loomis, Building Commissioner, Secretary. Paper 6 x 9 in.: pp. 75.

DANIEL H. BURNHAM, ARCHITECT, PLANNER OF CITIES—By Charles Moore. In two volumes. Boston and New York: Houghton Mifflin Company. Cloth; 8 x 11 in.; pp. Vol. 1, 260; Vol. 2, 238; Illustrated. $20.

CONTRIBUCION AL ESTUDIO DE LOS RECURSOS HIDRAULICOS PARA FUERZA MOTRIZ EN EL PERU—Por El Inginiero Juan N. Portocarrero C. Contribucion Presentada a la Seccion Vi Del Congreso Nacional de la Industria Minera. Lima, Peru: Imp. Torres Aguirre. Paper; 7 x 9 in.; pp. 64.

THE EDUCATION OF HEALTH OFFICERS—By George C. Whipple, Professor of Sanitary Engineering, Harvard University, Cambridge, Mass. Reprinted from the International Journal of Public Health, Vol. II, Nos. 3 and 4, 1921. The Author. Paper; 7x10 in.; pp. 35.

ELEMENTARY CONCRETE CONSTRUCTION—By Leon H. Baxter, Supervisor of Manual Training, St. Johnsbury, Vt. Milwaukee, Wis.: The Bruce Publishing Company. Cloth; 6 x 9 in.; pp. 101; illustrated. $1.25.
A book of instruction for the manual training student; how to make concrete products and to place concrete, illustrated by photographs of school boys at work.

FOREST EXPERIMENT STATIONS—By Earle H. Clapp, Assistant Forester, Forest Service, Circular 183, Oct. 1921. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 34. 10c. from Superintendent of Documents.

INDUSTRIAL WASTES FROM THE STOCKYARDS AND PACKINGTOWN IN CHICAGO: Report to the Sanitary District of Chicago, January, 1921. Albert W. Dilling, Chief Engineer; Langdon Pearse, Sanitary Engineer. Chicago: The District. Cloth; 6x9 in.; pp. 261.
An abstract of this report on activated-sludge, Imhoff tank, sprinkling filter, screening, and grease recovery tests was printed in *Engineering News-Record*, May 12, 1921, p. 815. Altogether, the tests covered nine years. A preliminary report was published in 1914.

MACHINE DRAWING: A Text and Problem Book for Technical Students and Draftsmen—By Carl L. Svensen, M.E., Assistant Professor of Engineering Drawing in the Ohio State University, Member American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, etc. New York: D. Van Nostrand Company. Cloth; 6 x 9 in.; pp. 214; illustrated. $2.25.

MODERN ROAD BUILDING: Address by R. E. Fishburn, Chairman Pima County, Arizona, Highway Commission, before American Association of Engineers, Tucson, Arizona. Paper; 6 x 8 in.

PRACTICAL BUSINESS METHODS FOR ENGINEERS AND CONTRACTORS AND ARCHITECTS—By Frank R. Walker, Assoc. Am. Soc. C. E. Chicago: 2209 Archer Ave., Frank R. Walker Co.; 8x11 in.; pp. 80.
Forms and methods of construction accounting for contractors, engineers and architects.

PRICE CHANGES AND BUSINESS PROSPECTS—By Leonard P. Ayres, Vice-President, Cleveland Trust Company, Cleveland, Ohio. Paper; 6 x 9 in.; pp. 27. Illustrated.
An unusually clear and readable study in brief compass. Gives with 1914 as basis) changes in cost of living and also in wholesale and retail prices, 1915 to 1921, for the United States; wholesale prices for the same period in the United States, England, France and Italy; wholesale prices in the United States for 110 years and weekly wages for 100 years, for artisans and common labor; prices for 25 selected industrial stocks for 22 years; and a brief summary and forecast. One of the conclusions is that we are probably "entering upon an extended period of falling prices, broken by occasional shorter periods of rising prices." Urges accumulation of data that will show business cycles, and keen watchfulness to note our position in the cycle at every moment.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES: Year 1920, with Notes on Mine Accidents Due to Explosives. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 44.

QUEBEC STREAMS COMMISSION: Ninth Report, 1920. Quebec, Canada: Louis R. Proulx. Paper; 7 x 10 in.; pp. 139.

REPORT OF THE PUBLIC SERVICE COMMISSION OF THE STATE OF NEW YORK. Year ending Dec. 31, 1917. Vol. III. Statistics of Light, Heat and Power Companies. New York. Bureau of Statistics and Accounts. Cloth; 6 x 9 in.; pp. 605.
Another example of long delay in publishing governmental reports, but apparently not chargeable to the commission.

THE ROCKEFELLER FOUNDATION: A Review for 1920; The Program for 1921—By George E. Vincent, President. New York: The Foundation. Paper; 6 x 9 in.; pp. 47; illustrated.

SALIENT FEATURES OF ELECTRIC COOKING, ELECTRIC HOT WATER HEATING AND ELECTRIC HOUSE HEATING—By Samuel S. Wyer, Consulting Engineer. Columbus, Ohio: The Author. Paper; 6 x 9 in.; pp. 31.
Conclusions adverse; based largely on research and opinion published by Idaho Public Utilities Commission in 1918 and 1919.

SCIENCE AND COMMON SENSE IN WORKING WITH MEN—By Walter Dill Scott, President of Northwestern University; President of the Scott Company, Philadelphia; Formerly Director of the Committee on Classification of Personnel in the Army, and President of the American Psychological Association; Author of "Influencing Men in Business," etc. and M. H. S. Hayes, Member of the Scott Company, Philadelphia; Formerly Associate Psychologist, Laboratory of Social Hygiene; Joint author of "Delinquent Women in New York State." New York. The Ronald Press Co. Paper; 5 x 8 in.; pp. 154. $2.
Deals with means of judging the ability of men in different grades and in various branches of industry and business. Advocates and explains scientifically devised physical and mental tests, studies of character, history, and desires of individuals in relation to being hired for a new position or changed to one better suited to the man and woman. More of an argument for scientific tests tempered by common sense than an exposition of how the various tests should be made.

SEE UND SEEHAFENBAU—By H. Proetel, Regierungs und Baurat in Magdeburg, III, Teil. Wasserbau. 2 Band; Hand: bibliothek fur Bauingenieure, edited by Robert Otzen, Geh. Regierungsrat, Professor an der Technischen Hochschule zu Hanover. Mit 292 Textabbildungen. Berlin. Verlag von Julius Springer. Cloth; 7 x 10 in.; pp. 221. 40 marks.

THE SMITHSONIAN INSTITUTION: Annual Report, 1918-1919. Washington: The Institution. Cloth; 6 x 9 in.; pp. 557; illustrated.

SOPHOMORE ENGLISH FOR ENGINEERS—By D. B. Cofer, Associate Professor of Department of English, Agricultural and Mechanical College of Texas. College Station, Tex.: The Author. Paper; 6 x 9 in.; pp. 20.
Contains a short address by the author on "English for the Engineering Student," delivered in 1917; lists of (1) books and articles, (2) technical journals and (3) biographies for outside reading, oral reports, etc. The address is an able plea for the study of English literature and composition by prospective engineers for cultural and utilitarian purposes, with a few notes on current instruction in English composition at the Agricultural and Mechanical College.

STANDARDIZATION OF MEASURES OF LENGTH AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—Ottawa, Ont., Topographical Surveys Branch, Department of the Interior. Paper; 6x9 in.; pp. 33; illustrated.

TECHNICAL EDUCATION IN RELATION TO RAILWAYS IN AMERICA—By H. L. Cole, O.B.E., M. I. Mech. E.; Locomotive Department, Indian State Railways, and Secretary, Railway Board. Technical Paper No. 219, Railway Board, Simla, India. Paper; 8x13 in.; pp. 46; illustrated. 14 Annas.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS: No. 197, Cementing Qualities of the Calcium Aluminates—By P. H. Bates, Chemist, Bureau of Standards. Paper; 7 x 10 in.; pp. 27; illustrated. Washington, D. C. 10c. from Superintendent of Documents. Limited number free on application.

TRAINING FOR THE PUBLIC PROFESSION OF THE LAW: Historical Development and Principal Contemporary Problems of Legal Education in the United States, with Some Account of Conditions in England and Canada—By Alfred Zantainger Reed. New York: Carnegie Foundation for the Advancement of Teaching. Paper; 6x9 in.; pp. 498.

UNION SCALE OF WAGES AND HOURS OF LABOR, May 15, 1920—[Wages and Hours of Labor Series] Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 280.
Ninth annual bulletin on this subject. Gives union wages and hours of labor of 1,054,204 persons in 42 groups of trades in 66 cities; also gives for each trade the per cent increase of wage rates in 1920 over each of the 13 previous years for the cities collectively.

THE VENTURI FLUME—By Ralph L. Parshall, Senior Irrigation Engineer, Carl Rowher, Irrigation Engineer; Irrigation Division, Bureau of Public Roads, U. S. Department of Agriculture. Based on Experiments Conducted in the Hydraulic Laboratory at Fort Collins, Col., at Cornell University, and at the field laboratory at Bellevue, Col., under co-operative agreement between the Irrigation Division of the Bureau of Public Roads, U. S. Department of Agriculture, and the Colorado Agricultural Experiment Station. Bulletin 265 (February, 1921), The Agricultural Experiment Station of the Colorado Agricultural College, Fort Collins, Col. Paper; 6x9 in.; pp. 28; illustrated.
An article on the early history of this device appeared in *Engineering News*, Aug. 10, 1916, p. 271. In *Engineering News-Record*, Sept. 2, 1920, p. 452, F. S. Wilson and C. A. Wright dealt with the experimental work at the Cornell Hydraulic Laboratory. The general subject was further discussed by Julian Hinds, *Engineering News-Record*, Dec. 23, 1920, p. 1223.

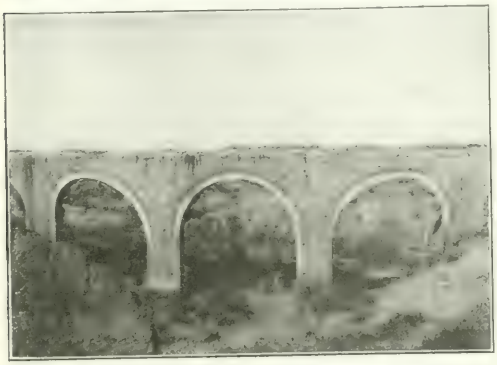
WATER RESOURCES OF KERN RIVER AND ADJACENT STREAMS AND THEIR UTILIZATION—Bulletin 9, California Department of Engineering, Based on Investigations in cooperation with Kern County, the Kern County Land Co., and the Tejon Ranch Co. Sacramento, Cal.: As above. Paper; 6 x 9 in.; pp. 209; eight separate maps and profiles.
The full utilization of Kern River is considered, including both power and irrigation uses, the development of storage and the utilization of ground water supplies.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Two Old Eccentric Arches

Sir—The illustration of an eccentric elliptical arch that appeared in a recent issue of *Engineering News-Record* prompts me in sending you a photograph of an old (perhaps ancient) aqueduct near the city of Chihuahua, Mexico, taken in 1899, in the belief that it may be of interest.



Taft, Cal. W. E. CONDON,
Civil Engineer.

## Some Engineers Good Managers

Sir—"The Engineer a Failure as a Manager" offers another topic for extended and perhaps useful discussion.

*Engineering News* pointed out some thirty years ago that about 50 per cent of engineers with experience graduate from strictly engineering lines into executive positions. In view of old statistics and confirming data of a more recent date it does not sound reasonable to say that the engineer is a failure as a manager. Not all engineers are managers and not all managers are engineers, but executive positions have a persistent way of offering themselves to a goodly proportion of engineers.

No doubt the typical engineer as trained by experience or by our technical schools and experience is of a scientific and studious type, disciplined and conscientious; for him to be otherwise would be to deny his birthright. On the other hand imagination, vision and idealism are not the result of training but rather of inheritance and association. No good reason can be given why the engineer as a type should not have as large a degree of foresight as any other class. His collegiate training does not minimize idealism; why should his experience suppress this quality any more than the early novitiate which the lawyer and doctor serve? Was not James B. Eads inventive, imaginative and also a great manager? Ericsson had visions and realized on them in a most spectacular battle which revolutionized the navies of the world. George S. Morison was a great engineer and by no means a failure as a manager. Frank Thomson rose from surveyor to president of the Pennsylvania Railroad. He is generally considered to have been something of an engineer and one of the greatest railroad organizers of this or any other country. The history of the railway age will list a number of engineers who were managers with vision but not visionary.

The fact remains that our technical institutions have not helped seriously in training engineers to be managers, until very recently. We have courses in Business Administration, Engineering Administration, Industrial Engineering and no doubt they aid in developing engineers so that after due experience they may fill positions of an executive character better than without this training. The qualifications of a good manager are somewhat illusive and they develop with experience and usually with maturity. Whatever the difficulties may be they constitute no reason why the technical school should not consider the possibility of a training adapted more to the needs of a manager group where there is evidence of ability in that direction. It boots nothing to attempt to train all engineers as managers but it is important that the education of all engineers should be broad enough so that it does not hinder and does help them on their way to executive positions. Then some might well be given special training of a post graduate character and designed for the managerial type. R. L. SACKETT,

State College, Pa. Dean, School of Engineering,
Nov. 4. Pennsylvania State College.

## Dirt Is Not Earth

Sir—A correspondent of *Engineering News-Record*, Sept. 29, says in substance: "Few if any of our engineering institutions lay sufficient stress on the importance of an engineer's ability to speak or write the English language correctly."

We must agree with this statement when we read in college textbooks of the construction of "dirt" roads when earth roads are meant. Specifications from a State Highway Department contain the statement, "cover the shoulder drains with dirt." Good scholarship is offended by the use of the term, dirt, except in ordering its removal from materials.

The professional engineers are now engaged in making a drive to secure license laws in many of the States. Doctors and lawyers are not licensed, but admitted to the bar on a diploma or examination. We license peddlers, auctioneers and formerly saloon keepers. In Michigan engineers are not licensed, but are registered after an examination or producing proof of qualification for the work of engineer or architect. There are a few engineering magazines that use the so-called simplified spelling. In the opinion of your correspondent, not many really able engineers would care to have their manuscript mutilated in that way. It would seem that in the many years since the founding of this nation the steady influx of foreigners, representing every known tongue, would have corrupted the English language. Such might have been the result had not Noah Webster stood like a rock, defending and protecting our language as Washington defended and protected our liberties. WINFIELD S. MERRILL,

Kalkaska, Mich., Oct. 14. Registered Civil Engineer.

## Early Overloading of Concrete Floors

Sir—The writer is moved by certain articles which have appeared in your issues during the current year upon reinforced-concrete failures to express some conclusions which experience and observation have caused him to draw regarding reinforced-concrete design.

Probably no engineer will dispute the fact that it is not wise to permit green concrete in a building or other structure to be overstressed during construction. Collapse or failure may not occur, but the concrete is likely to be so damaged that it will give trouble later on by working and getting out of shape, although it may carry the load for which it is designed.

The loads which come upon the floors of such light buildings as office, hotel, apartment and school buildings, during the construction period are frequently much greater than any loads to which these same floors will be subjected after completion. When such floors are designed for a live working load of 40 lb. plus super-imposed dead-load of 20 lb., for example, they are almost certain to be overstressed by the construction loads. The contractor may be careful and conservative in handling his work, and the superintendent may be on the job and watchful, but brick, stone, sand or some other material will be piled on the floors and the damage done without the knowledge of those in charge of the work. There is a feeling prevalent among workmen

that reinforced-concrete floors will carry anything. Even though subcentering is placed throughout the building and kept in place as long as possible there comes a time when it must be removed so that work can proceed.

The writer believes that the floor slabs of buildings including joists and secondary beams should not be designed for less than 80 lb. per square foot live-load; and main girders for not less than 60 lb. per square foot as a minimum for any type of construction; for some types of construction these figures should be increased as much as 25 per cent. The columns of a building are not affected in the same way that the floors are by construction loads, and it is not necessary to be as conservative in designing the columns and column footings.

In determining the design live-load for floor slabs and beams there are several important points which should be carefully considered. A solid concrete slab which weighs say 80 lb. per square foot, and designed to carry a live working load of 80 lb. plus 20 lb. per square foot, may be loaded to 150 lb. per square foot and the material will be overstressed about 28 per cent. A light joist construction weighing 40 lb. per square foot and designed for the same working load, when loaded to 150 lb. per square foot will be overstressed about 36 per cent. If the live-load for which the two types are designed is 40 lb. instead of 80 lb. and each should be loaded to 120 lb. per square foot, the solid concrete slab construction will be overstressed about 43 per cent and the lighter construction about 60 per cent. This fact must be borne in mind by the designer and a larger live-load used in designing the lighter weight construction to provide against possible overloading of the floors during construction or after completion of the building.

The advantages of two-way and multiple-way reinforced-concrete slabs in carrying concentrated loads when compared with one-way reinforced slabs and beams, and to a still greater degree one-way joist and girder floor construction, are well known and appreciated by the engineering profession. This advantage must also be kept in mind by the designers of reinforced-concrete floors to provide for construction loads and also for possible concentrated loads after the building is completed. Girderless floors which carry the slab loads directly to the column need to provide for only the same loads that the main girders of a beam construction building would be designed. This follows as a matter of course.

The points herein brought forward should receive the consideration of those who are responsible for drafting building codes, and engineers who are responsible for the design of either reinforced concrete or steel buildings. It is not sufficient to establish minimum design loads without regard to the type of design that will be used.

It is entirely possible that if these matters are given their proper consideration there will be fewer failures of reinforced-concrete buildings.

WALTER H. WHEELER,
Minneapolis, Minn., Oct. 22 Consulting Engineer.

## Two Concrete Piers; A Lesson in Competitive Practice

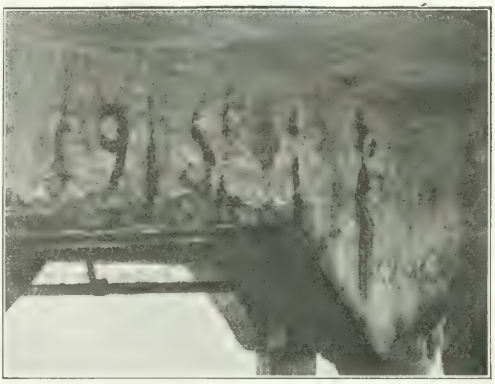
Sir—There are in Manila Bay two reinforced-concrete piers which constitute a most striking and forceful illustration of the advisability of following correct construction principles.

Piers "A" and "B" (a designation used for the purpose of this article), are both flat-slab and girder decks founded on precast concrete piles. They were built simultaneously in 1914, under almost identical conditions. They are located about two thousand feet apart and subject to the same sea action. Excellent trap rock and screenings from the same quarry and sharp clean sand, dredged from the Pasig River were supplied for each. The same brand of cement taken from the same shipments and warehouse, and fresh clean water from the same pipe were used throughout. Pier "A" is subjected to vastly greater traffic than is Pier "B."

Pier "A," after seven years' hard service, is in splendid condition. A careful survey reveals no sign of serious concrete deterioration, nor rupture due to oxidized reinforcement. There are a few rust stains.

Pier "B," after the same length of service, is in an advanced state of disintegration. At least seventy-five per cent of the deck beams are cracked and spalled, many so seriously as to expose the entire side and bottom of the reinforcing. The bottom of the floor slabs and the pile haunches have spalled, exposing the steel in many places. Many other places, particularly on the bottoms and sides of the main floor beams, are cracked and bulged. A chisel inserted in a crack will bring off great flakes of concrete exposing steel which in every case is heavily corroded. The concrete appears to be of excellent quality. The floor slabs, beams and haunches are strained with rust. The concrete piles which were precast in special forms are in excellent condition.

Here we have two piers built under identical circumstances, one in perfect condition the other failing rapidly.



RUSTED STEEL CAUSES CONCRETE BEAM FAILURE

The answer? It is simple, simply this. The superintendent who built pier "A" used common sense. The builder of "B" violated two of the most fundamental principles of reinforced-concrete construction, particularly vital where the work is exposed to sea water.

When the steel was delivered to both piers, it was found to be incorrectly bent. The beam stirrups were too large and the longitudinal beam rods were bent too high. The superintendent on pier "A" stopped his job, and re-bent his steel. The superintendent on pier "B" was too busy to do likewise, so put the steel in as it came.

The serious damage to pier "B" is unquestionably due to heavy corrosion of the reinforcing steel because it was placed too closely to the surface of the concrete. Measurements taken at many places show that it was embedded but from ¾ in. to 1¼ in., which is entirely insufficient cover. This is an excellent illustration of the vital importance of deeply embedding the steel in rich impervious concrete, on all work which will be exposed to the action of sea water or salt air.

Another contributing cause of this failure was undoubtedly the practice in vogue on pier "B" of pushing the portable mixer, with piles of cement and aggregate out onto the new floor slabs within a day or two after they were poured. The vibration of the running mixer on this setting concrete was sure to open hair cracks, and weaken the bond between the concrete and steel. It is a practice to be condemned utterly on this class of work.

The writer has just finished two concrete piers in the same neighborhood. Portable mixing plants were used on each, which were not allowed to move out on a new piece of deck until it had been poured two weeks. As the piers were built out from the shore end this involved considerable wheeling of concrete.

Extreme care was exercised to the end that no portion of the reinforcing steel should approach nearer than 1½ in.

to the surface of the concrete. It is believed that this is insufficient for safety and permanence under conditions which obtain in tropical waters, particularly if the concrete will be exposed to any abrasion. The minimum depth of rich impervious concrete, measured to the nearest surface of the steel should be not less than 2 in.

Manila, P. I., Aug. 6 H. H. BRAUN,
Engineer-Contractor.

## Some Weaknesses of Aerial Photo Maps

SIR—The article published in *Engineering News-Record* of Oct. 13, p. 596, on aerial photographic mapping is interesting so far as it refers to reconnaissance surveys, but when the writer attempts to show that photography may be substituted for ground methods of accurate surveying he is exceeding the limit of his subject. The principles of astronomy, trigonometry, geometry, geodesy and perspective cannot be consigned to oblivion as superfluous by simply pressing a button. It is not so easy as that. The use of aerial photographs for surveying has been investigated in Europe before and during the war—and the results achieved only served to demonstrate what was already well known to many surveyors, that for all practical engineering purposes the making of maps from photographs is impossible.

There are many things in the article referred to which would not stand the test of practical demonstration, but a reference to one or two may be sufficient to show the general debility. "Negatives, . . . by enlargement or reduction, can be brought to a uniform scale even though the airplane from which they are taken does not fly at a constant altitude." The perspective, or photographic distance between two points, may differ considerably from the horizontal, or plan, distance according to the shape of the ground and this cannot be adjusted by merely reducing or enlarging the picture. Nor will the correct altitude of the airplane with reference to one or two points be sufficient; the elevation of all points to be plotted must be ascertained with relation to a known datum, and if this cannot be done the picture will merely be a sketch map without a scale. In rolling or hilly country this is more noticeable. The altitude of the airplane is not the governing factor as may be seen from the diagram. The first position of the airplane at *A* overlooks two points, *C* and *D*, which are projected on the photograph, or picture plane, 200 ft. apart; the second position of the airplane, *B*, at the same altitude, projects the same two points, *C* and *D*, on the picture plane 320 ft. apart. This is only one of many discrepancies not referred to by aerial survey enthusiasts and it would be interesting to learn how such remarkable closures as "an error of less than one-half of 1 per cent" are arrived at. The city of Rochester may be on very level ground, but other results cannot be so easily explained.

The excerpts taken from the report of an "engineer" commencing—"An aerial map of the city would show more detail than we could ever hope to put on any plan prepared from surveys," etc.—become mere nonsense when compared with the photographic reproductions.

The last paragraph is very disheartening, when we consider its application to any of the photographs shown, and they must have been picked ones. "By placing tracing paper over the complete mosaic, all information desired may be traced off, thereby giving a line map without the photograph showing." Imagine the feeling of a draughtsman who was asked to make a ground line plan on tracing of the photograph on p. 597! He might get a little work done in the center of the picture, but outside of that it would be a hopeless task. Look at the E-shaped building, for instance, at the crossing of Park Ave. and 34th St.; judging by the roof there would appear to be 12 corners, but only one is visible on the ground line. The outer part of the picture is not in plan at all and would have to be treated as "oblique"—if, indeed, it was worth it.

The use of aerial photographs for making accurate plans is a very difficult proposition, but if we require relief, or contour, maps they cannot be considered in any shape or form.

The day of the airplane as a surveying instrument has not yet arrived, and the "old field tools" referred to in your editorial will have to be used for many a long day before a substitute is found for reliable mapping.

Winnipeg, Oct. 24. P. J. BARRY,
Dominion Water Power Branch, Department of the Interior, Canada.

## Problems in the Chlorination of Water

SIR—The answers to Q. 9 in "Problems in the Chlorination of Water," *Engineering News-Record*, Sept. 15, p. 444, show a wide difference of opinion among plant operators. I believe this subject should be discussed further. The question was stated as follows: "Does the bacterial reduction effected by an excessive use of chlorine warrant letting down on the possible efficiency of filter plants? In other words, should filter efficiency be allowed to drop with the idea that the bacterial efficiency may be raised by a liberal use of chlorine?"

I believe that the question could have been better stated. The implication of inefficient plant operation is one that few operators would admit and justly so, if due to an intentional low percentage of bacterial removal by their filters. Also the wording "excessive use of chlorine" is ill advised. The question is better stated in the editor's note preceding the first article, p. 392, Sept. 8 issue, "Should plant operators strive less to produce a low bacterial count by filtration, relying on chlorine for that, and try to get 100 per cent clarification as economically as possible?"

In many cases the answer to this question should be "yes." Mr. Armstrong says that "the efficiency of a filter plant should not be lowered in any respect with the idea of making up for careless operation by the use of chlorine." Note his phrasing: "careless operation." The operator who can produce the same results from a plant at a lower cost per million gallons than the one using a larger dose of coagulants is a "careless operator" because he does not get as high a percentage bacterial removal on the filters. I believe the way this question was put influenced Mr. Armstrong's answer.

Many of those who favor dosing the water with chemicals so as to obtain an effluent from the filters of satisfactory sanitary quality regardless of the chlorine treatment seem to feel that reliance on the chlorine treatment is not a safe expedient. This is probably true for the plant that relies on one chlorinating outfit, because chlorine tanks become empty and are not always immediately replaced. The apparatus may get out of order and then the water does not receive the proper does of chlorine, thus making chlorination intermittent. In advocating economical operation by obtaining 100 per cent clarification by means of the filters and the necessary sanitary quality by the use of chlorine, please give operators credit for insisting (1) on the filter beds and mechanical equipment being maintained in first class operating condition; and (2) on the chlorinating apparatus being so subdivided that the mechanical failure of one unit, the emptying of one cylinder without immediate replacement, will not reduce the chlorine dose below the point necessary to obtain a water of good sanitary quality.

It has been my experience that the chlorinators on the market are reliable and, if intelligently installed and operated in duplicate or multiple units, can be relied upon. Many large water supplies not filtered are successfully

and safely chlorinated by this arrangement. The cost of the equipment is small when compared to the total investment in the plant. Good engineering practice should then call for at least the duplication of the chlorinators. This overcomes the objection due to unreliability.

If the plant operators owned their plants and had to pay for the coagulants out of their profits, I do not believe they would advocate the use of more coagulant than was necessary for 100 per cent efficiency in clarification except under certain conditions mentioned later.

Some plants are fortunate in producing satisfactory effluents part of the time when dosing with just enough coagulant to obtain a good clear effluent from the filters. Others, producing a clear effluent but not a water of satisfactory sanitary quality, are troubled with odors or tastes due to the chlorine dose necessary to give the desired bacterial content. Whether this is due to primary chlorine tastes or to secondary tastes and odors due to trade wastes in the water, it is obvious that in this latter case the coagulant does should be regulated so as to obtain the necessary bacterial reduction on the filters. However, the latter case is special and does not represent the results obtained in the majority of plants.

Consider a hypothetical filtration plant representing approximate average filter plant conditions: Assume that 200 lb. of alum per million gallons are necessary to produce a clear sparkling effluent, regardless of the bacterial content; that 300 lb. would be required for an effluent of good sanitary quality, and when using 200 lb. of alum 2 lb. of liquid chlorine per million gallons would be necessary to reduce the bacterial content to the same value as would be obtained without chlorine but using 300 lb. of coagulant per million gallons. Operator 1, using 200 lb. of coagulant at 2c. and 2 lb. of chlorine at 8c., saves $1.84 per million gallons. If the 16c. used for chlorine were spent on coagulant, he would be able to use only 208 lb. Operator 1 is saving money but the consumer must be the first consideration of the operator. Both the public health and the public pocketbook should be considered since the consumer is ultimately the one who pays the bill.

Suppose, in this hypothetical filtration plant, that Operator 1 doses the water with 2 lb. of liquid chlorine just as it leaves the filters, then later on just before it reaches the pumps he gives it another 2-lb. dose of chlorine. The first dose of chlorine produced an effluent equal to that obtained by Operator 2 with 300 lb. of coagulant and the second dose produced approximately the same factor of safety that Operator 2 obtains by the use of 2 lb. of chlorine. Of course, the same effect would be produced by Operator 1 applying the chlorine all at one point. The comparative costs would then be: first operator, $4.32, and second operator, $6.16. Again the first operator saves $1.84 per million gallons.

If Operator 1 were in charge of a plant handling water requiring a large dose of chlorine to give a satisfactory plant effluent and could not double the dose on account of chlorine tastes in order to obtain the necessary factor of safety to take care of the failure of one chlorine apparatus, then the solution in this case would be the use of more chlorinators. If it were necessary to apply 3 lb. per million gallons to reduce the bacterial content to the desired point four chlorinators could be put into service, each dosing the water at the rate of 1 lb. per million gallons per day. The failure of one outfit would not have a serious effect on the quality of the water.

At the Akron filtration plant three chlorinators are installed. Two are kept in constant service, the output from each being regulated so as to be equal. Hourly reading of the weights of the chlorine tanks are taken and recorded. The third chlorinator is kept in reserve. During the past three years it has not been necessary to put the third machine into service. So much for reliability of equipment. The average yearly dose of liquid chlorine has been a little over 2 lb. per million gallons. During certain periods over 4 lb. per million gallons are used.

The editor's statement that "the consumer is the first consideration of the operator," and that "he must continually balance the public health against the form and economy of treatment," is true, but should not be used as a cloak for an inefficient business administration.

It is daily being demonstrated that it is possible with safety to the consumer to operate filtration plants to obtain 100 per cent clarification and the desired color removal, relying on the chlorine treatment for the bacterial removal. This being the most economical form of operation, it seems to me that it is the method that should be followed, except in the few special cases where trouble is encountered due to primary or secondary tastes or odors. An exception should also be made for those plants handling water subject to sudden changes in turbidity or pollution and not having large storage basins between the filters and source of supply.

Before the introduction of the use of liquid chlorine, polluted water was filtered so as to obtain a safe potable product. With the same or greater factor of safety as formerly, and with considerable reduction in operating costs, we can, by the intelligent use of liquid chlorine, supply the consumer with safe, potable water. If chlorination is resorted to as a precautionary rather than a primary measure, we are not making full use of the knowledge or science at our command.

J. S. GETTRUST,
Kent, Ohio, Oct. 11. Superintendent of Filtration.

## Paint Research Not Lacking

I have seen Prof. A. H. Sabin's letter of Aug. 5, appearing in your issue of Aug. 18, p. 291. I have noted his suggestion that research work on paint be started at the Forest Products Laboratory. Such work has been under way at the above named laboratory for several years.

Prof. Sabin's reference to the difficulty of obtaining railroad specifications is also noted. He must know that there exists in Washington an interdepartmental committee on paint specification standardization. This committee, which by the way includes engineering representatives of the highest type from various railroads, has drawn up specifications for the various ingredients used in paints, as well as specifications for paste and prepared paints, used by the railroads and by the various departments of the United States Government. These specifications are obtainable, in the form of circulars of the Bureau of Standards, from the U. S. Government Printing Office. They are being widely used throughout the United States.

The writer of an editorial in *Engineering News-Record* in connection with Prof. Sabin's article (p. 262) has apparently been misled by the article referred to. For instance, he makes the following statements:

"But the entire subject of the physical action of paint coatings is closely related to the specific case referred to, and is as much involved in ignorance. Nor is there any more knowledge on the chemical problems of paint, as in fact is directly suggested by a second case which Prof. Sabin cites to support his argument."

"Among paint users there has always existed an undercurrent of belief that paint is a field of mystery. . . ."

"Such a general confession would be a significant piece of progress. It would remove one of our great industries from its state of medieval mystery and put it on a plane of scientific knowledge."

The writer of the above editorial is probably not familiar with the fact that the Paint Manufacturers' Association of the United States was undoubtedly the first industrial organization in America to undertake scientific research on a co-operative plan. This work was started as early as 1907, when the laboratories were organized and an extensive series of exposure tests inaugurated. During recent years the National Varnish Manufacturers' Association has joined in this same work, which is now conducted at the writer's laboratory in Washington. The results of the work are published monthly in the form of pamphlets for the benefit of the trade at large and for the consumers of paint as well. These publications have from time to time been issued in the form of books, several of which have been published by the McGraw-Hill Book Co. of New York City.

H. A. GARDNER,
Washington, D. C. Oct. 20. Institute of Paint and Varnish Research.

# HINTS FOR THE CONTRACTOR

## Mixers on City Paving Work Charged by Batch-Box Method

BY T. W. DIECKMAN
With the Lakewood Engineering Co., Cleveland, Ohio

SEVERAL Detroit contractors, including Thomas E. Currie, J. A. Mercier and Julius Porath, have developed a method of using batch boxes to charge paving mixers on city street work. This gives the following advantages: Eliminates the wheeling and shoveling crew; prevents damage to the finished subgrade, because materials are not hauled over it in wagons or trucks; and stops losses of material because none is piled directly on the subgrade—when materials are placed on the subgrade, contractors usually take a loss of 5 to 10 per cent on sand or stone, since it is not possible to clean up all of it.

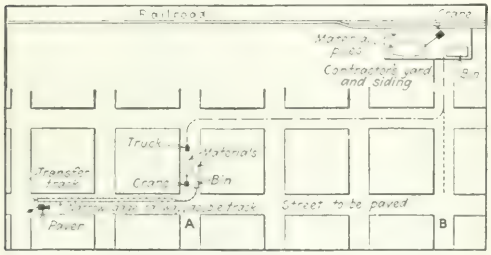



FIG. 1. BATCH-BOX SYSTEM WITH MOTOR TRUCK HAULAGE
Streets to be paved shown cross-hatched; transfer points located, in turn, at A, B and C

Sand and stone, unloaded by crane or other means at the contractor's siding, is hauled either in batch boxes on motor trucks or in bulk by motor trucks to the end of the street to be paved, or to some convenient cross street intersection. A short stretch of narrow-gage track is laid on the subgrade from this point to the mixer. If the material has been hauled in batch boxes on motor trucks, they are lifted directly on to the narrow-gage cars by a small crane, or, if the material has been handled in bulk, it is dumped on the ground or pavement and rehandled into a small portable bin by a crane or bucket elevator. The narrow-gage cars carrying batch boxes are run under this bin, charged with the proper amount of sand and stone and hauled by gasoline locomotive to the point where work is in progress.

The track is really laid as a double track from the mixer back to what is considered about a day's run. At the mixer end of this double track there is a transfer track which is a simple contrivance for moving the cars and empty batch boxes from the inside track next to the paver over to the outside track. This transfer track consists of two pieces of rail just long enough to carry the car. They are set to the track gage and are fastened on angles carrying four rollers which run in channels and allow the transfer to be moved easily from one track to the other. The transfer is mounted on a wood frame, which can easily be picked up and moved as the concreting advances. Generally a 5-car train is used; three sets of trains, or a total of 15 cars is usually required. This means that there is one train at the mixer, one at the bin or transfer point, and one in transit.

When the last batch is used from the train at the mixer, the locomotive is already there with another train of 10 batches on the inside track. These are placed, the locomotive uncoupled and backed on a switch to the outside track to pick up the empties. These are pulled down to the switch ready to be placed at the bin or transfer point as soon as the loading of the train previously placed there is completed. This method of operation insures that the mixer is at all times supplied with sufficient material to operate continuously.

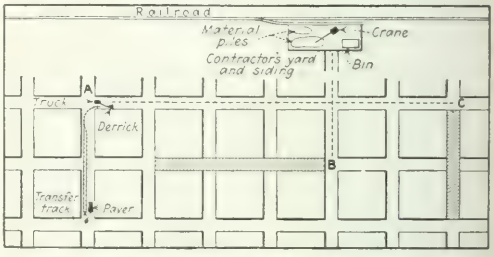



FIG. 2. LAYOUT WHEN BULK HAULAGE IS EMPLOYED
Transfer point first at A, then at B.

At the mixer the batch boxes are lifted off the running gears by the batch transfer of the paver and are swung over the skip where the material is dumped. No sand or stone is placed upon the finished subgrade, and no wagon or truck haul can damage the grading after its completion.

With this method only 3 men are required to charge the paving mixer, while with wheelbarrows a crew of about 18 would be needed. When material is dumped on the subgrade, 5 to 10 per cent of it is lost because it cannot be cleaned up. With the method here described the material never touches the subgrade, and this means a further saving to the contractor. No hauling is done over the finished subgrade, so that there is no extra cost for retrimming the subgrade. This cost of retrimming only 25 per cent of the area at 10c. per square yard, would amount to $400 per mile of 30-ft. street.

If batch boxes are hauled on motor trucks out to the street to be paved, bulk cement may be used, which will make an economy of at least 15c. per barrel, which is about $550 per mile of 30-ft. street. If bag cement is used, bags will all be handled in one place, instead of being carried out to the mixer to become lost.

A great advantage of the system is its ability to operate in weather which would close down other methods. A wet subgrade is no bar to operation. In the opinion of many contractors who have used this method, its ability to continue construction under weather handicaps is its biggest asset.

# NEWS OF THE WEEK

New York, November 17, 1921

## British View of Depression and Recovery Measures

### Lower Bank Rate Needed for Trade Revival—Foreign Markets Discussed

In a report to the Prime Minister the executive committee of the Federation of British Industries has given its views on the causes of the present depression and on remedial measures. The suggestions include a reduction in direct taxation, export credits, loans to the Crown Colonies and the Dominions. There are views, too, on exploitation of foreign markets which have a special interest for Americans.

The fundamental causes of the depression are set down as: 1. The general impoverishment of the world, owing to the enormous unproductive expenditure. 2. The destruction of the world's standards of value, due to inflation of currencies. 3. An alteration of the world's trade channels, due to (a) the partial or complete disappearance of many pre-war markets and sources of supply and (b) the development of industries in countries which formerly exported raw materials and imported manufactured goods.

As a result there will be, first, a period during which there will be serious hindrance to international trade and, second, a longer period, which will last until the destruction of goods and means of production has been made good by hard work and restricted consumption.

STABILIZE THE EXCHANGES

Looking to amelioration of conditions in the first period it is stated that the first necessity is to stabilize the exchanges. To this end it is suggested that Great Britain join with one or more strong powers to impose a common currency policy on the rest of the world. Pressure would be brought to bear through the extension or withholding of credits, the manipulation of international debts in some cases, the reparation payments and, in the event or extreme recalcitrancy, an economic boycott. The ends to be sought would be a cessation of inflation and a balancing of budgets, followed by stabilization of currencies and "re-anchoring them to gold, though not necessarily in the same ratio as their pre-war currencies." It is suggested, also that similar pressure might be exerted to induce countries "which are constantly varying and raising their tariffs" to lower them or at least to stabilize them.

As to remedial steps affecting both periods the consideration is urged of a lowered Bank rate, to induce trade revival; an immediate and substantial reduction of direct taxation is declared to be imperative; export credits as a means of developing markets not too severely affected by the war are suggested, as are, also, loans to enable the Crown Colonies and Dominions to develop their territories. It is recog-

(Continued on p. 832)

## President Signs $75,000,000 Federal-Aid Road Bill

### New Act Makes $25,000,000 Immediately Available—$15,000,000 for Forest Roads—Event Marked by Special Ceremony

President Harding affixed his signature to the highway bill Nov. 9, thereby making $25,000,000 immediately available for distribution among the states for federal-aid road projects. The remaining $50,000,000 carried by the bill will become available Jan. 1. In addition $15,000,000 is made available for forest roads and trails during the next two years.

The signing of the bill was accompanied by more than the usual ceremony, so that a motion picture could be made of the event which marks the establishment of an important precedent in the government's highway policy. There was a preliminary statement by W. C. Markham, of the Kansas Highway Commission, who has been acting as the legislative representative of the American Association of State Highway Officials throughout the consideration of the bill. His remarks were followed by a statement from the Secretary of Agriculture, who pointed out that the bill contains provisions for road maintenance, which should meet the full requirements specified by the President in his message to Congress. Senator Townsend then handed a specially wrought pen to the President who signed the engrossed bill. Others who participated in the exercises incident

HOW FEDERAL-AID HIGHWAY FUNDS WILL BE APPORTIONED AMONG THE 48 STATES:

| State | Allotment |
|---|---|
| Alabama | $1,553,420.67 |
| Arizona | 1,053,281.44 |
| Arkansas | 1,254,142.20 |
| California | 2,462,098.53 |
| Colorado | 1,341,175.69 |
| Connecticut | 480,897.78 |
| Delaware | 365,625.00 |
| Florida | 886,825.69 |
| Georgia | 1,997,957.58 |
| Idaho | 938,536.68 |
| Illinois | 3,246,281.07 |
| Indiana | 1,958,855.41 |
| Iowa | 2,102,872.74 |
| Kansas | 2,102,281.51 |
| Kentucky | 1,417,178.68 |
| Louisiana | 996,989.64 |
| Maine | 695,160.25 |
| Maryland | 640,629.01 |
| Massachusetts | 1,096,176.04 |
| Michigan | 2,249,532.43 |
| Minnesota | 2,123,597.07 |
| Mississippi | 1,294,906.22 |
| Missouri | 2,448,128.62 |
| Montana | 1,546,885.82 |
| Nebraska | 1,581,189.50 |
| Nevada | 953,436.78 |
| New Hampshire | 365,625.00 |
| New Jersey | 942,870.95 |
| New Mexico | 1,189,823.34 |
| New York | 3,696,447.97 |
| North Carolina | 1,709,333.90 |
| North Dakota | 1,164,714.42 |
| Ohio | 2,823,004.05 |
| Oklahoma | 1,752,339.44 |
| Oregon | 1,182,663.99 |
| Pennsylvania | 3,398,953.97 |
| Rhode Island | 365,625.00 |
| South Carolina | 1,061,237.34 |
| South Dakota | 1,204,060.51 |
| Tennessee | 1,647,692.24 |
| Texas | 4,425,172.41 |
| Utah | 849,417.21 |
| Vermont | 365,625.00 |
| Virginia | 1,456,828.47 |
| Washington | 1,103,709.77 |
| West Virginia | 802,359.27 |
| Wisconsin | 1,894,815.86 |
| Wyoming | 934,617.63 |

## Agree on Paving Brick Standards

Representatives of engineering societies and paving brick manufacturers met Nov. 15 in Washington, D. C., with officials of the Department of Commerce and agreed to recommend to the several engineering societies the approval of eleven varieties of paving brick as standard, thus eliminating all the remainder of the 66 varieties now current. The 11 varieties recommended, all of them 8½ in. long, include only four sizes, 4 x 3½ in.; 3 x 4 in.; 3½ x 3½ in. and 3 x 3½ in. Details of the deliberations and conclusions will be published next week.

## Seven Bidders for Big New York Subway Contract

Bids were opened by the New York Transit Commission, Nov. 9, for the construction of the extension of the Queensboro subway from its present terminal at Grand Central Station to the west side of 8th Ave. Seven bids, all from New York firms, were received as follows:

Powers-Kennedy Contracting Corp., $3,839,000; Keystone State Construction Co., $3,895,000; F. L. Cranford Inc., $4,171,000; Patrick McGovern, Inc., $4,235,000; Booth & Flinn, Ltd., $4,389,000; Rodgers & Hagerty, Inc., $4,800,000; T. A. Gillespie Co., about $5,000,000.

In advertising for bids the Commission's engineer estimated the probable cost of this extension at $4,000,000 upward.

## Prizes for Papers Offered by Illinois Society

Following the practice initiated last year, the Illinois Society of Engineers is offering five prizes of $25 for papers in five fields of engineering work: Drainage, sewerage, roads or street paving, surveying and miscellaneous civil or municipal engineering. To encourage the younger members, the competition is limited to those who have been members of the society for not more than five years, and is open also to candidates for membership. Papers, prepared according to prescribed rules, must be submitted by Jan. 1, 1922, and the prize papers will be read at the annual meeting at Decatur, Ill., Jan. 24 to 26. Particulars of the terms of the competition may be obtained from the secretary of the society, E. E. R. Tratman, Wheaton, Ill.

to the filming of the ceremony were John M. Parker, Governor of Louisiana; Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads; the senators and representatives making up the conference committee which perfected the bill and Paul Wooton, Washington correspondent of *Engineering News-Record.*

## British View of Depression

(*Continued from p. 831*)

nized that these plans might involve further borrowing, and thus increase the cost of these schemes over their financing out of taxation, but it is suggested that, "this expense might well be repaid by a more rapid return of prosperity."

The work to which the suggested Dominion loans would be devoted would be state-aided immigration schemes, based on agricultural assistance. Such schemes would furnish a market for British products and also relieve the pressure of surplus population in Great Britain.

Even if all these remedies should be applied—and with success—a long period of restricted world trade is forseen. Full employment can be obtained in Great Britain during that period only if the country secures a larger proportion of the world's trade than she had before the war. Discussing the possibility of obtaining this larger proportion the report says:

COMPETITION IN FOREIGN MARKETS

"It seems probable that circumstances will to some extent assist us in this, since the creditor position of the U.S.A., coupled with the maintenance of a high tariff, makes it extraordinarily difficult for them to develop competition as against ourselves in foreign markets. At the same time it is possible that the financial and other difficulties of our European competitors will in the long run so impair their productive power as to render them less formidable competitors for some time to come than the temporary effect of the exchanges is leading us to consider them at the present time.

"In this connection it is interesting to note that there are already signs that Germany, the most formidable of these competitors, may already be becoming a less important factor. They have obtained substantially fewer foreign orders at recent international fairs, such as Leipzig and Utrecht, than they obtained last year, and there are some reports from countries adjacent to Germany that they are failing to deliver goods ordered some months ago, and that in some cases additions have been made to prices previously agreed upon.

"These indications are very slight at present, but tend to confirm the belief that the present competitive power of Germany is based very largely on artificial and temporary conditions, which must in course of time disappear, these temporary conditions, of course, being the continued inflation of German currency and the direct and indirect subsidies to the cost of living to which are due in part the lower labor costs in German manufactures."

Concluding the report are these comments on the matter of lowered costs of production:

"However favorably all or any of these causes may work for us, they can only diminish the problem. We have got to realize that if we are to sell goods to an impoverished world we must sell them at a price which that world can afford to pay, and that if foreign labor costs are below ours in any trade, either through their workmen accepting lower rates of remuneration than ours, or giving higher efficiency for similar remuneration, no artificial measures will enable us to continue to give employment in that trade.

"The lowering of the cost of production involves, of course, two factors. The first is the improvement of management, organization, and plant, and requires time, and above all the expenditure of capital, which the war and present taxation and the diminution of the world's capital resources will render it extraordinarily difficult to supply.

"The second factor is either an increased efficiency of labor in proportion to its remuneration or decreased remuneration without a decrease in efficiency. The choice before the country is to reach this result either by agreement, which would be infinitely the quickest and most satisfactory to everyone concerned, or by the sheer force of circumstances — continued unemployment, continued distress, and in the ultimate resort starvation for the workman and bankruptcy for the employer."

## "Hydro" Presents Alternate St. Lawrence Scheme

At Ottawa on Nov. 14 the Hydro-Electric Power Commission of Ontario, through F. A. Gaby, Chief Engineer, laid before the International Joint Commission an alternate plan for the development of power on the St. Lawrence to replace the Wooten-Bowden scheme, noted in *Engineering News-Record,* Sept. 8. The new plan calls for two series of dams and power houses and is claimed to produce 1,600,000 hp., or 100,000 hp. more than the joint report, by a concentration of dams in the Long Sault and a minor plant near Morrisburg. Another plan was presented by W. S. Connolly, representing the New York & Ontario Power Co., for a development between Morrisburg and Waddington. At the same hearing Hugh L. Cooper, of New York, presented some engineering objections to the Wooten-Bowden plan.

## New York Pier Extension Allowed, Pending New Work

By order of Secretary of War Weeks the City of New York is permitted to continue the 100-ft. extension of the piers in the Chelsea district of the North River until longer piers are provided farther up the river. This is a controversy of long standing and by order of the Secretary of War some months ago the Chief of Engineers U. S. Army, was required to shorten the two piers in question because of their menace to navigation. The city promises that longer piers will be immediately provided in the 48th St. district in the North River and contends that until such long piers are provided there will be no place where ships of the "Olympic" and "Aquitania" type can dock. On this plea the Secretary of War has granted a further extension of time.

## Paterson Votes to Acquire System of Water-Works

By a vote of about 20,000 to 3,000 the electorate of Paterson, N. J., declared for municipal ownership of water-works on Nov. 8, but for no specific plan. The present supply is from the Little Falls filter plant on the Passaic River, owned by the East Jersey Water Co. and allied interests, which also own the Paterson distribution system. A similar vote in favor of municipal ownership was cast in 1910.

On the same date Paterson voted 16,000 to 7,000, against abolishing its Board of Public Works and vesting the powers and duties of the board in the City Council.

## Begin Work on Industrial District for Dallas, Texas

The contract for all grading work in the new Texas & Pacific industrial district at Dallas, Texas, was let early this month and all track work is expected to be completed by Jan. 1. This district was given to the Texas & Pacific Ry. Co. in exchange for the removal of their main line from Pacific Ave., and is the result of city planning work suggested by the city's consultant, George E. Kessler of St. Louis. The total cost of the project, exclusive of the cost of the land, will be $125,000.

## For the St. Lawrence Waterway

At a joint meeting of the four national engineering societies at New York City on Nov. 14 the arguments favorable to the St. Lawrence waterway and power development plan were presented by a distinguished group of speakers. The meeting was presided over by W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers who turned the introducing of speakers over to Julius Barnes, head of the U. S. Grain Corporation during the war. The speakers were H. I. Harriman, president of the New England Power Co., Boston; Gov. Henry J. Allen, of Kansas; ex-Gov. W. L. Harding, of Iowa; and Roy S. MacElwee, recently chief of the Bureau of Foreign and Domestic Commerce.

Mr. Barnes and Mr. Harriman laid the basis of argument favorable to the proposed project in explicit terms, but the hit of the evening was made by Governor Allen, who chose to state the position of the Middle West by controverting a recent speech of Governor Miller of New York, in which the latter attacked the St. Lawrence project. In answer to the New York governor's claim that the Barge Canal would answer every purpose of navigation hoped to be served by the St. Lawrence waterway, Governor Allen said: "We are bound for Liverpool, not Buffalo,"—a concise statement of the whole pro-St. Lawrence argument.

At the outset of the meeting Mr. Saunders read a letter from various New York bodies asking that the engineering societies set aside a day for the expression of arguments against the waterway. Mr. Saunders stated that Governor Miller had been asked to this meeting but had declined.

There was a large attendance at the meeting, the main auditorium of the Engineering Societies building being filled to overflowing.

## Drainage in One Missouri County To Cost $1,172,556

Ten projects for the drainage of marsh and sour lands in Grundy County, Missouri, aggregate 82 miles of large ditches to reclaim 55,680 acres at a cost of $1,172,556. With a cost of $20 to $30 per acre the land value is expected to be increased by $40. Two projects are completed, three are under contract, and five are in the preliminary stages, the estimated cost of these five being about $625,000.

Joseph Stewart, Trenton, Mo., is engineer for the Sugar Creek and two Medicine Creek drainage districts; M. H. Mooney, Trenton, Mo., engineer for Grand River drainage district No. 1, and M. Hazen, St. Joseph, Mo., engineer for the Brimson drainage district. Of the work under contract, McWilliams Dredging Co., Chicago, has 485,000 cu.yd. for the 10-mile Muddy Creek ditch; the Rinehart Construction Co., St. Joseph, Mo., has the Wilson Township ditch, and the Sampson Construction Co., St. Joseph, Mo., has 422,000 cu.yd for the 18-mile Honey Creek ditch.

## Iowa Water-Works Section Against Raising Pressure For Fires

Serious objections to raising water pressure above the normal during fires were raised at the meeting of the Iowa Section of the American Waterworks Association Nov. 1-3, at Omaha. The section declared by resolution that the method was an undesirable practice and that the use of motor pumpers or other auxiliary apparatus be extended as rapidly as possible as being more suitable and economical. C. R. Henderson, manager, Davenport Water Co., stated that an excessive pressure during a fire was a mistake, due to the likelihood of breaks in mains at a critical time.

In the resolution passed are the following points: An increase of pressure in itself results in more water being discharged through the numerous leaks which always exist and more water being used through fixtures, in damage to plumbing, in the breaking of service pipes, and at time, the breaking of large water mains, all at a time when the whole water supply should be strictly conserved. Accidents to pumping machinery and valves are more apt to occur, and do occur, under the additional strain and during the excitement of raising fire pressure. An increased pressure ordinarily requires that water stored in elevated reservoirs be shut off during fires, and so made unavailable, in order to permit of direct pumping into the mains, resulting in an extra burden being placed on filter plants, and consequent danger of an epidemic following a conflagration.

In handling fires in high buildings and in the case of other serious hazards, fire departments now require large and powerful streams far beyond the capacity of domestic waterworks systems to supply. Such streams and such pressure can be furnished by motor pumpers without the hazard of raising pressure in the city mains, making more and shorter lines of hose available without the heavy expense for equipment and operation formerly required in the case of steam fire engines.

## Suggest Commission of Engineers on Denver Water Problem

The Denver Civic and Commercial Association has proposed to the Municipal Board of Water Commissioners that a commission of three engineers be appointed to study and report upon the needs of the water system, with a view to inspire the citizen with confidence as to the necessity of a bond issue. The association recommends one consulting engineer of national prominence, a prominent government engineer acquainted with the water supply problem of the Rocky Mountains, and a local engineer of standing and experience. The names suggested, from which the water board might choose, are as follows: James H. Fuertes, Dabney H. Maury, and Nicholas S. Hill, Jr., for the consulting engineer; Arthur P. Davis for the government engineer; Herbert S. Crocker, L. G. Carpenter and F. C. Steinhauer for the local engineer.

## Ten Hetch Hetchy Headings Advanced 4060 Ft. in October

**In October the 10 headings of the mountain division tunnels of the Hetch Hetchy water supply system for San Francisco were driven by the Construction Company of North America, a total of 4,060 ft. This is the highest monthly progress yet made on the project. In the total of 679 shifts worked in October the average heading advance was 5.98 ft. The number of holes in each round varied from 25 in altered slate and schist to 50 in monolithic granite. On Nov. 1 a total of 45,073 ft. had been driven leaving approximately 50,000 ft. to go. The date on which the tunnel driving will be completed is now estimated to be about March, 1923.**

## International Chamber To Meet in Rome

Announcement was made recently by the American section that the second annual meeting of the International Chamber of Commerce will be held in Rome, Italy, during the week of Sept. 18, 1922. At the first annual meeting, held last June in London, there were more than 200 American business men, representing virtually every industry in the United States, in attendance. The date set for the next meeting was decided upon at a recent meeting of the council of the International Chamber held in Paris.

## 35 Per Cent Gain in Asphaltic Pavement Yardage

Reports from city engineers to the Asphalt Association, New York, show that over 30,000,000 sq. yds., or 1,750 miles of asphaltic pavement, 30 ft. wide, will be laid on city streets this year. Reports from state highway departments indicate that 23,000,000 sq. yd. will be laid on the state highways while the area laid in counties and other districts will bring the total to 65,000,000 sq. yd., or 3,690 miles of asphalt pavements 30 ft. wide. This will be an increase of 35 per cent over the yardage in 1920.

## Southern Power Co. To Build Two New Plants

The Southern Power Co., through the office of W. S. Lee, vice-president and chief engineer, has announced that it has just let contracts for the wheels and generators for the two new stations on the Catawba River.

The first of these is an addition to the present plant at Great Falls, S. C., and will be known as Great Falls Power House No. 2. The machinery contracts now let call for three units, each of 18,750 k.v.a. capacity. In the plant construction are involved 35,000 cu. yd. of concrete masonry and 100,000 cu. yd. of excavation. The dam at this point is already constructed, and the wheels will operate under a head of 72 ft.

The second new installation is to be made at a point 12 miles from Charlotte, N. C., and will be known as the Mountain Island Station. This will be an entirely new installation. The work required includes the building of a dam, penstocks, power house, etc. Four 18,750-k.v.a. units are to be installed. The construction work includes 220,000 cu. yd. of concrete masonry; 250,000 cu. yd. of rock excavation and 400,000 cu. yd. of earth fill. The head at this plant will be 80 ft.

The wheels and generators in the two plants will be of identical design. The wheel contract has been let to the S. Morgan Smith Co. and the generator contract to the Allis Chalmers Co. Contracts for the construction work are to be let shortly.

## Jersey City Favors Municipally-Owned Gas Works

A majority of nearly 31,000 votes was cast in Jersey City on Nov. 8 in favor of acquiring or building gas works for light, heat and power for both public and private use. No plan of action has yet been adopted.

## Bureau of Standards Studies Soil Corrosion on Iron and Steel Pipe

The Bureau of Standards has recently undertaken an extensive investigation of the corrosive action of soil on pipes used for gas and water mains and services. In this investigation the Bureau of Standards has the co-operation of the Bureau of Soils of the Department of Agriculture, pipe manufacturers and the public utilities. Forty locations have been selected as representative of the principal families of soils to be found throughout the United States and in them will be buried a number of samples of every kind of iron and steel pipe in commercial use.

Complete data on the physical and chemical properties of the soil will be obtained, also the chemical analyses of the pipe, their microstructure, and complete metallurgical heating will be determined. Extensive laboratory experiments will be conducted to determine the effects of variations in individual characteristics of both soils and pipe materials. Some tests of representative pipe coatings will also be undertaken.

It is expected that a good deal of data as to the relative rates of corrosion of different kinds of pipes in the soils under observation will be obtained within two or three years, but the experiment will probably continue over a period of eight or ten years. Progress reports will be published periodically.

## Plan To Tap Lake 45 Feet Below Water Level

The Tule and Baxter Creek Irrigation Districts in northern California have contracted with Leon Bly for the construction of a complete irrigation system to provide 50,000 acre-ft. of water per annum, and to cost $1,250,000. The contractor is to turn the system over to the districts with water rights, rights-of-way, structures, etc., complete and ready for operation. The two districts involve a total of 25,000 acres in the Honey Lake basin and the water supply is to be taken from Eagle Lake.

The plan proposes a distribution system by means of an 8,000-ft. tunnel that will tap the lake 45 ft. below water level. There are approximately 1,000,000 acre-ft. in the lake above the proposed tunnel level. If the level is drawn down 45 ft. below the present height, the area of the lake surface would be reduced from 30,000 to 8,000 acres and the saving in evaporation on this 22,000 acres is expected to be enough to supply the annual requirements of the districts.

Features of the distribution system will be a 5,000-ft. flume to carry 250 sec.-ft., and several large siphons, one of which will be 52 in. in diameter and 16,000 ft. long. The area to be irrigated is largely sage-brush lands, most of which are now desert. The scheme for tapping Eagle Lake has long been under consideration; a tunnel was started in 1873 but never finished.

T. H. Means of the Cope, Rand, Means Co., San Francisco, is engineer for the irrigation districts.

## California Objects to High Road Costs for Heavy Trucks

Pointing out that in the production of motor trucks in the United States in 1920 only 2 per cent were of 5-ton capacity and only 1 per cent over 5 tons, the California Highway Commission has issued the following statement, which raises the question of the advisability of adding greatly to road construction costs for the sake of a comparatively few users:

"As the ratio of use must be in close proportion to the ratio of production, it follows that only about 3 per cent of vehicles using California State highways are of the so-called heavy duty type. This year there were approximately 40,000 trucks of all kinds registered in the State, which indicates only about 1,200 to 1,500 trucks of 5-ton or more capacity.

"Highway construction, like other governmental activity, is based on public necessity, and this necessity should be met reasonably when highways are built, adequate to sustain 90 per cent of the traffic. In California this percentage will include all motor, and other vehicles, up to and including two ton capacity. Assuming that for $30,000 per mile an improved highway can be built adequate to sustain 90 per cent of the vehicular traffic of the State, but that it will require $50,000 per mile to construct a highway which will sustain the weight required by 10 per cent of heavier-duty trucks, should the general tax payer be required to invest an additional 66 per cent in road construction for the exclusive benefit of this particular class of heavy vehicles?

"In California highways are being constructed from bond funds provided by general taxation. Motor vehicle license fees are inadequate to provide funds necessary for proper maintenance, and the fees bear no relation to the wear and tear to which the vehicle licensed subjects the highway. The legal weight limit here is equaled by only three other states in the Union."

## Ask Bids To Build Piers of Philadelphia Bridge

**Bids to construct the two main piers of the Delaware River bridge to connect Philadelphia and Camden are asked by the Delaware River Bridge Commission, 806 Widener Bldg., Philadelphia, until 3 p.m., Dec. 19. The piers, located approximately at the pierhead lines, are to be sunk to bed rock by the pneumatic caisson process. They will be 70 x 143 ft. each.**

## Civil Service Examinations United States

*For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.*

One vacancy in each of these positions in the Bureau of standards, Department of Commerce, Washington.

Structural Engineer, $3,600 to $4,800 a year.

Associate Structural Engineer, $2,500 to $3,600 a year.

Assistant Structural Engineer, $1,800 to $2,400 a year.

Junior Structural Engineer, $1,200 to $1,500 a year.

# ENGINEERING SOCIETIES

## Calendar

### Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, New York City, Nov. 8-19.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

**The Engineers Club of Seattle,** (Wash.) has leased the College Club Building as its new headquarters.

**The Houston (Tex.) Engineers' Club,** on Nov. 1, was addressed by Dr. Edward Ardern of Manchester, England, on "Activated Sludge Process."

**The Webster City Engineers' Club** of Webster City, Iowa, Oct. 29, was addressed by E. E. Schenk, on "What the Club can do for the City," and by Prof. J. H. Dunlap on "Is the Present Engineering Education Adequate?" Mr. Schenk argued that the engineer should mold public opinion to the attainment of better public improvements. Following Prof. Dunlap's talk a committee on the education an engineer should receive was appointed to collaborate with active Iowa clubs and report to the Iowa Engineering Society in January at Sioux City.

**The Princeton Engineering Association of New York,** composed of technical graduates of Princeton University, has created "The Cyrus Fogg Brackett Lectureship in Applied Engineering Technology." The lectures will be given at Princeton and the speaker at the first meeting, Dec. 1, will be Samuel Insull, president of the Commonwealth Edison Co., Chicago, on the subject of "The Production and Distribution of Electric Energy in the Central Portions of the Mississippi Valley."

**The Allied Engineering Association,** Charleston, S. C., at its Oct. 17 meeting was addressed by Col. Eugene Kelly, manager of the White Truck Agency, Charlotte, on the motor truck, its uses, cost and maintenance, and also on good roads.

**The Society of American Military Engineers, New York Post,** at its meeting Nov. 1, in the Engineering Societies' Building, New York City, was addressed by Maj. George W. Johnson, of Columbia University, on "Strategy and Tactics of the Great War in Their Relation to Geographical and Geological Features of the Theatre of Operations." The talk was illustrated by lantern slides.

**Engineering Institute of Canada**—At a recent meeting of the civil engineers of London and St. Thomas, Can., preliminary plans were made for a formation of a branch of the Institute. Organization will take place Nov. 16. At the preliminary meeting, H. A. Brazier, city engineer of London, was elected chairman.

# PERSONAL NOTES

HARRY L. MAIER, formerly engineer in charge of sewers, Street and Sewer Department, Wilmington, Del., has been appointed chief engineer, succeeding Edgar M. Hoopes.

JAMES W. PHILLIPS, chief of the grade-crossing division of the Bureau of Surveys, Philadelphia, has been engaged to represent the City of Minneapolis in a suit involving $12,000,000.

A. CRAINE, formerly division engineer of the Chicago, Burlington & Quincy R.R. St. Joseph, Mo., has been appointed district engineer, maintenance of way, with headquarters at St. Louis, Mo.

GEORGE POSEY, who recently has assisted in preliminary surveys of the Sacramento-Woodland railroad and in Richmond harbor developments, has been appointed surveyor of Alameda County, Cal.

DONALD E. A. CAMERON, formerly engineer with Robinette-Bruyere-Cameron, Toledo, Ohio, has been appointed chief engineer for the Watts & Suhrbier Co., general contractors Toledo, Ohio.

RICHARD A. HALE has been appointed chief engineer of the Essex Co., Lawrence, Mass., to fill the vacancy caused by the death of Hiram F. Mills. As resident engineer, Mr. Hale took charge of the Essex Co. work in 1892, when Mr. Mills went to Lowell. Later on, Mr. Hale was made principal assistant engineer. Although Mr. Mills held the title of chief engineer up to the time of his death he had not visited Lawrence nor taken any active part in the Essex Co. for the past ten years.

J. E. BARLOW, formerly city manager of Dayton, Ohio, has been appointed city manager of New London, Conn.

THE RANDOLPH-PERKINS Co., engineers and manager, successor to Isham Randolph & Co., the Edmund T. Perkins Engineering Co., and the George B. Massey Co., has incorporated with offices in Chicago. The officers of the company are LeRoy K. Sherman, president; George B. Massey, vice-president; Charles T. Mordock, treasurer; and Robert Isham Randolph, secretary. Mr. Sherman was formerly chief engineer and vice-president of the Edmund T. Perkins Engineering Co. Mr. Massey is a mechanical engineer specializing in excavating machinery and methods. Mr. Mordock was formerly Chicago representative of the J. G. White Co. and specializes in public utilities. Mr. Randolph was formerly senior partner of the Isham Randolph & Co., specializing in land drainage, levees and pumping plants.

THEODORE F. LEIST, formerly major of engineers, Construction Division, U. S. Army, and recently architect of the central district with the bureau of valuation, Interstate Commerce Commission, has been made Chicago representative of the National Lumber Manufacturers' Association.

## OBITUARY

SAMUEL M. GRAY, consulting engineer, of Providence, R. I., died in Slocum, R. I., Nov. 5. A sketch of his professional experience, which included 31 years of practice, mainly in the fields of water-works and sewerage, will appear in next week's issue.

COL. GEORGE H. WEBB, chief engineer, Michigan Central R.R. since 1905, died Nov. 3 in Newton, Mass. He was born in Dubuque, Iowa, in 1860 and was graduated from the Pennsylvania Military College in 1880. His first position was that of rodman with the Baltimore & Ohio R.R.; later he was levelman and transitman with the Pittsburgh Southern Ry. and division engineer Pittsburgh & Western R.R. Leaving railroad work in 1883 he became city engineer of Johnstown, Pa. and in 1884 was made engineer in charge of construction work for the Johnson Steel Street Rail Co. Later he returned to railroad work as assistant engineer on branch lines of the Chicago, Burlington & Quincy R.R. and from 1889 to 1891 he was engaged in the construction of government railways in Chile, for two years of this time as division engineer of the North and South American Construction Co., in charge of all construction. He then became division engineer and superintendent of construction, Summit division, Central Ry. of Peru, through the main range of the Andes. From 1893 to 1897 he was engaged in private engineering practice, and then became chief engineer of the Cincinnati, Georgetown & Portsmouth Ry. His connection with the Michigan Central began in 1903, when he located the Ostimo division. During the war he was lieutenant-colonel of the 16th Engineers in France and later served as section engineer, intermediate section, (east) of the Division of Construction and Forestry of the A. E. F., at Nevers.

HOWARD C. HOLMES, civil and consulting engineer of San Francisco, died in that city on Oct. 30. He was born in Nantucket, Mass., in 1854. He went to San Francisco and started at an early age as a surveyor; when he was nineteen years old he made the topographical survey for the development of Lake Chabot. For some years he was assistant engineer of the California State Board of Harbor Commissioners and later chief engineer. Early in his career he gave attention to the construction of cable railways and was identified with both design and construction on a number of the San Francisco cable systems as well as similar lines in Seattle, Portland and Spokane. He had charge of the foundation work on the San Francisco Ferry Building and carried out the construction of the Alameda mole, the Key Route Mole, the greater part of the Oakland, Alameda and Piedmont Railroads, the yacht harbor and freight and passenger terminal at the 1915 Panama Pacific Exposition and the Hunter's Point drydocks. He was at different times the former consulting engineer of the Massachusetts Harbor and Land Commission, the Esquimalt Shipbuilding and Drydock Co. of British Columbia, the Port of Portland Dock Commission, the Bethlehem Shipbuilding Co., the Moore Shipbuilding Co., the Western Pacific R.R. and other corporations.

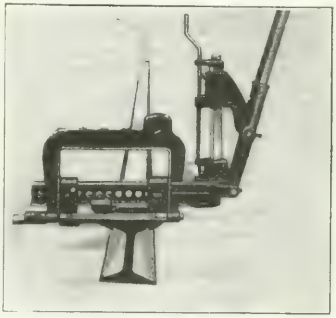
WILLIAM E. BAKER, civil engineer, died in New York City Nov. 7. He was born in Springfield, Mass., 1856, and was graduated from Lafayette College in 1877, of which institution he was a trustee for many years. From 1877 to 1888 he was engaged in railway work on the engineering staff of the St. Paul & Pacific R.R. as transitman and engineer; as transitman with the engineering staff on the survey of the Canadian Pacific Ry. through the Rocky Mountains; and as resident engineer in charge of bridges and buildings of the International & Great Northern Ry. From 1888 to 1892 he was with the Thompson Houston Electric Co. in charge of installation of electric equipment of the West End Street Ry., Boston, Mass. He was general manager of the Columbian Intramural Ry., at the World's Fair in Chicago and later general superintendent and general manager of the Metropolitan West Side Elevated R.R., Chicago.

MAJOR-GEN. PETER C. HAINS, U. S. A., retired, Civil War veteran, and former member of the Isthmian Canal Commission, died at Washington, D. C., Nov. 7. He was born in Philadelphia in 1840 and was graduated from the U. S. Military Academy at West Point in 1861. He was commissioned second lieutenant in the Second Artillery on June 24, 1861, and two years later was transferred to the Corps of Engineers, being promoted through the several grades until he became a brigadier-general in 1903. During the Civil War, he served in the defenses of Washington, in the Manassas campaign and was engaged in the battle of Bull Run. He was in the Virginia Peninsular, Maryland and Rappahannock campaigns, and was chief engineer of the Thirteenth Corps from March until July, 1863. In 1862 he was brevetted captain "for gallant and meritorious services" in the battle of Hanover Court House, Va.; major, in the same year, for services during the siege of Vicksburg, Miss.; and lieutenant-colonel, in 1865, for services during the war. He served also in the Spanish-American war as brigadier-general of volunteers and was in command of the Third Division, First Army Corps, and later was in command of the Second Brigade, First Division. He was a member of the Nicaragua Canal Commission in 1897 and 1898 and later served as a member of the Isthmian Commission. His army assignments included numerous works of harbor and river improvement and harbor defense. He retired from active service in the army in 1904. He was appointed major-general, U. S. A., in 1916, under a special act of Congress and was assigned to active duty in 1917 as engineer, Norfolk Harbor and River District. He retired from active service in 1918. Gen. Hains developed the concrete mixer which bears his name.

## EQUIPMENT AND MATERIALS

### Lever-Handled Hacksaw

A portable hacksaw for cutting rails and steel shapes, brought out by Crerar, Adams & Co., of Chicago, has the frame clamped to the rail or shape to ensure



a straight cut and the saw is operated by a long lever so that the work is faster and less laborious than operating a hand hacksaw. The frame is adjustable to any width up to 9 in. and to any horizontal angle up to 45 deg. Saws 14 to 17 in. long are used, and the machine in working order weighs about 110 lb. Track, bridge and building construction and track maintenance are the fields of work for the new hacksaw. It is stated that a 90-lb. rail can be cut in 30 minutes, a 125-lb. 9-in. grooved girder rail in 45 minutes, and a 9-in. I-beam in 25 minutes.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Railroads Show Operating Gain

The net operating income of 197 Class 1 railroads amounted to $82,707,607 for September, 1921, an increase of 11 per cent reported for September, 1920. This report lacked four roads to be complete. Road revenues for the month were $479,938,638, a decrease of 19.7 per cent compared with the amount a year ago. Operating expenses for the 197 roads were 26.2 per cent less this year than in September, 1920. Expenses this year stood at $865,342,237. In August the roads reported net railway operating income of $90,241,103.

The greatest single saving in expense was accomplished by the eastern district which cut its operating cost 29.8 per cent.

## Railways Placing Orders For New Equipment

The Chicago, Burlington & Quincy R.R. and the Colorado & Southern Ry. Co. have been authorized to purchase $15,000,000 worth of new rolling stock, and it is understood that immediate arrangement is to be made for the purchase of 7,300 freight cars, 55 heavy freight and passenger locomotives and 127 all steel passenger cars. This decision was made on the "belief that there is a decided upward tendency in traffic and that before long additional facilities will be required to meet the transportation demands of the country."

A report has been made also that the Illinois Central R.R. Co. has placed orders for 900 cars, at an aggregate cost of $2,660,000 and has invited bids for 2,000 coal cars to cost $4,000,000.

## Railroads Refused Right to Raise Freight Rates

The Public Service Commission of Missouri has notified the committee representing the Missouri railroads that it would refuse to increase their freight rates on coal, coke, stone, brick, gravel, limestone, cement, oil, etc., in compliance with the order of the Interstate Commerce Commission issued November 4. The refusal of the public service commission is construed as meaning that no permits for higher rates upon the commodities listed will be filed until the right or lack of right of the Interstate Commerce Commission to regulate freight rates is determined by the Supreme Court of the United States.

## Labor Paragraphs

The 79 member firms of the Employers' Association of Detroit added 4,400 workers to their pay-rolls, making the total at work 115,800, although half are on part time schedules.

Sacramento is in urgent need of building labor of all classes. Lowered material prices are reported to have increased construction.

Bricklayers now place 1,300 brick per day as against 600 to 700 in war days, according to W. L. Rathmann, president of the St. Louis Chapter of the American Institute of Architects.

## Trend of Business

**Stock Market**—Better tone resulting from good news from iron and steel industry, improved demand for copper, good railroad reports, and the upward trend of the bond market. Total sales last week were 2,484,337, as against 6,641,461 a year ago; high average of fifty stocks was about 67 as compared with nearly 80 in the same week last year.

**Bonds**—Slight check on buying, probably due to unloading by those who bought at low prices eight or ten months ago. New issues were heavy for a three-day week, totaling $55,000,000. Two industrial issues—Goodyear Tire & Rubber Co. 8 per cent sinking fund debentures, due 1931, at 99½, and Wilson & Co. ten-year 7½ per cent convertible debentures, at 96½—amounted to $37,725,000. Municipals strong throughout the week.

**Money**—No stringency, and easy money expected to the end of the year. Following is range of ruling call money loans last week and for the same period in other years: 5½ per cent; 9 per cent in 1920; 8 in 1919; 6 in 1918; 4 in 1917; 2⅜ in 1916; 1⅞ in 1915, 5⅜ in 1914. Total exchanges of checks last week (two holidays) in New York, as reported by the Clearing House was $2,840,410,705 compared with $4,665,924,290 the preceding week.

**Foreign Exchange**—German marks dipped to .33 cent. Other markets generally inactive.

**Textiles**—Census Bureau reports that cotton actually ginned prior to Nov. 1 amounted to 6,646,136 bales against the Department of Agriculture's forecast in October of 6,537,000 as the total yield. A net 1921 crop of 7,500,000 bales is predicted. The contract cotton market has dropped $9 as a result of the Census report; spot down $6. Thus, with ample supply, prices are not expected to go higher.

**October Steel Production** was one-third greater than for September. October steel ingot production was at the rate of 23,000,000 gross tons per year, or 44 per cent of estimated capacity. The Corporation's unfilled tonnage decreased 273,841 tons last month. Steel prices are slightly weaker than last week.

## Chicago Committee Proposes to Enforce Landis Award

A committee of citizens of Chicago has been formed to bring about a full adoption and enforcement of the terms and conditions laid down two months ago by Judge Landis in the building arbitration decision.

The reasons for the establishment of the committee were summed up by J. W. O'Leary at the organization meeting: "In spite of his efforts and the agreements of contractors and building trade unions to participate in the arbitration some contractors and unions have proceeded with work in Chicago without regard to the award. . . . The committee is making no fight on trade unions as such. Those unions which, in letter and in spirit, have accepted the Landis award and are working under it, will have the support of the committee in their action. Those crafts which withdraw from the award or refuse to accept its conditions automatically place themselves beyond the support of the public. Those contractors who have entered into agreements with unions outside of the award deserve neither the consideration nor the support of the public."

More than 150 citizens have already enrolled and all the money necessary to carry on the work is said to be available. Addresses have been made by leaders of a similar movement in San Francisco where it is said $1,000,000 was available in a similar campaign to clear up the restrictions on the building industry.

## New Roads for New Jersey to Cost $1,885,741

Road building contracts aggregating $1,885,741 will be awarded by the New Jersey State Highway Commission as a result of President Harding's conference on unemployment giving $942,870 in federal aid to New Jersey. The national appropriation was voted with the understanding that New Jersey would match whatever appropriation was forthcoming. New Jersey's allotment comes out of the $75,000,000 available for road work. Governor Edwards wired the Government that "New Jersey will immediately prepare to contract for new roads as a result of this action."

## Building Trades Employers Make Survey of New York City

A complete survey of conditions in the building industry in New York City is being undertaken by the Building Trades Employers' Association upon which the 1922 wage agreement between employers and employees will be predicated. The survey will reveal exactly what is to be expected in the volume of construction needed and likely to be contracted for under a given set of conditions. It is also hoped that information will be secured which will indicate the attitude towards construction of building and loan associations, banks

and other financial institutions having money to loan for construction purposes.

The employers association feels that labor and materials are not alone responsible for the holding up of work, and cites several examples in support of such a contention. It points to Philadelphia, for instance, that despite a 23 per cent reduction in wages, still lacks construction of any magnitude.

similar reduction is to be sought. It is not known exactly what the reduction will be but it is believed it will approximate 10 per cent for all operatives in the eastern and western districts. The wage reduction will affect approximately 1,650,000 railroad workers of all classes.

It is understood, however, that the new wage reduction, if granted by the Railroad Labor Board, will be translated immediately into reduced railroad rates, with the agreement of the Interstate Commerce Commission. Executives have been in conference with the Interstate Commerce Commission in order that a full and final understanding of the situation may be made clear.

Inasmuch as the Railroad Labor Board has made known that it plans to clear up its docket insofar as questions concerned with wages and working conditions are concerned before new wage rates are considered, it is possible that the consideration of the proposed wage reduction will not be arrived at by the Railroad Labor Board before three or four months. However, it is believed in railroad circles that the Railroad Labor Board will not long hold off consideration of the proposed reduction if an immediate translation of that reduction into lower railroad rates is quite possible of realization.


## *Do You Know the Business Side of Construction?*

THE KIND of business information published weekly by *Engineering News-Record* needs to be read by all engineers, contractors and materials producers and dealers who hope to keep up with the business of their profession and industry. *Engineering News-Record* keenly recognizes the need for economizing readers' time. Expert, inside knowledge of finance and trade can come only with deep and continual study of the multifarious elements that make up modern business. Financial leaders employ such students of business to keep them and their executives informed of the movements in industry and the meanings of the movements. *Engineering News-Record* gives a rapid survey of business in general and of construction affairs in particular.

A general knowledge of the trend of business, as referred to the construction industry, is essential to the successful conduct of engineering and contracting enterprises. Such knowledge goes a long way toward assuring the success of both the organization and the individual. It is this knowledge that *Engineering News-Record* is offering each week in its BUSINESS SIDE OF CONSTRUCTION.

*The Regular Features of This Department Consist of the Following:*

MONTHLY PRICES OF CONSTRUCTION MATERIALS. — *Including "Ups and Downs of the Market."*

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY. — *Covering seven classes of labor in twenty cities.*

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER.—*Giving comparison of current cost with cost in 1913.*

ENGINEERING NEWS-RECORD CONSTRUCTION VOLUME INDEX NUMBER.—*Giving amount of contracts let per month and per year in terms of 1913 values.*

CONTRACTS AWARDED EACH MONTH. —*Value of contracts let in each class of construction.*

TREND OF BUSINESS.—*Highlights in finance and human relations—stock, bond and money markets, wholesale and retail prices, cost of living.*

SKETCH OF PUBLIC BOND SALES EACH MONTH. — *Presenting essential data on some thirty representative issues of state, county and municipal bonds.*

MATERIAL STOCKS AND PRODUCTION. —*Showing time required to get materials on the job in the important cities.*

IN ADDITION to these standing features there is a stream of special studies, which completes the picture of construction activity. Just a few of these since March this year:

SPRING PRICES OF CONSTRUCTION MATERIALS SINCE 1913.—*Giving prices of all the important materials for April, May and June of each year since 1913, and an interpretation.*

CEMENT AND STRUCTURAL SHAPES COMPARED FOR 21 YEARS.—*With charts and a table of annual production.*

CEMENT, LUMBER AND STEEL BEFORE AND SINCE THE WAR. — *Prices over nine to twelve years, with charts. Comparison of prices with production.*

WHOLESALE COSTS — CONSTRUCTION AND LIVING. — *General construction costs compared wtih wholesale prices of all commodities and with special groups of commodities.*

FREIGHT RATES ON PRINCIPAL BUILDING MATERIALS. — *Showing actual shipping cost to contractor.*

WAGES AND THE COST OF LIVING.— *Relation between wholesale and retail prices shown. Actual decline in living cost established.*

CONSTRUCTION NEWS hardly needs an introduction to readers of *Engineering News-Record.* This is the department where jobs are found —jobs for the contractor's organization and for the individual. In 1920 a total of 26,986 items were published, of which 11,709 called attention to proposed work, 6,028 announced bids desired, and 9,249 contracts let. Every one of these items was sent in by our regular correspondents. Construction News is 100 per cent verified.

All this is the business side of construction as conceived and carried out week by week by *Engineering News-Record.* Modern business is complex. It is not enough to know only the little world of one's own organization. The cement man must know about brick and hollow tile, the brick man must know about cement and tile, the steel man about lumber, and all must follow the broad trends of the construction industry. The contractor must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. The engineer must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. These, and more, are the BUSINESS SIDE OF CONSTRUCTION.


## Railroads to Push Plan To Secure New Wage Reduction

Following an announcement made by managers of a western group of railroads at a meeting held in Chicago November 7 that immediate posting of notices of wage reductions of 10 per cent would be made, executives of the railroads in the classification territory east of the Mississippi and north of the Ohio River have announced that a

## Heavy Freight on Lumber Injures the Industry

"As long as it costs more to transport lumber from the sawmill to the consumer than it costs to make the lumber in the first place, conditions in the lumber industry will never be satisfactory," said a prominent lumberman in Washington a few days ago. He cited the instance of a car load of 2 x 4's sent from Tacoma to Buffalo, the freight

bill amounting to just one and a half times as much as the lumber cost at the mill. Another lumberman in the South told of having shipped a carload of dressed lumber to Cleveland and after he had paid the freight his net profit from the transaction amounted to $6.75.

At one end of the scale are those who want lumber and are eager to build. At the other end are the sawmills with abundant supplies of lumber. Between are the railroads.

These are not isolated instances, nor are they confined to the lumber industry. They are typical.

### Will Publish E. N. R. Cost Number 1913 to Date

So many requests have been received for a full list of *Engineering News-Record's* Construction Cost Index Number that this is being compiled for every month from 1913 to date. The numbers will be published as fast as computed, the first installment (January, 1920, to date) appearing Nov. 24. The other installments—each with a chart to date—will follow each week thereafter. Get the complete list.

### Dallas Co. to Let Contracts for 67 Miles of Roads

The Dallas County (Tex.) Commissioner's Court expects to let contracts for 67 miles of improved roads on Dec. 12, as a result of the sale of the second series of District 1 road bonds, aggregating $2,700,000. The price received for the bonds is equivalent to 96.75 and the purchasers pay par and accrued interest making a total of $2,786,625. The county pays a brokerage fee of $87,750. The sale nets the road district $2,698,875 or within $1,125 of the face value of the bonds. The bonds bear 5½ per cent interest.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $2.88 | $4.00 | $4.00 | $2.88 | $3.06 | $3.75 | $3.70 | $4.00 | $4.00 |
| Structural rivets, 100 lb. | 3.70 | 5.25 | 5.50 | —3.43 | 4.15 | 4.25 | 5.50 | 4.50 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2.78 | 3.20 | 3.50 | —2.68 | —3.08½ | 3.57½ | 2.90 | 3.75 | 3.25 |
| Steel pipe, black, ⅜ to 6 in. lap, discount | 51% | 52.65–5% | 45% | +57% | 58.9–5% | 38% | 51.8% | 50% | 35.10 |
| Cast-iron pipe, 6in. and over, ton | 47.30@48.30 | 40.50 | 54.30 | 42.60@44.10 | 47.80 | 52.00 | 50.00 | 53.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.40 | 2.60 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.12 |
| Gravel, ¾ in., cu.yd. | 1.75 | 2.00 | 2.25 | 1.65 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1.25 | 1.35 | 2.25 | 1.65 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.80 to 1.90 | 2.25 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 45.00 | 38.00 | 37.00 | 48.00—35.00 | | 50.00 | —30.00 | 24.00 | 120.00 |
| Lime, finishing, hydrated, ton. | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | 27.50 | 21.00 |
| Lime common, lump, per bbl. | 3.69 | 1.60 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 2.75 | 15.00 |
| Common brick, delivered, 1,000. | 18.40 | —10.50 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .10 | .124 | .0821 | .092 | .09 | .12½ | .10 | .08@.29 |
| Hollow partition tile 4x12x12, block | .11120 | .10 | .124 | .0657 | .... | .10 | .14½ | .11 | .... |
| Linseed oil, raw, 5 bbl. lots, gal. | .72 | .85 | .93 | .74 | .80 | .90 | .83 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour. | .75@.80 | .35 | .... | 72½ | .50 | .50@.55 | .75 | .50@.60 | .... |
| Common labor, non-union, hour. | .... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45 and 50 means a discount of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone at quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags, common lump lime per 180-lb net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex. mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

## Changes Since Last Week

Quotations on structural steel shapes, plates and bars at the Pittsburgh mills remain $1.50@$1.65 per 100 lb. Bars are easily obtainable at $1.50; $1.60 is the minimum on shapes and plates, with small tonnage selling at $1.65. Mill shipments, New York, of shapes and plates continue at $1.88@$2.03; bars $1.80@$1.88 per 100 lb.

The only actual increase in price in any of the construction materials quoted in the nine cities listed, is a reduction in steel pipe discounts in Chicago. Wrought pipe is the first steel product expected to show any marked improvement in the construction market. Montreal quotes 3½-in. lap-welded, black steel pipe at $35.10, galvanized $44.46 and 3½-in. black wrought-iron pipe at $47.97; galvanized, $57.33 per 100 ft.

Structural shapes are quoted in Minneapolis at $3.06 as against $3.16 per 100 lb. Chicago quotes structural rivets at $3.43 as compared with $3.68 formerly. Both Minneapolis and Chicago report reductions in reinforcing bars.

A reduction of $1 per M. ft. is quoted on Douglas fir in Minneapolis and on long-leaf yellow pine, base sizes, in San Francisco. Seattle quotes Douglas fir, 2-in. tongue-and-groove, 10 in. x 16 ft. at $17 as against $24 per M. ft. Lumber prices with a few exceptions show a tendency to stiffen with increased demand, especially as affecting the export trade.

Common brick is quoted in Atlanta at $10.50 as against $11 per 1,000; no changes in any of the other principal cities.

Linseed oil quotations have remained stable throughout the country during the last week.

A Consolidation of Engineering News [illegible] Engineering Record

McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 NEW YORK, NOVEMBER 24, 1921 Number 21

## First General Rate Reduction

IT WAS a good move on the part of the railways to reduce rates 10 per cent on agricultural products in advance of action on further proposed wage reductions which, they promise, are to be passed on to the public if granted. It indicates a willingness to add to the stress under which they are working and to suffer some decrease in the rising rate of their earnings. This attitude will bring public appreciation, even if it will not—and it should not—decrease the public's demand for lower rates. Rate deflation is as necessary as deflation of other charges upon the public. That wages need deflation simultaneously is not to be doubted, but a general rate reduction running ahead of wage lowering will tend to accelerate the latter.

## Leadership in Industry

LAST week's paving-brick conference in Washington illustrates the helpfulness of the leadership in industry being afforded by the Department of Commerce. Secretary Hoover's well-known sympathy with the idea of eliminating all forms of industrial waste and the emphasis he has placed on the desirability of eliminating indefensible varieties makes it logical for industries that are burdened with an abnormal number of styles to appeal to the department for assistance. The fabricated products department of the U. S. Chamber of Commerce is working to the same ends and is furnishing the stimulus that is leading some industries to the department. In one way the department had very little to do with the result achieved last week; it took no part in the meeting other than to stress the desirability, as a general principle, of eliminating industrial waste; it offered no survey or report on the subject; it had no experts to counsel what, in detail, should be done. In another way, it had all to do with the good result, for without its encouragement the meeting might not have been held. It was entirely impartial. It had neither manufacturing ends to serve nor engineering theories to exploit or censerve. Its attitude in that conference should be an encouragement to other industries which need variety elimination.

## Achievement in Detail

PROGRESS in any art finds reflection in the perfection and power of its detail devices. In the light of this principle the Stock Exchange Extension framing described in this issue by one of its designers takes high rank as a demonstration of how far the art of applying rolled steel to structural uses has progressed. The architect put unusually severe demands on the structural engineer by suppressing an entire story of interior supports and asking him to carry more than twenty stories over a large hall. The conditions imposed by this demand not only necessitated the remarkably heavy truss construction shown, but also restricted the wind bracing seriously. In respect to both of these difficulties the key to success lay in efficient, ingenious detail design rather than in new method or conception. Thus, the transfer of huge forces through the trusses was accomplished within surprisingly confined space limits by extreme concentration of metal in main members and by integration of multiple gusset plates with the truss members to such degree that the end diagonals are nothing more than splices connecting the gussets. Similar difficulties, though they are less obvious, were overcome in the wind-girder system, again through command of detail. The merit of the result achieved is easily overlooked, since the finished construction proves the possibility rather than the near impossibility of meeting the requirements imposed. Yet those who have themselves handled difficult cases of steel detailing will appreciate the problems involved and the relation of detail perfection to their solution.

## Approaching Great Problems

BURIED in the daily routine of professional tasks amenable to precedent, rule, and weighing of dollar against dollar, the engineer tends to lose his appreciation of the creative thinking on which enduring achievement in the art depends. Indeed, the conceptions and intuitions of which it is composed are in a field somewhat remote and separate from the ordinary currents of professional thought, and are easily forgotten in the constant use of the tools that serve our work-a-day purposes. The thoughtful essay of Gustav Lindenthal on long-span bridge design, page 861 brings back to the consciousness the transcendent importance of broad contemplation and integral grasp of a problem. His stressing of the architectural viewpoint strikes near the root of the matter—not, we take it, because ornament or curved beauty-lines are of any significance, but because the structure that shall fulfill all its purposes most fittingly must be seen by the mind as an entity and must be evolved in complete harmony of its several elements; it cannot be pieced together of separately devised parts. In broad, truly creative consideration, the form and functioning of each element develops in subordination to form and functioning of the whole. It is in the great problems that this method of approach is indispensable—in those problems which, regardless of mere bulk, strain to the limit the capacity of materials or method. But its power and inspiration have value even in everyday work, in degree depending on the individuality of the engineer. If, then, the essay shall strengthen the engineer's regard for broad contemplation of his problems, it will contribute measurably to the advancement of the profession.

## Solidity and Success

PRESIDENT HIBBEN, in opening the new term at Princeton University last month, pleaded with the students for "a revival of learning." In thorough intellectual discipline he saw aids in the settlement of

the difficult problems that have followed the wake of the war. It is not uncommon to hear emphasis laid upon the need for thorough scholarship as opposed to the veneer which is all that many men acquire in college. It is true that energy counts heavily in getting things done and rising to high place. But it is a mistake to think that typical American "pep" and selling ability are alone sufficient to carry men to high achievement. These things are valuable, but they are most valuable when they are the assets of a man with a well-disciplined mind.

## Is the St. Lawrence Waterway Practicable?

NEW YORK—both city and state—is beginning to take notice of the St. Lawrence waterway project. The governor is making stump speeches against it, the metropolitan newspapers are viewing it with alarm and the Port Authority is calling for a counter-offensive against the propaganda of the Northwestern States association which favors the project. This is a good thing. The country needs waking up as to the magnitude of the proposition and its national importance. A good fight will serve to clear up misapprehensions and to decide the issue in the clear light of facts rather than on the basis of sectional preference and interest.

Much loose talk has been indulged in by both sides. New York, through its governor, has centered its opposition on the claims that the navigation advantages of the St. Lawrence can be more cheaply and safely served by the Barge Canal and that the power prospects are merely a scheme of the "interests" to get free power and charge excessive rates. The first claim has been answered epigrammatically by Governor Allen, of Kansas—"We are bound for Liverpool, not Buffalo." In other words, the transshipment charges at Buffalo and New York City which served so admirably to swing those two communities into a majority for the Barge Canal in 1901 are a horse of another color when viewed as added costs to the shipper. As to the "power grab," can any one take it seriously in these days of public rate control? The West, on the other hand, seeking a cheaper outlet for its grain, looks at the difficulties of navigation, the cost of the improvement, and the prospects for freight movement other than grain through the rosiest of glasses.

Out of the welter of biased argument three questions emerge—Is the project physically possible? Will it pay? How is it to be built, controlled and paid for? They may be answered by the forthcoming report of the International Commission. Meanwhile, what do we know about them?

Engineers have no doubt as to the feasibility of the waterway. To build a 25- or 30-ft. channel from Montreal to the Lakes and simultaneously to provide millions of horsepower is quite possible. Already one general plan has been submitted by international government engineers and several other schemes are before the Commission. Furthermore, it will be quite practicable to build an 8,000-ton ocean-going steamship which can be operated economically through the Great Lakes and on the St Lawrence—not as economically as a present lake steamer, but that is beside the question for there is to be no competition between the lake steamer plying only between lake ports and an ocean steamer tying up lake and ocean. Engineering details of the waterway will have to be worked out, but that is merely a question of time and talent.

As to the economics of the project, it should not be necessary to remind men with any regard for honesty in figures that the costs of the navigation features must be separated from those of the power-development, and that against each must be set separately the corresponding uses and benefits. To say that the power rates will pay a satisfactory return on the cost of the whole project is to ignore the practice of public regulatory bodies in basing returns on the cost of service. No commission will permit electric-rate earnings on the whole cost when a large part of the expenditure has been incurred by navigation features. The best that can be hoped for is that there will be a fair spread between the return allowed through the power charges and the rate at which the government can borrow money to finance the project.

If it be true that the proponents must be mindful in the use of figures equally true is it that the opponents must be honest and not set the whole cost of the project against the navigation benefits.

Whether the project from the navigation side is economically feasible remains to be seen. Estimated first costs now being used by the proponents are undoubtedly too low and the estimated freight flow a matter of guesswork. Bulk shipments—grain, coal, ore, raw chemicals—will be moved more cheaply, not only where no transshipment is required but also, on account of the perfection in bulk transfer, to and from inland locations where part rail haul is necessary. Bulk shipments, however, are only a part of the necessary business a lake to ocean waterway must do and the economies of package freight have not been thoroughly examined. Obviously shoes made at Brockton could be hauled by motor to Boston, loaded on a ship which would deliver them to a pier warehouse at Duluth cheaper than they could be by rail, but equally obviously a machine made at Pittsburgh could not be shipped to New York, sent by steamer to Cleveland and by rail thence to Louisville cheaper than over an all-rail route. Somewhere between these two examples are the economic limits of the waterway. Similar reasoning applies to the area of economic delivery beyond lake ports for goods arriving from Europe via the St. Lawrence.

As to power economies, there should be no question. The greatest water power in the world is going to waste on the St. Lawrence. It must and will be developed. The present issue is whether that power is to be developed by itself or whether the works necessary to create it shall be utilized to help create a navigable channel. Any investigation of the economies of the waterway as a freight carrier must be based on the cost which the navigation features add to the power project.

The last question to be answered is largely in the hands of the diplomats. How are we going about building an international improvement, which may prove directly profitable—that is in actual cash return—and guarantee equal rights, privileges and control. Will we form a corporation, with stock jointly held by the two countries, and issue bonds to pay for the improvement or will we form a joint commission and leave each country to appropriate the necessary money, to be raised of course by taxes equably distributed over the whole people? These are important details that have never been discussed by either country officially. The International Joint Commission will have to give some attention to them before individuals can consider them. As to selfish national interests there need be no question.

There are opponents and proponents on both sides of the line. And in the incredible event of war, no advantages are offered either nation; the military authorities are agreed on that.

What then does the St. Lawrence case boil down to? That there is a decidedly predisposing argument in favor of the project, but that much remains to be investigated by expert authority. That the West overemphasizes benefits and underestimates difficulties. That the opposition of New York is largely selfish, one more indication of the strange fear that apparently hangs over the state and city of being dispossessed of its premier position. How curious that a state could cheerfully gamble away $101,000,000 (which has grown to half as much again) on a doubtful canal project and then oppose the expenditure of two or three times that much by the whole country on a scheme which insures from the power revenue at least a return on more than half the investment—a business proposition so superior to that of the Barge Canal that no comparison is possible. Widespread discussion is going to be the best possible thing for the project, but even that discussion will not begin to tell until the International Joint Commission puts before both countries the data which have resulted from its two-year investigation.

## Fewer Sizes of Paving Brick

AN AUSPICIOUS start was made last week in the elimination of indefensible designs in products manufactured for the construction field when a conference of engineers and manufacturers approved the reduction in current varieties of paving brick from 66 to 11. Work of this sort was undertaken during the war, and is now being resumed.

The recommendations in the paving-brick case, if approved by the organization represented, should bring to the construction field the benefits commonly conceded to flow from concentration on a limited number of models or varieties. Lost time in changing machines will be reduced, production will be increased, and overhead spread over a greater number of units. Less capital will be tied up in patterns, dies and special machinery. Carrying charges on stock will be reduced. These benefits, primarily, accrue to the manufacturer. In a competitive market they pass to the consumer.

We do not infer that reductions in paving-brick prices can be looked for at once, or even soon, but the healthier industry that will result must eventually show its effect in better service, a better product or lower prices.

The effort at Washington is to be particularly commended because the benefits will be secured without any sacrifice in quality, desirability or service of the product. For the manufacturer the elimination of 55 varieties from the current list is a radical improvement. Technically, however, the step is not radical. The varieties eliminated have no superiority over the varieties retained. To put it more broadly, the results sought by the paving and highway engineer can be obtained without loss by using the varieties retained.

In reaching its decisions the conference sought to balance manufacturing against engineering considerations. For manufacturing reasons a still smaller number of accepted varieties is desirable, yet engineering practice dictated retaining eleven. With these varieties the engineer has a choice of 3, 3½- or 4-in. pavements, which covers all the demands of present paving practice.

It should be remembered, too, that determinations of this sort are not made for all time. If future conditions should demand new sizes last week's recommendations will need revision, and this is provided for by the designation of a permanent committee composed of representatives of interested organizations. Moreover, there is nothing to prevent any engineer from getting anything he wants, provided he is willing to pay a premium in proportion to the added cost. In the past, the extra cost of freak sizes was loaded on to buyers generally. Now it will properly be assessed against those who insist upon departing from standard. This will create some dissatisfaction, yet we acquiesce in this trade practice in many other trade lines. In fact, the practice is well-nigh universal. If we choose a "special" I-beam for a steel structure, we expect to pay an additional price for it.

Last week's step, however, does not complete the work. It must be approved by all the organizations represented at the meeting. This approval should be prompt and hearty. The proposed simplification is in the interest of all concerned.

## Wire Cable Questions

WHAT Mr. Lindenthal says of suspension bridge towers is likely to stir up various reflections, from those which revolve about the properly stigmatized "bandy-legged towers" of the Williamsburgh Bridge (and they are now proposing to call it the Roosevelt Bridge!) to those which doubt the possibility of dogmatizing on principles of steel designing. We are still fairly far back in the stone age as regards notions of architectural aesthetics, and men will disagree on questions of the beauty of steel towers. Everyone, no doubt, wishes to see stress carried visibly in naturally spreading paths from load to base; but, though we all think we know how this is to be accomplished in stone, in cast iron or in concrete, the strength of these materials is patently foreign to that of steel, and forms must therefore differ. We can afford to wait for fuller development of ideas on this subject.

On the other hand, the subject of cable strength is of immediate urgency, since it concerns the most efficient structural element we possess, and affects the possibility of many river crossings, quite aside from the fact that, if the wire cable is ruled out of the long-span field, one of our most highly admired bridge forms must be modified. Mr. Lindenthal casts doubt on the sufficiency of parallel-wire construction, as heretofore practiced, for extremely large cables. His reasoning is so weighty as to suggest that the bridge-building profession is under obligation to bring to light all facts discoverable as to the production, the stress behavior and the permanence of existing large bridge cables. That has not yet been done, but should be done in the future. Beyond this we have the possibilities of stranded cables, of eyebar chains and of built plate chains to consider—a large field for exploration in the fuller exploitation of the suspension bridge.

At the moment the subject is in highly activated condition, since the engineers of the Delaware River bridge have built up their project on parallel-wire cables of unprecedented size—and difficulty, says Mr. Lindenthal—while he himself is planning to use eyebar chains of enormous proportions for his great Hudson River crossing.

# Heavy Steelwork in New York Stock Exchange Extension

## Four Trusses Weighing 150 Tons Each Required To Span New Board Room and Carry 24-Story Building—Steel for Upper Stories Used in Erection Falsework

By John W. Pickworth
Member [illegible] Pickworth, Consulting Engineers, New York

OF THE MANY unusual engineering problems in building construction presented by a crowded business district, the addition to the New York Stock Exchange, now in course of erection, contains some of the most interesting and unique. The present building, an 8-story structure situated between Broad and New Sts., is to be extended northward to Wall St. The addition is to be 24 stories high, faced with marble, and will be one of the most imposing buildings in the financial district. One of the top stories will be the home of a brokers' club, and the rest of the upper floors will be used as offices. The trading room or "board room," occupying the ground floor of the present building, is to be enlarged to include almost the whole area of the addition, three openings being cut in the wall between the two buildings for communication. The necessity of providing for this extension of the board room gave rise to the most interesting feature of the structural design, a group of exceptionally heavy trusses which carry the entire weight of the central portion of the building above ground. So far as the writer knows, these are the heaviest trusses ever used in office-building construction, and the columns supporting them are probably among the heaviest building columns ever designed.

*Truss System of Support.*—It was the architect's desire to make the extension of the board room an open space without columns, with a ceiling height of about 40 ft. Because of the importance of the lower floors, the trusses for carrying the structure over the board room had to be placed in the fifth story. These trusses, four in number, run north and south from columns on the Wall St. front of the addition to new columns just north of the old building. The third floor, forming the ceiling of the board-room extension, and the fourth floor, which forms a mezzanine in the third story, are hung from these trusses. The fifth and sixth floors frame into the bottom and top chords of the trusses respectively, the rest of the building standing on top of them.

As the plot is irregular the trusses vary in length, from 60 ft. 9¼ in. to 77 ft. 10⅛ in. c. to c. of supporting columns. Truss *C*, though not the longest, is the heaviest of the trusses, because the peculiarities of the various leaseholds which go to make up the plot necessitated designing that particular truss strong enough to carry a partition wall, should the owners desire to divide the building into two parts at the expiration of leases eighty-odd years hence. It weighs 165 tons, while the other three weigh about 150 tons each. Access to the different parts of the fifth story is obtained by doors or passages which go through the trusses between the diagonal members.

The depth of the trusses is 15 ft. 10 in. c. to c. of

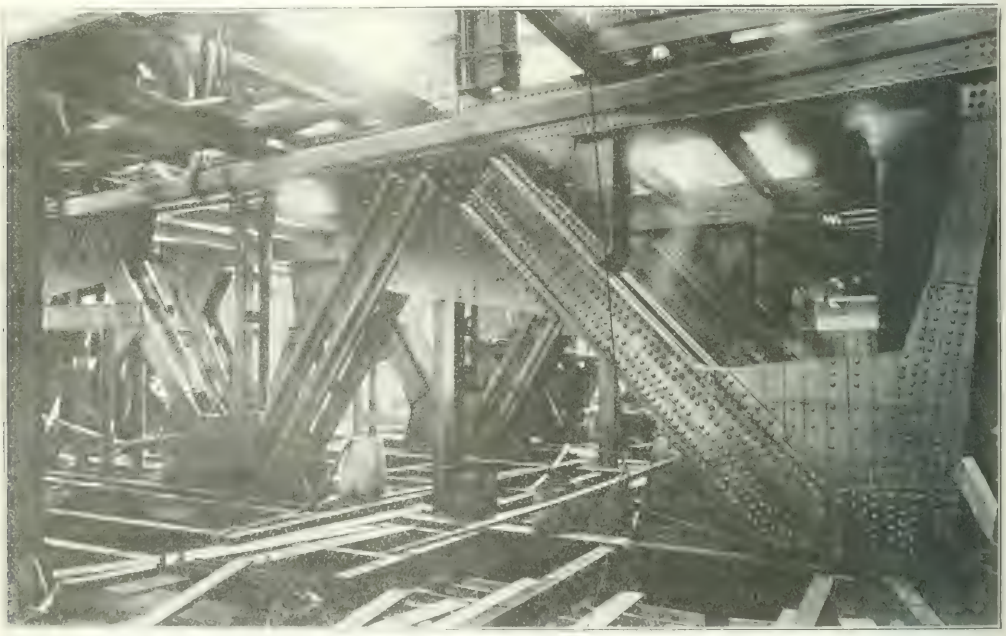


FIG. 1. HEAVY TRUSS CARRYING 21 STORIES OF STOCK EXCHANGE EXTENSION
Triple gusset of end joint at right; part of forked hanger at middle of truss at extreme left.

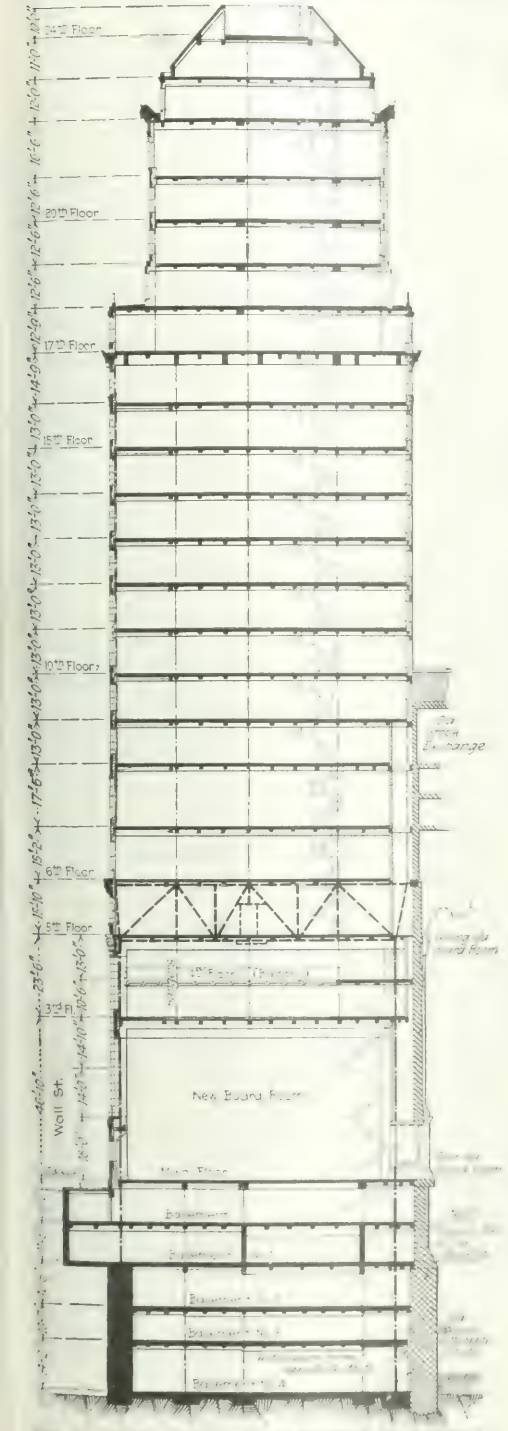



FIG. 2. STOCK EXCHANGE EXTENSION IN VERTICAL SECTION

chords. The calculated stresses run as high as 2,310 tons in the chords, while the heaviest diagonal has a stress of 2,480 tons. Column 13 receives the largest truss reaction, namely 2,406 tons, and the heaviest column load at the base is 2,556 tons. These large forces made necessary the design of particularly heavy built up sections for the columns and main truss members.

*Truss Makeup and Joint Details.*—There are many things that contribute to the engineering difficulties in a design of this kind. It was necessary to contend with the fact that the plot is of irregular shape, and further, is cut into several still more irregular pieces by property lines. Though having no relation to the design of the building as a whole, these lines had to be observed in order that legal difficulties might not arise due to encroachments and mutual dependencies, if the various owners should desire to separate when their present long leases expire. Then too, there is the great value of space in the financial district to be thought of. The structural work is continually being cramped to preserve architectural conditions, as a few more inches of headroom here, or a few more square feet of floor space there, are likely to be thought more desirable than the saving of steel through more economical design. Thus it was as the result of considerable study that the very compact riveted section used for the trusses and heavy columns, which made possible the design of a structure that would perform its functions within such dimensional limits, was developed. The problem of providing the heavy gusset-plate connections between the main members was a critical element in the design and the use of triple-thickness overlapping gusset plates interleaved with the plates of the columns and the truss chords furnished the solution, giving adequate strength of connection in the confined space available.

The columns and the main truss members are similar in design. In Fig. 4 is given a typical section of one of the members. The material is built up on a 14-in. 287½-lb. Bethlehem H-section, forming the web of the member, with three 24 x ¾-in. plates on each side, and angles and fillers as shown. This design lends itself to the use of the heavy gusset plates needed, which consist of one, two, or three thicknesses of ¾-in. plate replacing the 24-in. side plates of the members. They are stepped off, and compensating material is provided over the splicing points to preserve the required section throughout.

In order to carry the interior columns above without splicing to the trusses, which would have been complicated and taken up valuable floor space, the gusset plates at the truss panel points were extended slightly above the top-chord material and milled to form an accurate bearing. The milled ends of the columns above are seated directly on these milled bases, and angle clips or small plates are used to hold the columns in place. Wing plates on the column are used to develop the required bearing. The heaviest of these columns brings in a calculated concentration of 1,086 tons.

The size of the supporting columns, and more especially the spread of their foundations, made it necessary to keep them some distance back from the property lines, while the columns above the trusses are required to be nearer the building face. For this reason the end posts of the trusses are inclined outward, the end panels of the trusses thus forming cantilever extensions on which the wall columns above are supported.

The middle hanger for the third floor intersects the

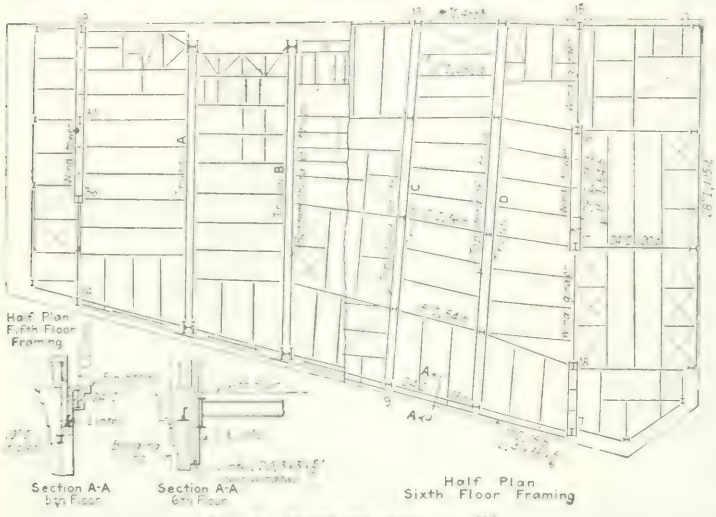



FIG. 3. TRUSS FRAMING PLANS

line of the passage in the fifth story. The upper end of this hanger was therefore forked as may be seen in Fig. 4, the passageway going through between its two arms.

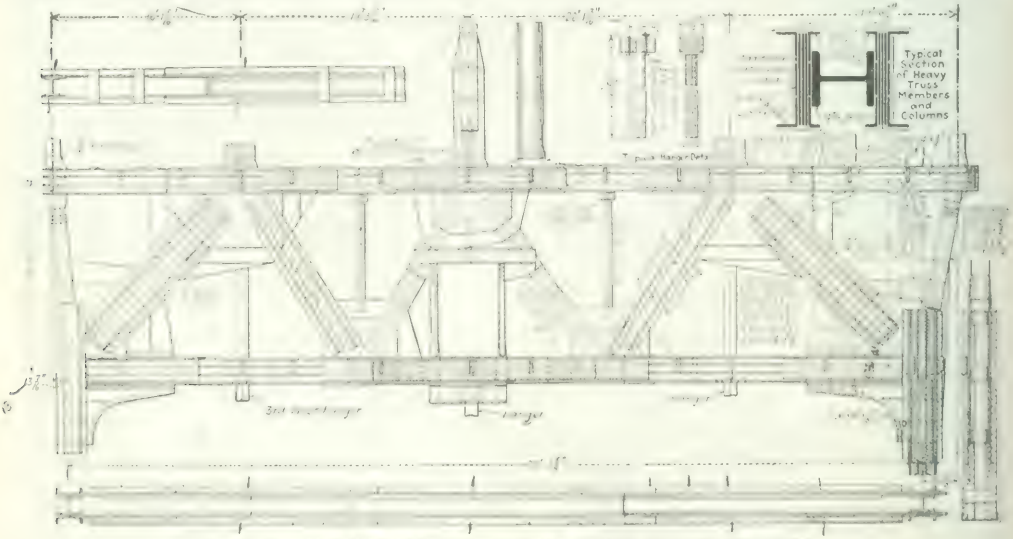
All main truss connections were made with 1⅛-in. rivets, and the minor connections of other members in the truss have 1-in. rivets.

*Erection of Heavy Trusses.*—The erection of these trusses at such a height seemed likely to involve considerable expense in falsework, but the work was arranged in such a way that this expense was almost wholly eliminated. Steel columns, girders and beams intended for the upper part of the building were used in place of timber falsework up to the ceiling level of the board room; the hangers for the third and fourth floors were erected on this temporary structure, and, acting as columns, formed a support for the trusses. Thus the bottom chords of the trusses were placed directly on their hanger splice connections in permanent positions. The fifth floor framing was then set, forming a working deck and stiffening the structure, and the diagonals and top chords were erected in turn.

The heaviest unit to be handled in the case of each truss was the main section of the top chord. Two 50-ton derricks were used, and the maximum weight lifted by them was the top chord of truss *C*, which weighed 53 tons. No difficulty was found in the erection of the trusses other than was to be expected in the handling of such heavy pieces. The members fitted together perfectly, and the holes, which were all drilled from steel templets, were remarkably accurate.

When the trusses were completely riveted the temporary steel below the third-floor level was removed, and subsequently re-erected in its true position above. Credit is due to the steel contractors for the way in which they worked out the details of the scheme of erection, which was suggested by the consulting engineer. Selecting the right pieces and adapting them to their temporary uses, and calculating the temporary loads and stresses, involved considerable study, which was done with a thoroughness indicated by the facility with which the work proceeded in the field.

*Wind Bracing.*—Particular attention had to be given to the wind bracing of the structure in north-and-south




DETAILS OF THE HEAVY TRUSS SOUTH COLUMN AT RIGHT
Detail of connection of upper column also shown

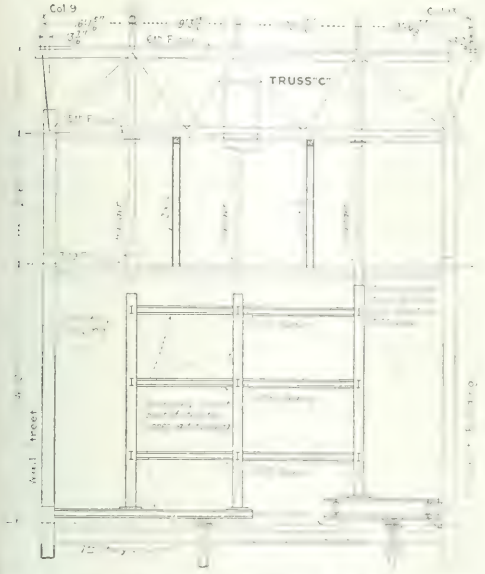



FIG. 5. UPPER-STORY STEEL USED AS FALSEWORK

location is accounted for by the offset at the eighth floor on the Broad St. front. At the west end there is no such offset, but the bracing could not be placed in the street wall because the floors directly adjoining the wall are so cut up by openings for elevators that they are not capable of transmitting the increment of shear from floor to wall.

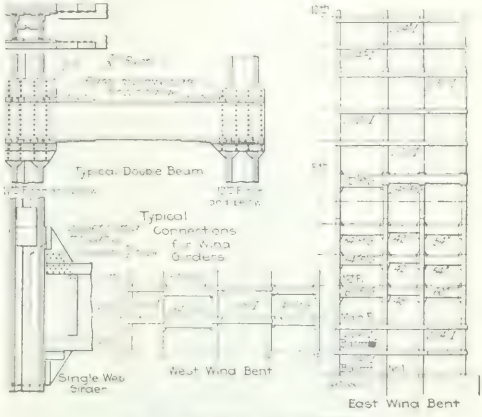



FIG. 6. WIND-BRACING TYPES

direction. The central portion of the building having no interior columns in the lower stories, it was decided to make a stiffening bent of the four columns in the east or Broad St. wall (at ground level these columns are one bay west of Broad St.), and similarly of the five-column bent one bay from the west or New St. wall. The former

Both bents constitute rigid-joint square-panel frames, with connections arranged within the depth of the girder as far as possible. Depending on architectural conditions, the horizontal members in these bents were designed either as single plate girders which connect to the columns by means of gusset plates slotted through

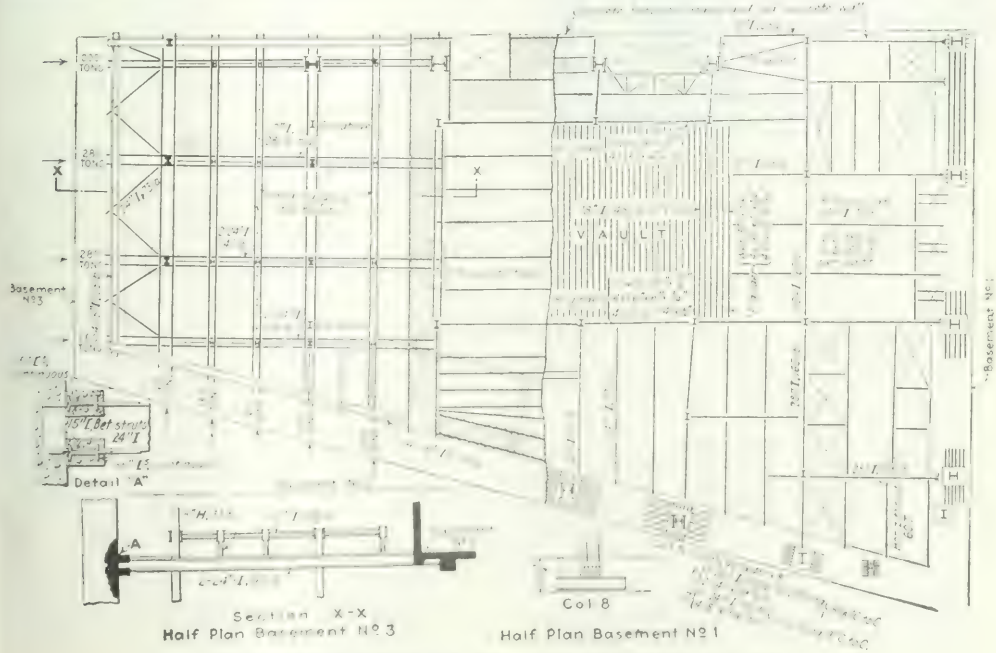



FIG. 7. BASEMENT FRAMING AND CAISSON COFFERDAM BRACING

the column, or as double beams connected on either side of the column by means of angles (Fig. 6). The combination of moments caused by the wind, dead and live loads was calculated with great care and the connections designed accordingly.

An interesting detail occurs where the double beams connect to the interior columns of the wind towers. Owing to the fact that it is the *algebraic* sum of the separate girder moments which must be transmitted to the column, it was found best to run one pair of beams by a column to a point 3 ft. beyond the centerline, and there to splice to the next pair, developing in the splice

FIG. 8. FRAMEWORK OF STOCK EXCHANGE EXTENSION NEARLY COMPLETED

the calculated moment at that point. This made a column connection which projected but little outside the column and in which the rivets could be placed to advantage well away from the center of gravity of the group. Thus the use of ugly brackets was avoided.

*Caisson Bracing.*—The building has five basements and the foundations are on rock about sixty feet below curb level. The new reinforced-concrete rim 7 ft. thick on Broad, Wall and New Sts., which acts as a retaining wall, has to be supported horizontally by the floor of basement No. 1, which is an 8-in. concrete slab, and the floors of basements No. 2 and No. 3, which are 12-in. concrete slabs. The east end of basement No. 3, however, is badly cut up by the two-story boiler room. Here ranging pieces (Fig. 7) composed of four 15-in. channels along the cofferdam, send the pressure through horizontal struts composed of two beams, to which they are connected by gussets. The pressure is re-distributed from the struts into the solid floor beyond the boiler room opening. The boilers are hung from these struts.

Trowbridge & Livingston are the architects for the addition to the Stock Exchange, and the firm of S. C. Weiskopf designed the steel. Moran, Maurice & Proctor are the foundation engineers, who designed and superintended the cofferdam construction work, which was done by the Underpinning & Foundation Co. The building is being erected by Marc Eidlitz & Son, Inc. Levering & Garrigues are the contractors and erectors for the steel, and the work was fabricated at their plant at Dunellen, N. J. with the exception of the heavy columns and trusses, which were fabricated at the Bethlehem Steel Bridge Co. plant at Steelton, Pa. The total weight of the steelwork is about 5,660 tons.

## Repairing Asphalt Streets in Winter

A METHOD of repairing asphalt pavements during the winter months, when municipal and county asphalt plants usually are closed down, has been evolved by Charles L. Harrison, engineer in charge of street repairs at Cincinnati.

The old asphalt pavement is removed from the streets and hauled to the yards during the regular working season, the pavement being broken down to approximately 2½ in. The heating plant consists of four horizontal four-wheeled kettles, each of 100-gal. capacity. The old asphalt, broken to proper size, is placed in the kettles in the afternoon and the fire started at 5 o'clock the next morning; 4 or 5 gal. of water are added and the covers are placed on the kettles. After being allowed to steam for half an hour the mixture is turned over with heavy bars, is spaded at one end and then allowed to steam again.

The operation is repeated until at the end of three hours the water has evaporated and the mixture is ready for use at a temperature of 325 to 375 deg. F. It is then transferred to another kettle, under which a hot fire has been built, and is hauled therein to the street where it is laid in the same manner as "new stuff," except that it is tamped into place instead of being rolled. The four kettles are never allowed to be more than half full, as the mixing cannot be done in an economical manner if the kettles are full.

The force engaged in breaking, heating and laying the asphalt in Cincinnati consists of only the seven men who are kept during the winter as the nucleus for the spring force and a driver for a two-horse wagon. No additional bitumen or dust filler is added to the old asphalt and the cost is reported to be slightly less than the average cost for repairs with new material.

### New Water Supply Legislation in Ohio

As a sequel to the terrific typhoid epidemic at Salem, Ohio, in 1920, a law has recently been passed providing stringent control of water supplies to insure their continuous safety. The features of the control are as follows: (1) Plans must be approved by State Board of Health; (2) the board may order purification plants or new supplies installed where the old one is dangerous; (3) the board may order better operation; (4) general supervision is vested in the board, and examinations are required upon request of the local health officer; (5) regular analyses must be made and reported to the board; (6) plans of existing plant must be made and reported to the board; (7) cross-connections with emergency or auxiliary supplies is prohibited without the board's approval; (8) when an existing supply is found to be subject to the danger of contamination the board can order changes.

# Dust Explosion and Collection in Grain Elevators

## Difficult To Keep Elevators Clean—B. & O. R.R. Applies Dust Collection Equipment to Old Timber Elevators

THAT the dust explosion hazard is a factor in the structural design as well as the operation of grain elevators and certain other classes of industrial buildings has been shown clearly in articles on the wrecking of the Chicago elevator of the Chicago & Northwestern Ry. and on dust explosions in general, in *Engineering News-Record* of March 31 and April 14, pp. 560, 621 and 634. Many modern elevators, including the Chicago elevator, are provided with dust collecting equipment, but this deals only with dust produced in the handling of the grain within the building.

Rules made by certain grain authorities in regard to the operation of grain elevators prohibit the application of suction to the grain before it is weighed. In a paper read recently before the Western Society of Engineers, David J. Price, of the Bureau of Chemistry, U. S. Department of Agriculture, stated that for some time this Bureau has been recommending aspiration or the application of suction during the preliminary handling of the grain, in order to remove the dust before it has an opportunity to escape and accumulate in the elevator. He urged that the Northwestern explosion showed again the need for revision of this regulation.

The purpose of the prohibitory rule is to protect the shipper against reduction of weight of his shipment, but Mr. Price considered that safety to life and property demands its revision. He suggested that the shipper can be reimbursed for the dust and material removed, which has some value for cattle feed. Further, Mr. Price stated that where great quantities of grain are handled in a short time, the dust accumulates so fast that it is almost impossible to keep the elevator clean by ordinary methods of brushing and sweeping.

### Baltimore & Ohio Elevators

An example of the application of dust collecting equipment to old elevators is afforded by the grain elevators of timber construction operated by the Baltimore & Ohio R. R. at its Locust Point terminal at Baltimore, Md. Early in 1920 it was decided to install a complete system for the collection and removal of dust in order to eliminate as far as possible the fire and explosion hazard and also to reduce the differential in fire insurance rates which applies to all grain handled through these elevators as compared with modern concrete structure. One elevator 100 x 330 ft., built in 1874, has a storage capacity of 1,200,000 bushels and is operated by the original installation of boilers, engine and line shafting. The other, 87 x 410 ft., built in 1881, has a storage capacity of 1,300,000 bushels and was converted to electric operation several years ago. In addition to the facilities for unloading grain from cars, each elevator has a marine leg with a capacity of 20,000 bushels per hour.

Besides installing the dust collecting system, it was considered desirable to include modern facilities for cleaning grain. The old cleaners were in the cupola of each house, where they constituted a considerable fire risk, were not readily accessible for adjustment and supervision, and in many cases involved an undue amount of handling of the grain. The new cleaner units are on the ground floor distributed so that as wide a range as possible can be served by each machine. In each house there are three machines having a capacity of 4,000 bushels per hour, fitted with sieves and screening brushes and operated by individual motors.

For collecting sweepings in each elevator, a complete sweeper system was installed, consisting of the usual equipment of fans, cyclones and galvanized iron pipe lines. Approximately one pick-up was provided for each 2,000 sq.ft. of floor space on the ground floor and all cupola floors. Discharge of dust from each cleaning machine is directly connected to the sweeper system through a cyclone for each individual cleaner. This sweeper system was designed to handle not only the dust but also the grain which necessarily collects on floor and is mixed with sweepings. Four fans for the sweeper system in the larger elevator discharge into a large cyclone which is located on the roof, directly over the dust bin. In the smaller elevator, dust collecting fans discharge into a small intake box, which is connected to a 6-in. underground pipe line leading to the dust room. Dust in this pipe line is handled by a blower in the dust house and is discharged directly into the dust bin.

Screenings which accumulate from each cleaner are collected in a small hopper under the floor, and are delivered to the dust house by a blower and 8-in. pipe lines. At the point of collection, bins are provided for the receiving and storage of screenings from each house. Screenings are then sacked and loaded into cars through a sack chute. Dust is loaded directly from the bin into box cars by a special screw conveyor, with an air blast for trimming dust in the car.

One man is required particularly for the operation of this system, his duties being the operation of machinery in the dust house and attending to the sacking and loading of screenings and dust. Operation of equipment throughout the elevators, including the sweeping of floors, cleaning of beams, etc., is handled entirely by the regular elevator force. The equipment was installed under the direction and supervision of L. P. Kimball, engineer of buildings, and T. H. Seal, superintendent of elevators, Baltimore & Ohio R. R. Stinson & Godfrey, Chicago, were the engineers and general contractors. The sweeper system and blow pipe work was installed by the Cyclone Blow Pipe Co., Chicago, and the "Airveyor" equipment was furnished by the Guarantee Construction Co., New York, as sub-contractor.

---

### War Water-Works and Houses at Hopewell Sold

The 30,000,000-g.d. water-works plant built at Hopewell, Va., during the war to supply the munitions plant of the E. I. de Pont de Nemours Co. and adjacent villages has been sold by the Du Pont Chemical Co. to the Industrial Service Corporation of Virginia, which took possession Nov. 1. The works included pumping stations, filtration plant, and distribution system. The general manager of the purchaser is J. F. Muhlig, with headquarters at Hopewell. Recently the Du Pont Chemical Co. gave title to the last of the houses owned by it in one of the large villages in the Hopewell district. The transfer included 73 dwellings. Twenty firms have located at Hopewell since the movement to turn Hopewell and vicinity over to permanent industrial development was begun.

# Experiences in Pneumatic Caisson Sinking in Mexico

## Bridge Pier Sunk 80 Ft. With Green Labor—Caisson Provided With Open Well for Dredging Simultaneous With Pneumatic Work

By T. Hind
Special Engineer, Southern Pacific R.R. Co. of Mexico,

NATIVE Mexican labor was successfully employed last year in the construction of a somewhat complicated foundation for a bridge for the Southern Pacific R.R. Co. of Mexico across the Fuerte River, a turbulent stream, in the State of Sinaloa on the west coast of Mexico. A special feature was the use of a pneumatic caisson and open well excavation in the same pier at the same time.

In the original construction of the railroad in 1906-1907 the river was crossed by a so-called temporary bridge consisting of 750 lin.ft. of pile and timber trestle and twelve 70-ft. steel deck plate girders on substantially constructed pile and timber piers, the girders being placed on the south side of the river over the deepest portion of the channel and the strongest currents. The structure averaged about 40 ft. high from normal low water to base of rail.

The original structure was satisfactory and gave no trouble until the winter of 1919, the highest floods in the meantime being about 20 ft. But on Jan. 2, 1919, the river rose to a height of nearly 35 ft. above normal low water, washed out four piers at the south end of the bridge and dropped five sets of the steel girders into the river, some of these girders weighing nearly 70,000 lb. They were carried downstream several miles by the force of the current.

LOCOMOTIVE CROSSING SHOO-FLY TRESTLE JUST BEFORE IT WASHED OUT

As conditions at the time were not favorable to undertaking expensive construction, it was decided to replace the washed-out portion of the bridge practically in kind, first reopening traffic on a temporary track and depressed trestle on a shoo-fly alignment.

Owing to the war-time conditions of the markets in the United States, from which practically all material and supplies had to be secured, work on the main bridge was considerably delayed. There was also additional delay owing to the fact that the summer and fall of 1919 were unusually wet and the river consequently high. For these reasons the main bridge was not ready for reopening traffic until the morning of Jan. 11, 1920, when the first revenue train passed over, at which time a rise in the river had already commenced. By 5 p.m. of the same day the flood had risen to practically the same extreme height of the flood of a year before, washed out three of the new piers and dropped four sets of girders, and washed out the greater portion of the shoo-fly trestle, which had already been washed out and replaced twice during the summer floods.

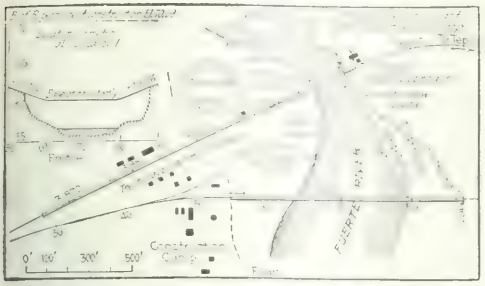
The floods both of 1919 and 1920 indicated scour in the river bottom of nearly 50 ft. to bedrock on the line of strongest current near the south end of the bridge and it seemed wise to span this region of greatest erosion with permanent construction. In view of the expensive maintenance of the shoo-fly trestle during flood periods it seemed wise to rush the work to completion before the summer floods.

A 350-ft. steel span would have been ideal for the situation but structural steel was still unreasonably high priced and quick delivery impossible to secure, so a 200-ft. span which the company already had in stock was decided on.

There was a good bedrock location for a pier to support the south end of this span practically at the south edge of the river but soundings for the pier at the north end indicated a necessary penetration of slightly over 40 ft. through sand, gravel, and large quantities of heavy riprap to a sloping surface of bedrock, into which there would have to be a penetration of 8 ft. on the north side of the pier in order to provide a proper bearing. The pneumatic caisson method of sinking seemed advisable. An effort was made to have the pier constructed by contract but various proposals from contractors were not satisfactory, and the unusual course of undertaking pneumatic caisson construction with the everyday working forces of the company was adopted; traffic, in the meantime, being again opened over the replaced shoo-fly trestle.

Together with the construction of the 200-ft. span with its necessary piers, some rearrangement of the remaining portion of the bridge was necessary in order to properly close the washout gap, the entire work consisting of one 200-ft. pin connected through truss of span, two 60-ft. deck plate girders, a short timber trestle, an ordinary concrete pier, a pneumatic caisson pier and one pile pier, with piling driven to bedrock.

Sounding for bedrock, designing, and the selection and purchasing of equipment and materials consumed a great deal of time, but by April 1 considerable material and some equipment was on the ground and actual work commenced. On April 3 all transportation on the company's lines was tied up by a general strike of train and engine men and simultaneously began the revolution which ousted President Carranza. The forces at the bridge were completely isolated from the outside world until April 26, when traffic was again reopened



PLAN AND PROFILE OF FUERTE RIVER BRIDGE SITE

over the company's lines, only to find that, owing to the switchmen's strike in the United States, necessary equipment and materials were tied up all over the United States with very indefinite prospects of delivery.

Under these circumstances it seemed wise to abandon the idea of sinking the caisson before the summer floods, but a small force was continued on preliminary work, constructing camp buildings, the concrete pier at the south end of the 200-ft. span, and the pile pier north of the pneumatic caisson pier, the framing of the wooden shoe of the caisson, and the partial assembly of the power plant.

During the summer, floods were not sufficiently high to again wash out the shoo-fly trestle, and work on the main structure was recommenced about Oct. 1. Sinking of the caisson was commenced Oct. 20.

The pier sunk by pneumatic caisson consisted of concrete reinforced with old rails and with 36 in. of wooden shoe to cushion shocks of blasting, the cutting edge of the wooden shoe being reinforced with 8-in. channel irons. Facts regarding its design and construction may be tabulated as follows:

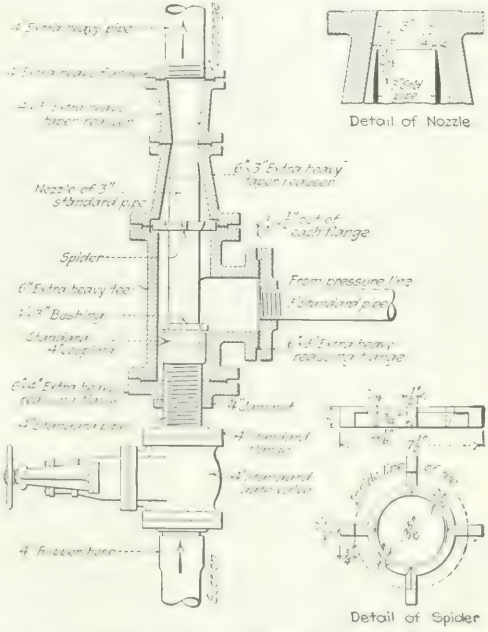
| | |
|---|---|
| Horizontal dimension of caisson | 20x50 ft. |
| Height of air chamber | 9 ft. |
| Thickness of concrete ceiling poured before commencing sinking | ft. |
| Age of concrete in caisson at time sinking commenced | 4 to 6 days |
| Penetration of caisson shoe below base of rail | 79 ft. 3 in. |
| Penetration of concrete below caisson shoe | 3 ft. 6 in., max. |
| Total penetration of pier below base of rail | 82 ft. 9 in. |
| Total penetration of caisson in sand, gravel, riprap and solid rock | 42 ft. 5 in. |
| Total penetration of caisson below normal low water surface | 42 ft. 5 in. |
| *Net Excavation* | |
| Sand | 543 cu.yd. |
| Gravel | 526 cu.yd. |
| Heavy riprap | 241 cu.yd. |
| Solid rock | 165 cu.yd. |
| Concrete in pier | 1,535 cu.yd. |
| Total lumber permanently in place in caisson and pier | 49,000 ft.b.m. |
| Reinforcement | 40 tons, 40 lb. relay rails and 4,080 lb. twisted steel. |
| Total hardware, inclusive of various steel forgings, bolts, etc | 30,500 lb. |
| *Chronological Data* | |
| Shoe of caisson placed in position | Oct. 10 |
| Commenced sinking | Oct. 20 |
| Sinking completed | Dec. 3. |
| Air chamber filled with concrete | Dec. 6. |
| Pier completed | Dec. 15. |
| *Progress* | |
| Average rate of sinking in sand and fine gravel | ft. 7 in. per day. |
| Average rate of sinking in boulder gravel | 1 ft. 10 in. per day. |
| Average rate of sinking in rip rap and solid rock | 5½ in. per day. |

*Principal Equipment*

2—125 hp. stationary boilers.
3—Straight line steam-driven air compressors total capacity 942 cu.ft. per min.
3—Heavypressure duplex steam pumps 10x6x12 in.
2—4-in. hydraulic ejectors.
1—Steam driven 9 kw. electric light plant.
1—Portable 180 amp. hour gasoline driven storage battery. Electric light plant.
2—Locomotive cranes—10-ton and 20-ton capacity.
1—Orangepeel bucket, ½ cu.yd. capacity.
1—½-yd. batch concrete mixer, complete with boiler and engine.
1—Track pile driver.

*Schedule of Wages*

| | |
|---|---|
| Common labor on surface | $1.25 per day |
| Handy labor on surface | 1.75 per day. |
| Carpenters on surface | 2.25 per day. |
| Sandhogs, first 10-ft. penetration | 2.25 per day. |
| Sand hogs, second 10-ft. penetration | 2.50 per day. |
| Sand hogs, third 10-ft. penetration | 2.75 per day. |
| Sand hogs, fourth 10-ft. penetration | 3.00 per day. |
| Foremen, stationary engineers, etc | $125 to $150 per month with board. |




HYDRAULIC SAND EJECTOR USED IN FUERTE RIVER BRIDGE

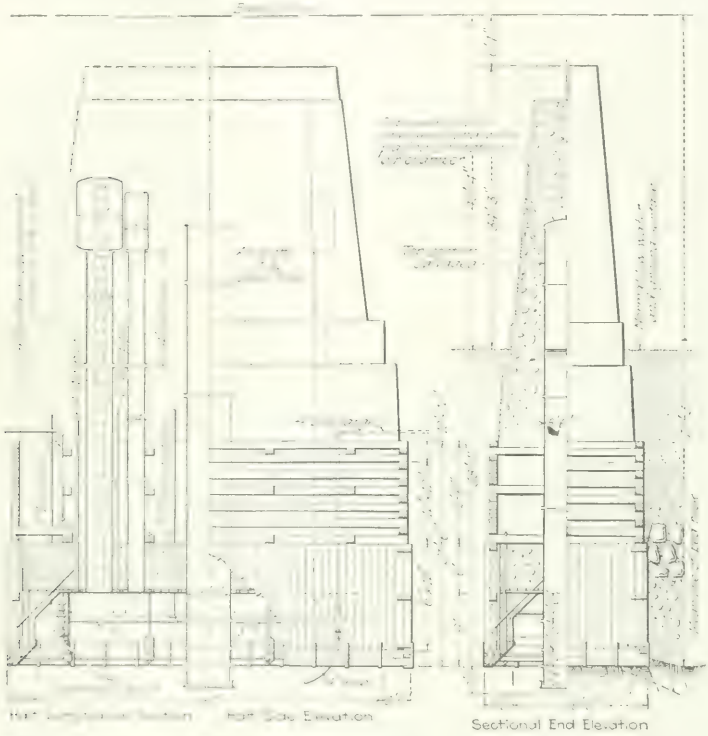
| | |
|---|---|
| General foremen | $200 to $225 per month with board. |
| Blacksmiths, machinists, etc | $3 to $5 per day. |

Working time—8 hours per day (4 hours on and 8 hours off) for sand hogs and machine men actually engaged in sinking caisson, and 10 hours per day for others.

All common laborers, sand hogs, mechanics, clerks, and foremen, also the master mechanic and two general foremen were native Mexicans. They were absolutely inexperienced in pneumatic caisson work and steel bridge erection. In fact, there were only three men on the rolls in addition to the writer who had ever

seen a pneumatic caisson, and these three had to be discharged very early in the game because of Bolsheviki tendencies. From laborer to general foremen they were resourceful and faithful and soon caught on, not only to the practice but also to the principles and theory of what they were doing. They also worked much more steadily than it is generally supposed that Mexican workers do.

In quantity performance the writer believes that, considering all the conditions, good results were obtained.




The riprap and solid rock through which the caisson was sunk were very difficult and the difficulties were increased by the thick strata of very open gravel penetrated. In sinking through the upper stratum of sand there was no difficulty in keeping the water surface from 6 in. to 12 in. below the cutting edge of the caisson, but after the open gravel was reached it was impossible to lower the water surface more than an inch or two below the highest point of the cutting edge, and at the least disturbance there was always a heavy inflow of sand.

Also, not a bad performance for inexperienced men, the 200-ft. pin connected span was swung in 13 days from the placing of the first seat to the driving of the last pin and safety against loss of false work.

Another quite unusual feature of the work is that the entire work was accomplished without a single accident of any consequence, and this feature is not detracted from by the fact that in the sinking of the caisson over 700 lb. of dynamite was used. From his experience on this work and on other work, the writer believes that the Mexican people are capable of quite high industrial development if proper general conditions can be secured in their country.

The supervising organization might by some be criticised as topheavy and unnecessarily expensive, but it must be remembered that inexperienced men were doing work of quite special nature. During the sinking of the caisson there was a master mechanic in general charge of the power plant, 24 hr. per day; three general foremen on the surface, 8 hr. each per day; one general foreman in charge of air chamber work, on duty 24 hr. per day in case of emergency, but in routine putting in two hours in the air chamber with each gang of sand hogs; three sand-hog foremen and three sub-foremen, 8 hr. per day; one concrete and general purpose foreman on the surface, 10 hr. per day; the writer in general charge with no specific hours.

Having one general foreman in charge of air chamber work worked out nicely until the heavy riprap was reached, but after drilling and blasting commenced it soon developed that there was too much lost motion at change of shifts with the incoming gang "getting set" and picking up the work where the outgoing gang left off. Also there were blasts to fire and powder gases to blow out. Another general foreman was appointed and it was arranged that a general foreman spend the last hour in the air chamber with each outgoing shift and the first hour with each incoming shift. The results were good. Ten sand hogs working four hours on and eight hours off were worked in each of the three air chamber gangs until the heavy riprap was reached and afterwards as many as could be packed into the air lock, an average of from twenty to twenty-five.

As the season in which the caisson was sunk was not one of positive low water, plans for the prosecution of the work had to be based on the possibility of floods of medium extent.

The main power plant was located on the high solid

rock south bank of the river above the reach of any possible flood, the pumps being placed at the foot of the bank in such a way that flooding would not damage. A 4-in. air line from the air compressors and a 5-in. water line from the pumps were carried across the river channel to the location of the pier on floats, 40 ft. of the air line being looped below the water surface for cooling purposes. Connection of air and water between the pipe lines and the caisson were made with links of fire hose.

From the remaining northern portion of the bridge, falsework was extended as a work track to the location of the pier. On the extreme end of this falsework a locomotive crane was placed to handle the dredging, etc.

The concrete mixer was placed in the bed of the river about 300 ft. to the north and alongside of the bridge both for the purpose of being above probable flood waters and of being convenient to a good bed of gravel. The mixer was served by another locomotive crane which also transported the mixed concrete in a bottom dump bucket dumping it into a hopper in the track behind the dredging crane. From this hopper the concrete flowed under the dredging crane in a galvanized iron chute to the caisson.

The wooden shoe of the caisson had been framed and assembled on the north bank of the river about 400 yd. distant from the location of the pier the previous spring. In the fall when work was commenced there was about 5 ft. of water at the pier location. The location was enclosed by a slip constructed of timber, piling, brush, and wire to protect against floods, and filled to the water surface partly by silting and partly by dredging and the caisson shoe was skidded to place.

The necessary forms, outside 6 x 12-in. sheeting, various shafts, and piping were placed after the timber shoe was landed and concrete poured to a depth of 6 ft. above the ceiling of the air chamber, a very rich mixture, 6 sacks of cement to the cubic yard of river gravel being used to a height of 12 in. above the ceiling, and above this an ordinary mixture of 4 sacks to the yard was used.

Four days after the completion of the pouring of the concrete to the 6-ft. line sinking was commenced; perhaps a rather risky procedure as the concrete was very green, but no harm resulted.

The construction of the caisson was very satisfactory. Usual preparations were made in advance to stop leaks when air pressure was first turned on but there were no leaks either at this time or subsequently.

The removal of excavated material from the air chamber was accomplished by hydraulic ejectors or sand pumps by blowing out with air and by dredging with an orange-peel bucket through an open shaft or water column 5 ft. 6 in. in diameter. All the methods worked satisfactorily.

The hydraulic ejectors were, to the best of the writer's knowledge, original in design, being constructed practically altogether by the assembly of ordinary commercial pipe fittings. No attempt was made to determine their actual capacity, but with the water-supply at from 90 to 100 lb. pressure they ejected all the sand or gravel that could be fed to them and without any trouble except an occasional plugging with material too large to go through.

At about 20 ft. penetration the material became too coarse for the ejectors; the nozzles, etc., were removed and the same hose and ejector pipes were used to blow material through with air. Even in the heavy riprap and solid rock these air guns were of good service, considerable quantities of accumulating spalls, gravel, and sand being ejected through them.

The orange-peel bucket in the open dredging shaft or water column was effective in every way. Rocks of several cubic feet contents were grappled and removed. When rocks too large to be thus removed, or solid rock, was encountered at the bottom of the shaft, it was broken, either by blasting, if this seemed the most convenient way, or by dropping a rock breaker through the shaft from above.

The rock breaker was a small box girder bridge seat built up of four extra heavy 10-in. I-beams with miscellaneous web and cover plates, the whole securely riveted together. By manipulating it the same as a

WORKING ON THE CAISSON OF THE PUERTE RIVER BRIDGE

pile-driver hammer through the dredging shaft, with the locomotive crane above, quite large rocks could be quickly broken if they were loose or detached, but it was too light to have much effect on solid rock.

The bottom of the dredging shaft extended 2 ft. 6 in. below the cutting edge of the caisson so as to provide leeway in case material encountered should prove sufficiently tight to enable the water surface to be held conveniently below the shoe of the caisson, but if working again in material so open as that encountered actually proved to be, the writer would not extend the shaft more than perhaps a foot or, at the most, a foot and a half below.

Blasting in the air chamber was done by drilling, by snakeholing in crevices, and by driving loaded 1¼-in. pipe in seams. The heaviest single charge placed was 3 lb. of 40 per cent dynamite and the heaviest blast consisting of a series of holes eleven pounds. Firing was done by a blasting battery located in the air lock, the lower door of the lock being closed but the pressure not equalized.

In the first 30 ft. penetration no difficulty from skin friction was encountered and it was never necessary to reduce air pressure. At this point the caisson become

badly bound in rock and very drastic reduction was necessary for all penetration secured until sinking was finally completed. Pressure was reduced at each shift change, the general air chamber foreman on duty at the time throwing both 4-in. ejector pipes and a 2-in. ventilation pipe wide open and blowing down to 3 or 4 lb. pressure. At this stage of reduction the air chamber would be filled with water to within 3 or 4 ft. of the ceiling, but when the valves were closed and the three compressors started full force the chamber would be unwatered by the time the incoming shift had reached the bottom. This blowing out also served to clear the air of powder smoke.

The highest air pressure used in actual sinking was 18 lb., but in filling the air chamber with concrete as high as 31 lb. was used for the purpose both of crowding the concrete under the cutting edge and of compressing it.

The air chamber and locks were kept well lighted with electric lights and telephonic communication was maintained between the chamber and the surface.

There was no caisson disease of any description, although there was no physical examination. The precautionary measures taken to avoid such trouble were common sense in hiring men, the bushing of air lock valves sufficiently that neither compression or decompression could take place too rapidly, the furnishing of hot and cold water bathing facilities, and the serving of hot coffee at each change of shift.

### Cost of Work

The estimated cost of the work was as follows:

| | |
|---|---|
| Concrete pier on south side of river | $4,893 |
| Pneumatic caisson pier | 79,579 |
| Pile pier north of caisson pier | 7,374 |
| 200-ft. pin connected truss span, complete with track | 25,500 |
| 2-60 ft. deck plate girders, complete with track | 5,959 |
| Permanent trestle | 300 |
| Miscellaneous | 4,763 |
| Total | $128,359 |

In the light of the comparatively cheap labor prices involved the substructure costs may seem high, but cheapness did not extend to equipment, materials, and supplies. As typical samples, cement cost approximately $5.50 per bbl., f.o.b., at the river, and coal cost $10 per ton. The steel superstructure units were, however, in stock prior to the development of war bridge prices, and were charged out to the work at about 3c. per lb.

The work was handled under the general direction of the late Epes Randolph, president, and L. H. Long, vice-president, of the company, with the writer in direct charge of design and construction. W. E. Schley, Division Engineer of the Sonora Division, served as chief assistant and rendered very valuable services.

## Oxygen Consumed Varies with Concentration Cornell Investigation Shows

After an elaborate set of tests at Cornell University on the recommended method of determining the oxygen consumed in sewage and other heavy concentrations it has been found that the amount indicated in dilution varies with the strength, being greater for the weaker solutions. However, the variation is in accordance with mathematical formulae which John Scacciaferro worked out and reported in the October *Cornell Civil Engineer*.

## Cement Stucco Covering for Small Railway Buildings

A CHEAP and durable type of construction for houses of section foremen and laborers and for small stations and office buildings, which has been developed on the Nashville, Chattanooga & St. Louis Ry., consists of a wood frame sheathed with wire mesh over or woven with, building paper and covered with 1 in. of stucco appiled by the cement gun process. Fig. 1 shows the general construction for section houses, some of the details being given in Fig. 2.

Composition red shingles on ⅞-in. tongued and grooved sheathing cover the roof. Ceilings and inside walls are of ½-in. pine ceiling or of plaster on electrically welded lathing. At the corners of all openings the stucco is reinforced by sheets of the wire mesh, with paper removed, these sheets being placed diagonally, as shown. The wire mesh often used is electrically welded, with building paper between the woof and warp, the latter being placed next to the studding. In some cases, tarred felt has been used, being tacked in place before the wire

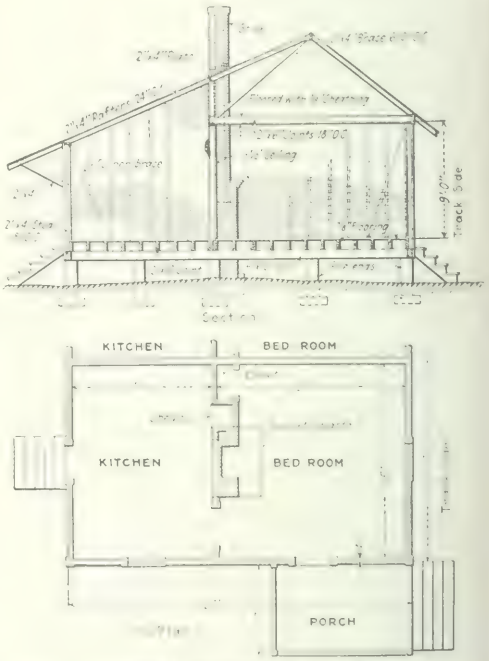



FIG. 1. SECTION LABORERS' HOUSES OF STUCCO ON WIRE MESH AND WOOD FRAME

mesh is applied. Wood trim with which wet stucco will come in contact is first given two coats of paint to prevent swelling and subsequent shrinkage cracks. Outside trim is painted brown, with window sash black, the interior being light buff. All painting is three-coat work.

The section laborers' buildings are for two families with a kitchen and bedroom for each, the bedroom having a brick fireplace and concrete hearth and the kitchen having a stove flue. About 75 per cent of the track laborers are negroes. A four-room house for the section

foreman is built on the same general plan, but with doors provided in the two interior partition walls, one porch being omitted and two of the doors replaced with windows.

Similar construction has been used for two-story buildings for storehouses and yard offices, but these have usually plank storm sheathing, over which paper or felt and wire mesh are applied on furring. A stucco covering has been applied also to old frame and brick buildings, the brick being cleaned with wire brushes or

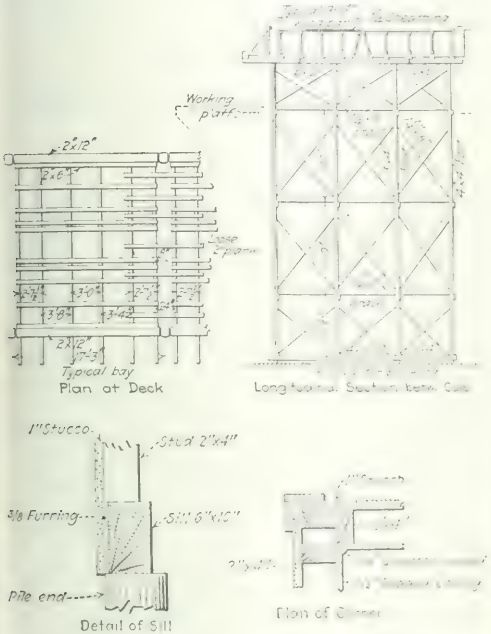



FIG. 2. DETAILS OF HOUSE WITH STUCCO COVERING

by sand blasting with the cement gun. Old section houses of boxing and batten construction have been successfully coated with the stucco. In doing this, the battens are first removed and all exterior trim is adapted to the stucco treatment, inserting nailing grounds where needed. The paper backed wire mesh is applied with fence staples, the staples not being driven clear home in order that the stucco may get a grip behind the wires.

The 1:3 mixture of cement and sand is passed through a ½-in. screen, moderately coarse and slightly damp sand being preferable to very fine dry sand. Pressures of 35 lb. of air at the gun and 50 lb. of water at the nozzle are recommended in the railway company's instructions, the water supply being regulated to give a plastic mixture that will remain on the wall without flowing or sloughing. The nozzle is held usually about 3 or 4 ft. from the wall.

Two coats of stucco are applied, preferably with an interval of not more than half an hour between them. The first ¾-in. coat (½-in. on old buildings) is screeded to a plane surface and then a ¼-in. second or "flash" coat is applied for a smooth finish. While the latter is still wet, it is brushed lightly with a wet whitewash brush, to secure uniform color and texture, the stucco being then kept sprinkled for two or three days. Corner and frieze boards, steps and similar parts are applied to grounds in the stucco after it has set.

With present prices and conditions, the cost of a double section house complete is about $2,700. If the exterior walls were of pine drop-siding, with three coats of paint, the saving would be only $125, and there would be the expense of painting at intervals of four or five years. As the stucco requires no such maintenance, it shows a real economy. There is little trouble from cracking or spalling of the stucco, if it is properly applied. This style of building construction and repair, begun in 1914, has been developed gradually under the direction of Hunter McDonald, chief engineer of the Nashville, Chattanooga & St. Louis Ry., the work being done by the forces of the engineering department.

# Porous Concrete for Well Strainers and Well Casing

### No Fine Aggregate Used—Precast Sections Strung on Vertical Rods with Bottom Cutting Edge—Interior Sand Pipe

CONCRETE of high porosity as a substitute for the usual brass well strainer and steel casing is a new development for water supply wells in gravel and sand formations which has been applied in several cases for depths up to 130 ft. A porosity of about 22 per cent in volume is obtained by removing all sand from the aggregate, the concrete being a 1:4 mix

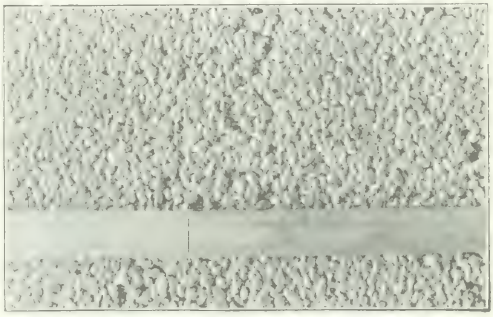


FIG. 1. POROUS CONCRETE FOR WELL STRAINER

made with gravel screened to reject all material retained on a No. 5 screen and all that passing through a No. 12. Typical crushing strengths are 1,110, 1,626 and 2,633 lb. per square inch for ages of 7 and 28 days and 2 months respectively. The appearance of the concrete is shown in Fig. 1.

This well casing, Fig. 2, is made in 48-in. lengths reinforced with ¼-in. steel rings and having eight 1¼-in. pipes for vertical rods or bolts. The bearing surfaces are mortised and are put together with 1:3 cement mortar. With an internal diameter of 36 in. and a wall thickness of 5 in. the 4-ft. section has a weight of 1,523 lb. and gives an external area of 37.7 sq.ft. Its porosity permits a flow of about 10 gal. per minute per square foot of external surface. There is said to be less clogging or choking of sand around the concrete than around a brass strainer, so that there is less diminution of flow with age.

To sink a concrete-lined well, a 40-in. riveted steel

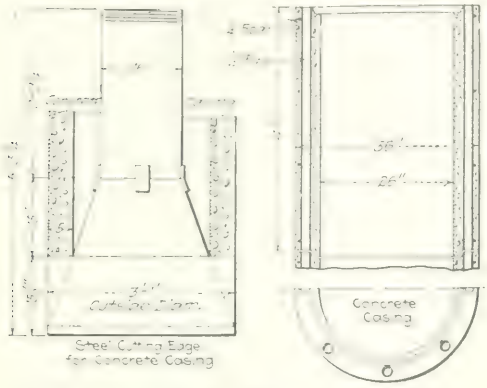



FIG. 2. CONCRETE WELL CASING AND STEEL CUTTING EDGE

casing with Z-bar cutting edge, Fig. 3, is driven down to the water bearing stratum, the casing being suspended in a steel derrick frame and the inclosed material being excavated by an auger or sand pump. Into this casing the porous concrete lining is lowered, as in Fig. 4, the bottom section resting on and being bolted to a funnel-shaped cutting edge (see Figs. 2 and 3). To the smaller end of this funnel is screwed a 16-in. pipe which serves to lower the casing and in which the sand-bucket excavator operates. This method of working protects the concrete from abrasion or injury by the bucket.

When five sections have been lowered, the sand is pumped out, causing the concrete casing to sink. Additional sections are placed and the operation is repeated until the desired depth is reached. Then the temporary steel shell is withdrawn, the bottom of the well is sealed with concrete, and finally the 16-in. pipe is cut off near the cutting edge and pulled up.

Greater rate of flow and more permanent flow are claimed as advantages over brass strainers, the low velocity of the water due to the large inlet area causing little movement of fine sand towards the well. In a recent well the velocity to and through the strainer was only 2.125 in. per minute. This porous concrete well casing is patented and is manufactured by the Well Casing & Strainer Manufacturing Co., Alton, Ill. For work at distant points the steel forms are shipped so that the sections can be made at the site.

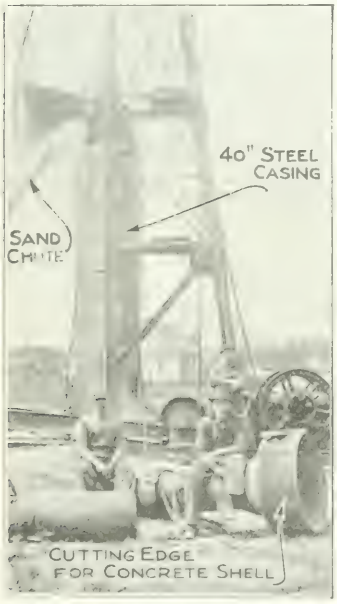



FIG. 3. STEEL SHELL FOR CONCRETE WELL

FIG. 4. CONCRETE CASING

## Open vs. Closed Impellers in the Brockton Sewage Pumping Plant

By H. S. CROCKER,
City Engineer, Brockton, Mass.

ELECTRICALLY-DRIVEN centrifugal pumps have recently been put in use at the sewage pumping station of Brockton, Mass., to replace the original equipment—steam pumping engines—that were installed in 1894. The chief feature of the new pumps is the open impeller that proved more efficient than the enclosed type after tests had been made on each.

The main intercepting sewer discharges into a reservoir of about 500,000 gal. capacity built at the pumping plant, so that pumping would be required only during the day time. This method of pumping has long since lapsed owing to the extension of the sewers and the growth of the city. At present the reservoir serves only to afford more uniform pumping throughout the 24 hr. of the day. The suction piping for the pumps connects at a pump well at the lower end of this reservoir. There is little grade to the floor of the structure and considerable settling takes place within. (For a description of the original sewage-works see *Engineering News*, first half of 1895, pp. 292 and 334.)

Originally there were two 5-m.g.d. steam pumping engines, designed to raise 5,000,000 gal. of sewage in 24 hr. to a height of 46 ft. through 16,650 ft. of 24-in. cast-iron force main to the disposal works.

As time progressed the steam pumping plant became more and more inefficient, partly due to age and partly due to the fact that with the building of the sprinkling filter plant it became necessary to elevate the sewage 16 ft. higher; and of course the friction head had slightly increased during this time. Good judgment required that it be replaced by a more modern plant.

Estimates prepared by the writer in September, 1917, for electricity, oil and steam as motive power showed that the installation of electrically-driven centrifugal pumps would be cheapest not only as far as first cost was concerned but also when considering maintenance. The Sewerage Commission therefore decided to ask for bids for this type of a plant.

The specifications required that three electric motors directly connected to centrifugal pumps be furnished; one unit to lift 2,000,000 gal. and each of the other two units to lift 3,500,000 gal. of sewage 62 ft. through 14,650 ft. of 24-in. pipe in 24 hr. to the disposal plant. The length of force main was decreased 2,000 ft. at the time of the construction of the sprinkling filters. Synchronous motors were specified for the larger sizes because the local Edison Co. offered an extra 10 per cent

discount from its bills if [illegible] type of motor was installed for sizes of 75 hp. or over. The type of equipment as well as efficiencies were left to the bidders. The contract stated, however, that tests for capacity and efficiency of the units would be run both at the factory and at Brockton after being erected, before acceptance.

Bids were received and the contract was awarded in December, 1917, to the Power Equipment Co., of Boston, whose bid of $12,750 was the most satisfactory one for the city. Its efficiency guarantees were as follows: the small pump, 72 per cent; the larger pumps, 73; overall of small unit, 64; overall of larger units, 66 per cent. The temperature-rise guarantee above room temperature for the motors was 50 deg. C. on the synchronous motors and 40 deg. C. on the squirrel-cage motors.

### Pump and Motor Specifications

The pumps were manufactured by the DeLaval Steam Turbine Co., Trenton, N. J. They are of single-stage, double-suction, single-impeller type. The small pump is 8 in. in size and is designed to run at 1,750 r.p.m. The two larger pumps are 10 in. in size and their speed is 1,200 r.p.m. The pumps are of such design that they can readily be dis-assembled, and all parts can be inspected without disturbing the suction or discharge pipe connections. The impellers, as originally furnished, were of the enclosed type, but since the first test they have been replaced by open type ones. Each pump was originally provided with special patented sewage wearing rings, dividing the suction and discharge chambers. They are designed to eliminate wear, and are arranged to be self cleaning, and to prevent stoppage in the impellers. A special form of stationary cast-iron sleeve surrounding the rotating sleeve, locked into the pump casing at one end and butting the impeller at the other end, is furnished to prevent winding of strings, rags, etc., around the shaft. These pumps are directly connected by flexible couplings to motors manufactured by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The small pump is driven by a 40-hp. squirrel-cage induction motor, and the larger pumps by rotating-field synchronous motors, each having a full load of 75 hp. when impressed with 3-phase, 60-cycle, a.c. at approximately 2,200 volts. These two motors have a 1.25-kw., 125-volt direct-connected exciters for furnishing exciting current when running. The motors are started and brought to approximate synchronous speed as induction motors. When this speed is attained, the auto-transformers are cut out and full line voltage is impressed on the stator, the exciter is connected to the rotor windings and the motors fall into synchronism.

The plant was put into operation in May, 1919. It was to have been tested immediately or as soon as the 500,000-gal. receiving reservoir was cleaned—that is, the sludge pumped out so that the pumps could be tested to maximum lift. This reservoir served in a dual capacity—both as a regulator of the sewage flow so that pumping could be at a uniform rate and also served as a partial settling basin. The new pumps could not raise the sludge 17 to 18 ft. although it was well diluted with water. The contractor thereupon started experimenting with an open-type impeller in order to accomplish the work that the enclosed impellers could not do. Before a suitable one was shipped to Brockton a year had passed by without the reservoir being cleaned once.

This new impeller was installed on Jan. 5, 1920, and after experimenting with it for a week the real cleaning began. It lasted until the thirtieth of the month, at which time all sludge had been removed. The sludge contained quantities of sand, cotton waste, grease, etc. It was broken up by the incoming sewage and also by hydrant streams, and flowed to the pump well at about the consistency of oatmeal. Men were continuously raking the bar screen between the reservoir and the pump well, and during the cleaning period removed from the screen 58 cu.yd. of material. This was a small part of the actual sludge, which was estimated at 1,000 cu.yd.

Acceptance tests were conducted on these pumps on April 21, 22, and 23. Each pump was tested twice—first taking the sewage directly from the main sewer, protected only by the bar screen; and second, taking the settled sewage from the reservoir. The pumps failed to pass test in either output or efficiency, as shown in the following table:

| Unit | Gallons Delivered per Minute | | Per Cent of Overall Efficiency | |
|---|---|---|---|---|
| | Contract | Test | Contract | Test |
| 1 | 2,450 | 2,380 | 66 | 59.5 |
| 2 | 1,400 | 1,240 | 64 | 47.5 |
| 3 | 2,450 | 2,410 | 66 | 58.5 |

The test on Unit 1 was connected with the open impeller instead of the enclosed or contract impeller.

The contractor claimed that the failure to come up to guarantee was the result of the hard usage the pumps received during the year before the test, and especially during the cleaning of the reservoir. Owing to the fact that the pumps had performed so satisfactorily—pumping water—in the shop tests at Trenton, the contractor was granted another chance with new impellers to prove that the pumps could do the work. The Power Equipment Co. was satisfied that the larger waterways of the open-type impeller were necessary to do the work, especially as the Pump 1 had been tested with the open impeller, and they, therefore, requested that the DeLaval Co. make the open-type impellers. Work was immediately started on the design of the new impellers. They were installed in January, 1921, and acceptance tests were conducted in February. Through a misunderstanding the Venturi meter was not calibrated previous to the tests, but as no adjustments had to be made to it when calibrated before the previous tests this work was waived until afterwards and tests were conducted. This was unfortunate as after tests the Venturi people did not calibrate but adjusted the meter. The actual readings of the meter were therefore not as reliable as had been expected. The figures of the last test are accordingly not absolutely reliable:

| Unit | Gallons Delivered per Minute | | Per Cent of Overall Efficiency | |
|---|---|---|---|---|
| | Contract | Test | Contract | Test |
| 1 | 2,450 | 2,695 | 66 | 65.1 |
| 2 | 1,400 | 1,710 | 64 | 63.5 |
| 3 | 2,450 | 2,710 | 66 | 64.8 |

These figures show that the pumps exceeded the output requirements by a considerable margin and that the efficiencies of the units were very close to contract guarantees.

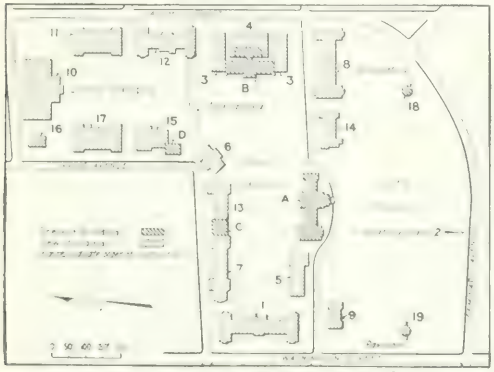
There is absolutely no comparison between the two types of impellers for small high-speed pumps as far as sewage work is concerned. The open impeller pumped far more liquid in the final test than did the closed impeller even in the shop tests at Trenton. And as seen

by the figures, there is no comparison in the efficiencies. The contractors made the claim that wear was the cause of the inefficiencies in the 1920 tests. There is no doubt that there was considerable wear but the real work and the real wear was not on the closed impeller of Pumps 2 and 3 but on the open impeller of Pump 1, which was designed only for high suction lift with a heavy material to pump. Regardless of that fact, its output in the 1920 tests was only 30 gal. short of the closed impeller and the overall efficiency of that unit was a whole per cent higher. Strange as it may seem, there is no doubt as far as pumping Brockton's sewage is concerned—even when that sewage is settled and very dilute—but that an open-type impeller properly designed will give a greater output and a higher efficiency than the enclosed one for small high-speed pumps even when the impellers are new.

# Program for 20-Year Expansion of Small College

## Engineering Department to be Established and Several New Buildings Erected at Total Cost of $2,680,000

A PROPOSED expansion of Wheaton Congregational College at Wheaton, Ill., has been planned on a comprehensive program extending over a term of 20 years in order that the completed institution may be harmonious in the style and arrangement of its buildings and facilities. An engineering department is to be



PROPOSED EXPANSION OF WHEATON COLLEGE

tions to women's dormitory; 4, dining hall; 5, history and English; 6, library; 7, men's dormitory (first section); 8, women's dormitory; 9, administration; 10, gymnasium; 11, science; 12, women's dormitory; 13, men's dormitory (second section); 14, chapel; 15, academy; 16, hospital; 17, engineering.

added as part of the expansion. This program calls for the expenditure of about $2,680,000.

Wheaton college, founded in 1848, has at present a four-story main building 75 x 190 ft., a women's dormitory, a gymnasium and an academy for preparatory students. At the rear of this last is a heating plant which serves all the buildings. The first two structures shown in black on the accompanying plan, will be retained, although remodeling of the main building is included in the program. New buildings of the proposed scheme are shown by hatched areas.

From a study of the growth of the institution it was concluded that in 20 years the number of students would be 1,200, if the necessary facilities were made available. A somewhat higher capacity would be provided by the instructional buildings as planned, but the dormitories would accommodate only about 900, as a certain number of students live at home or in private residences. The main building is on the crest of a slope toward the south, and as there is plenty of room toward the north, this slope is to be left practically undisturbed. All the buildings are to front on a large interior space comprising the present campus and a new campus, the latter being within two blocks of the present athletic grounds. A new heating plant would be located on the low ground adjacent to the Chicago & Northwestern Ry. For the new buildings, an English gothic style of architecture is proposed, the structures to be of reinforced concrete, with brick and stone walls and tile or slate roofs. The present main building is of buff stone and the dormitory is of red brick.

PROPOSED BUILDINGS FOR WHEATON COLLEGE

| | Building | Size, Feet | Stories | Cubic Feet | Cost |
|---|---|---|---|---|---|
| 1 | Men's dormitory No. 1 | 235 x 90 | 3 | 612,800 | $270,700 |
| 2 | Heating plant | $125,000 for first unit, total | | | 235,000 |
| 3 | Wings on women's hall | 115 x 40 | 3 | 441,600 | 198,800 |
| 4 | Dining hall | 115 x 70 | 1 | 241,500 | 85,000 |
| 5 | History and English | 127 x 47 | 2* | 243,700 | 97,500 |
| 6 | Library | 74 x 54 | 2 | 95,200 | 57,000 |
| 7 | Men's dorm. No. 2 (first sec.) | 190 x 45 | 3 | 391,200 | 177,000 |
| 8. | Women's dormitory No. 2 | 200 x 90 | 3 | 552,000 | 248,500 |
| 9. | Administration building | 75 x 45 | 2 | 135,000 | 61,000 |
| 10 | Gymnasium | 170 x 84 | 2 | 662,400 | 200,000 |
| 11. | Science hall | 136 x 82 | 2 | 428,800 | 171,500 |
| 12 | Women's dormitory No. 3 | 170 x 90 | 3 | 480,000 | 216,000 |
| 13 | Men's dormitory, add to No. 2 | 160 x 45 | 3 | 320,000 | 143,000 |
| 14. | Chapel | 60 x 120 | 1 | 380,000 | 190,000 |
| 15. | Academy building | 92 x 47 | 2* | 181,000 | 72,500 |
| 16 | Infirmary (move old academy and remodel) | | | | 15,000 |
| 17 | Engineering hall | 136 x 82 | 2 | 428,800 | 171,500 |
| 18. | Observatory | | | | 20,000 |
| 19 | Pavilion | | | | 10,000 |
| 20 | Grounds | | | | 30,000 |
| 21 | Remodeling main building | | | | 10,000 |
| | Total | | | | $2,680,000 |

*No basement.

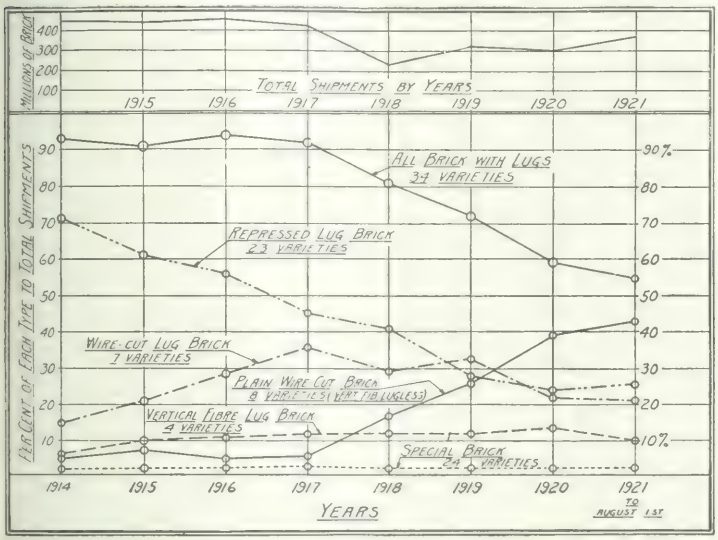
Figures noted on the plan indicate the order in which the buildings would be constructed, but no dates are set as the progress would depend upon financial conditions and the growth of the institution. The sizes and estimated costs of the several structures are noted in the accompanying table. This program of enlargement has been worked out by Wolf, Sexton, Harper & Truax, engineers and architects, Chicago. Dr. C. A. Blanchard is president of Wheaton College.

## Tie Shortage on Indian Railways

The problem of maintaining the supply of ties in India, both for renewals and for new construction, is becoming more acute every year, according to the report of the Railway Department for the year 1919-1920. As supplies of native hardwood that can be used without treatment are limited experiments are encouraged with ties of various materials in order to develop substitutes that will be satisfactory under the conditions of Indian railways. A creosoting plant is being built for treating native soft woods, its capacity being 300,000 ties annually, but completion of the plant has been delayed considerably. Several types of reinforced-concrete ties are on trial, but most of these are still in the experimental stage. Pressed steel trough ties and cast iron ties consisting of pairs of bowls or plates connected by tie bars are used extensively, the latter forming a type of track construction distinctive of the Indian railways but used also in South America.

## Many Varieties of Paving Brick Shown by Survey

IN RECOMMENDING the adoption of only 11 varieties of vitrified paving brick, in place of the 66 varieties which have been on the market from 1914 to date, representatives of paving brick manufacturers and engineering societies, who met in Washington, D. C., Nov. 15, with officials of the Department of Commerce, as noted in the news section of this journal Nov. 17, p. 831, based their conclusions largely upon a comprehensive report of a variety survey in the vitrified paving-brick industry made by the National Paving Brick Manufacturers Association for the U. S. Department of Commerce. A summary of the report follows:




VARIETY TREND OF PAVING BRICK SHIPMENTS, 1914-1921 (AUG. 1)

In the shipment of 66 varieties of vitrified paving brick from 1914 to 1921 there were five major divisions of type, each with a variable number of sizes included as follows: (1) Plain wire-cut brick (vertical fiber lugless), 8 varieties; (2) repressed lug brick, 23 varieties; (3) special brick, 24 varieties; (4) vertical fiber lug brick, 4 varieties; (5) wire-cut lug brick (Dunn patent), 7 varieties. Each size of product, according to its type, is designated as a variety in the report.

The classification in Table I demonstrates the trend and status of variety according to type of brick, this year's figures being as of Aug. 1.

TABLE I. VARIETIES OF BRICK [illegible] YEAR 1914

| Type of Brick | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 |
|---|---|---|---|---|---|---|---|---|
| [illegible] | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 |
| [illegible] | 12 | 12 | 12 | 12 | 13 | 16 | 13 | 13 |
| [illegible] | 12 | 12 | 13 | 13 | 13 | 16 | 13 | 12 |
| [illegible] | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| [illegible] | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | 43 | 43 | 43 | 46 | 47 | 47 | 43 | 40 |

The data in the report are based upon replies from 14 companies operating 64 plants in 16 states. The total annual tonnage of brick produced is normally 4,245,300, or approximately 90 per cent of the total productive capacity of the entire industry.

The position of each type of brick during each year since 1914 is shown in Table 2, in which "1" signifies the brick in highest proportion, "2" the next highest, and so on to the lowest which is "5." In general the distribution of types shows that up to and including

TABLE II. TYPES OF BRICK CLASSIFIED IN ORDER OF PRODUCTION VOLUME

| Type of Brick | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 |
|---|---|---|---|---|---|---|---|---|
| Plain wire-cut brick (v. f. lugless) | 4th | 4 | 4 | 4 | 3 | 3 | 1 | 1 |
| Repressed lug brick | 1st | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| Special brick | 5th | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Vertical fiber lug brick | 3rd | 3 | 3 | 3 | 4 | 4 | 4 | 4 |
| Wire-cut lug brick (Dunn) | 2nd | 2 | 2 | 2 | 2 | 1 | 3 | 3 |

1918 the pre-dominant brick was of the repressed type with lugs. In 1919 the wire-cut lug brick had the ascendancy, closely followed, however, by repressed lug brick and plain wire-cut brick. In 1920 and 1921 the plain wire-cut brick is the predominating type.

An analysis of each type of brick by sizes indicates that two sizes stand out predominantly; they are 3½ x 4 x 8½ in., and 3 x 4 x 8½ in. In 1921 these two sizes constituted 83.1 per cent of all brick shipped; the 1921 shipments were about equally divided between the two prevailing sizes.

A sharp upward trend of the combined shipments of the two prevailing sizes of brick began in 1918 and reflects a tendency toward simplification of variety, following the wartime depression of industry. As the quantity of shipments has increased the proportions of the 2 sizes and 10 varieties has grown at the expense of the remaining 56 varieties shown in the report.

## Cores Taken from New Jersey Roads Aid Research

Cores obtained by drilling through the pavements of New Jersey highways, according to R. B. Gage, chemical engineer of the state highway department, indicate the wisdom of not permitting the coarse and fine aggregate to be dumped on the sub-grade. Evidently a great deal more of this sub-grade material got mixed with the aggregates during handling than was thought possible. This sub-grade material, Mr. Gage points out, frequently is very deleterious. The effect of permitting concrete to be dumped on a muddy, soft sub-base has also been noticed in the samples taken. Irregularity in the contour of the sub-base is shown quite plainly by the cores; there is a variation in height of nearly 4 in. The borings also will be utilized as a means of studying drainage conditions of the sub-base.

# The Frequency of High Rates of Rainfall

## A Probability-Method Study of Data for the Eastern and Middle Western States in Morgan's Miami Technical Reports, Part V, and Meyer's "Elements of Hydrology"

By Allen Hazen,
Civil Engineer, New York City

ARTHUR E. MORGAN, Chief Engineer of the Miami Conservancy District, Ohio, has collected data for high rates of rainfall in the eastern part of the United States. (Part V, Miami Technical Reports.) All the records of the U. S. Weather Bureau were brought into a series of tables and diagrams showing the rain-producing capacity of the climate in every part of the eastern United States. Apparently this is the first time that these splendid data have been examined in a comprehensive way to learn from them the frequency of high rates of rainfall. Mr. Morgan's work in making these results available cannot be too highly commended. The data are in a form that lends itself to examination by graphic probability methods. The object of the present study is to apply such methods, and to compare the results so reached with similar results from carefully collected but less extensive data otherwise available.

FIG. 1. MAP SHOWING LOCATION OF RAINFALL QUADRANGLES

In the Morgan report the data are summarized by quadrangles of latitude and longitude, extending two degrees in each direction. All of the data for each quadrangle are combined as if they formed a single record, and results taken from this combined record are shown in figures printed upon the maps of the Miami report. To study average relations between time intervals and varying degrees of rainfall intensity, a limited number of quadrangles were selected. The basis of the selection was to take those that had the most numerous data. All quadrangles showing over 500 years were first taken. There are 28 such quadrangles. (See map, Fig. 1.)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | Days | | |
| | | | | 5.43 | 5.79 | 6.42 | |
| | 0.04 | | | 6.57 | 7.20 | | |
| | | | | 7.03 | 7.45 | 7.84 | |
| | 0.01 | | | 8.23 | 8.94 | 9.23 | |
| | | | | | | | |
| | 0.0667 | | | 5.08 | 5.68 | | |
| | 0.04 | | | 6.05 | 6.60 | | |
| Once in 50 yr. .. | | | | 6.88 | 7.22 | 7.60 | |
| | | | | 7.97 | 8.40 | 8.70 | |
| | 0.00064 | | | | | 13.00 | |

The data from these 28 quadrangles were then summarized. A like summary was made for the six North Atlantic quadrangles covering New England, except Maine, southern New York, eastern Pennsylvania, New Jersey, and parts of Maryland and Delaware (Fig. 1). The results of this study (Table I) show first the amount of rainfall in inches to be expected for the maximum day in 15, 25, 50 and 100 years, and in the period corresponding to the average of the number of years represented in the quadrangles. The decimal position used in plotting the results on probability paper is the reciprocal of the time in years given in the Morgan report and is taken as representing the chance of the occurrence of rainfall of high rate in any one year. For the maximum reported rainfall the decimal position is computed by the rule used in probability plottings for the first term of a series.

In Fig. 2, these values for the maximum day, maximum two days, and maximum six days have been plotted on logarithmic probability paper. It is interesting and a little surprising to find that the two series are in close agreement. This does not mean that the same results would be found for all parts of the country. An inspection of the Morgan maps makes it clear that this would not be the case. It is simply an accident that the average results of these two series are practically identical.

In Adolph F. Meyer's "Elements of Hydrology," p. 124, is given a summary of rainfall data from several hundred stations in six selected localities, comparable, as far as they go, with the more complete data collected by Morgan. Meyer's data lends itself to plotting on probability paper. I have arranged it this way in Fig. 3, making my own calculations from the published data, and not following some of Meyer's methods, which are not appropriate for this purpose. Table II shows the numerical values corresponding to the plotting and also the rates of precipitation to be equaled or exceeded once in 10 years and once in 100 years, scaled from

TABLE II MEYER RAINFALL DATA FOR HIGH RATIO OF RAINFALL IN SIX DISTRICTS See Fig. 3

| | Alabama | Minnesota | Ohio | Eastern Kansas | Central Kansas | Western Kansas |
|---|---|---|---|---|---|---|
| No. of stations | 63 | 72 | 100 | 42 | 38 | 26 |
| No. of years | 15 | 20.75 | 15 | 15 | 15 | 13 |
| Station-years | 973 | 1,470 | 1,500 | 630 | 570 | 390 |
| Ratio of number of daily precipitations above limit to number of years in record | | | | | | |
| 9 in. | 0.0031 | 0.0013 | ..... | ..... | ..... | |
| 8 in. | 0.0082 | 0.0027 | | | | |
| 7 in. | 0.0205 | 0.0047 | 0.0020 | 0.0095 | 0.0053 | 0.0025 |
| 6 in. | 0.0440 | 0.0087 | 0.0047 | 0.0223 | 0.0035 | 0.0077 |
| 5 in. | 0.1080 | 0.0161 | 0.0080 | 0.0650 | 0.0175 | 0.0205 |
| 4 in. | 0.3400 | 0.0605 | 0.0340 | 0.1560 | 0.0750 | 0.0665 |
| 3 in. | 1.0200 | 0.2250 | 0.1450 | 0.4950 | 0.2700 | 0.1490 |
| 2 in. | 3.8800 | 0.9650 | 0.8500 | 1.7600 | 1.2000 | 0.6850 |
| 1 in. | 15.8000 | 5.4000 | 6.9500 | 8.7500 | 6.4500 | 4.0500 |
| Once in | | | | | | |
| 10 yr., in., | 5.1 | 3.6 | 3.3 | 4.3 | 3.2 | 2.2 |
| 100 yr., in., | 7.8 | 5.7 | 4.8 | 6.9 | 5.4 | 3.7 |

the plotting. These values may be compared with Morgan's. In Fig. 31 of the Miami report are shown the maximum 24-hr. precipitations to be expected once in 100 years, in all parts of the eastern United States. I have taken from this approximate values corresponding to Meyer's districts. The corresponding figures side by side are shown in Table III. The check between

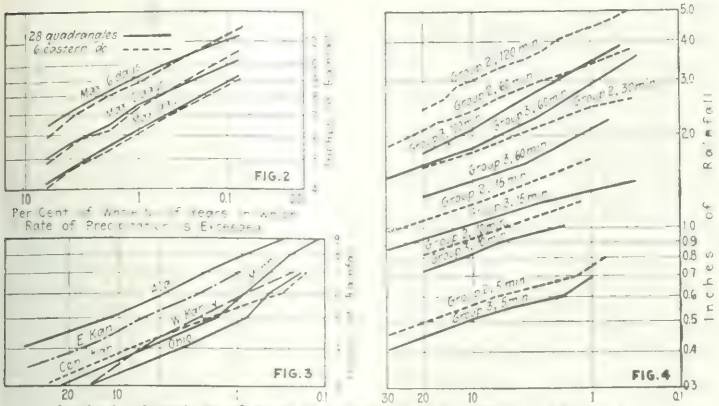



FIG. 2. COMPARISON OF HIGH RAINFALLS IN THE 28 AND THE 6 QUADRANGLES
FIG. 3. HIGH RAINFALLS FOR ALABAMA, OHIO, KANSAS AND MINNESOTA, PLOTTED FROM MEYER DATA
FIG. 4. MEYER RAINFALL DATA PLOTTED BY INTENSITY GROUPS

Meyer's and Morgan's values for the same districts is close. On an average Morgan's values are 3 per cent higher. The agreement is satisfactory and adds confidence to the use of the data.

TABLE III. COMPARISON OF MEYER AND MORGAN DATA

| District | 100 Years | |
|---|---|---|
| | 5.7 | 5.5 |
| | 4.8 | 5.3 |
| Eastern Kansas | | |
| Western Kansas | | |
| Central Kansas | | |
| Alabama | 7.8 | 8.0 |
| Average | | |

There have been frequent compilations of high rates of precipitation for periods ranging from 5 to 120 minutes. Charles W. Sherman's article on the 26-year record at Springfield, Mass., *Engineering News-Record*, Sept. 2, 1920, p. 445, and Kenneth Allen's analyses of New York data, *Engineering News-Record*, April 7, 1921, p. 588, and H. P. Eddy's figures in the *Journal* of the Boston Society Civil Engineers, February, 1921, may be mentioned.

Meyer in his Hydrology, p. 144, attempts a general classification of this kind of data in groups, according to the intensities of precipitation at the various stations. His work may be compared with Morgan's, though the data used are much less numerous. His map on p. 151 of his book shows the classification of the country into groups. This resembles in a way Morgan's Fig. 31, showing the maximum 24-hr. precipitation to be expected in 100 years.

Meyer's Groups 2 and 3 cover, in a general way, that part of the country corresponding to the 28 quadrangles. In Fig. 4 are plotted Meyer's data for these groups, showing the rates of precipitation to be expected in 5, 10, 15, 30, 60 and 120 minutes. Solid lines are used for Group 3, and broken lines for Group 2.

In Fig. 5 I have brought together Morgan's data for the 28 quadrangles and Meyer's data for short periods of intense precipitation, using values intermediate between those found for Group 2 and Group 3, and to these I have added figures for annual and monthly rainfall based on 45 in. mean. This plotting is logarithmic in both directions. On it have been drawn lines showing the rates of precipitation at which there is one chance in 10, one in 100, one in 1,000, and one in 10,000 of being exceeded in one year. The last one (or two) values were obtained by extending the appropriate lines of the preceding figures on logarithmic probability paper. These indicated extreme values are to be taken only as rough approximations but perhaps give a better idea than is otherwise available as to the probable occurrence of extreme rates. All of the values shown by this and the preceding diagrams relate to probable precipitations at one observation station. They must not be taken as applying to considerable areas, because precipitations are not the same even at stations a short distance apart. The probable precipitation on any considerable area will be less than that at a particular station.

The marked variation in the direction of the lines in the different parts of their course suggests that there are certain periods in rainstorms. Very heavy intensities last, at most, from one to two hours. It is unfortunate that we do not have 4- and 8-hr. records for comparison; but the maximum day's rainfall is only 50 per cent greater than the corresponding 2-hr. rainfall. It seems that the hardest rainfalls usually work themselves out in a 2-hr. period, and only moderate rates are to be expected immediately before and after.

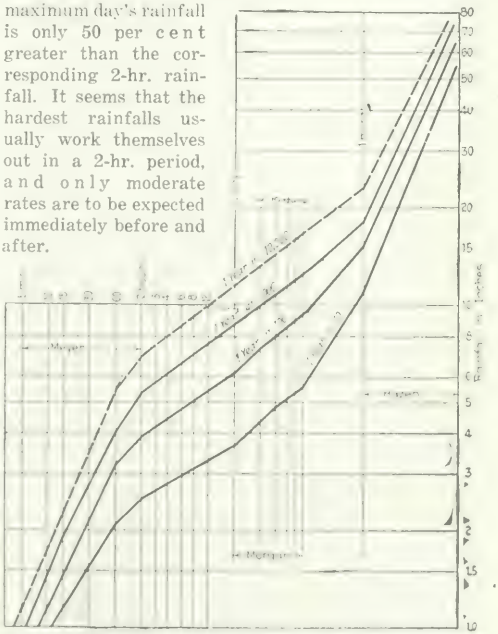



FIG. 5. COMPARISONS OF MORGAN AND MEYER RAINFALL INTENSITY DATA; DISTRIBUTION OF ANNUAL AND MONTHLY RAINFALL BASED ON 45 IN. MEAN

Some interesting and useful ratios may be obtained from these data. These ratios are between the maximum precipitations occurring in longer and shorter periods of years, and also during varying numbers of minutes, hours and days. All the data are very consistent in these ratios and only the average results are here given, in Tables IV and V.

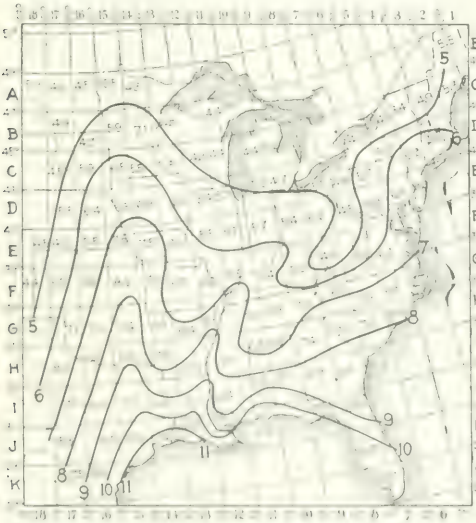
TABLE IV. RATIOS OF AMOUNTS OF PRECIPITATIONS IN EQUAL TIME INTERVALS OF DIFFERENT DEGREES OF PROBABILITY

| | | | |
|---|---|---|---|
| 1 hr. | 0.64 | 2 hr. | 0.78 |
| 2 hr. | 1.00 | 4 hr. | 1.00 |
| 4 hr. | 1.45 | 8 hr. | 1.32 |
| 6 hr. | 1.80 | 12 hr. | 1.58 |

TABLE V. RATIOS OF MAXIMUM PRECIPITATIONS OF EQUAL PROBABILITY IN VARIOUS TIME INTERVALS

| | | |
|---|---|---|
| 6 days | 1.48 | |
| 5 days | 1.42 | |
| 4 days | 1.36 | |
| 3 days | 1.29 | |
| 2 days | 1.19 | |
| 1 day | 1.00 | Basis |
| 12 hr. | 0.88 | Interpolated from logarithmic plotting |
| 6 hr. | 0.77 | |
| 3 hr. | 0.69 | Interpolated from logarithmic plotting |
| 2 hr. | 0.64 | Combination of Morgan's & Meyer's data |
| 1 hr. | 0.50 | |

These ratios may be applied directly to the value found for any locality by an examination of Morgan's Fig. 31 (here reproduced as Fig. 6). This shows the maximum 24-hr. precipitation to be expected in a 100-yr. period, by means of lines drawn on the map of the eastern United States. Applying the above stated ratios to the base value for any locality taken from this map gives an idea of the probabilities of heavy precipitation in that locality. For example: If the map indicates a 1 per cent chance at a given locality of a 24-hr. precipitation of 6 in., then the precipitation, the chance of the occurrence of which in any given year is 10 per cent, will be 0.6 of this or 3.6 in.; and for a 0.1 per cent chance 1.45 of it or 8.7 in. In a similar way for other time intervals there is a 1 per cent chance in any one year of 7.14 in. in two days; 8.9 in. in six days, and 4.62 in. in 6 hr. Such estimates may well be supplemented by detailed studies of local data, where available, examined by similar methods.



An estimate can never be more accurate than the data on which it rests. We all know the limitations of rainfall observations, and the errors in many of the records will certainly be reflected in results deduced from them. It is also to be said that some day we shall, no doubt, have much better probability methods for this kind of data.

For the present the information made available by the Morgan report adds very greatly to our knowledge on this important subject; and estimates based on it, though by no means precise, may be useful in many undertakings.

## Electrification of Logging Equipment In the Pacific Northwest

The electrification of logging railroads and the substitution of electric yarders and loaders for steam donkeys working in the woods is a subject of general discussion in the lumber industry of the Pacific Northwest and a few electrical installations have been made. Factors to be considered in making changes of this sort were reviewed in a paper by E. J. Barry, electrical engineer, Tacoma, Wash., presented at the recent Pacific Logging Congress at San Francisco. The following has been abstracted from his paper:

One of the principal advantages of electricity in logging operations is in the fuel saving. Refuse from the sawmill will supply all the power required in a logging operation at a cost much below that which would be entailed in developing the same power with fuel oil, coal or wood. Unlike the steam engine, motors require no water and the colder the weather the better operating conditions become; these are distinct advantages in many parts of the woods. As compared to steam power, the greater hauling capacity and higher speeds of electric locomotives makes it possible to render the same service with less number of locomotives and hence fewer train crews.

After experiment with single-phase and three-phase alternating current, the present practice favors high voltage direct current. Reasons for this are (1) that direct current gives good speed control with easy acceleration, (2) it can be used for regenerative control, that is, the motors of a locomotive on the down grade act as generators to pump energy back into the line, and (3) direct current can be used for dynamic braking with great saving in wear of brake shoes, wheel faces and rails.

The electric locomotive requires much less in upkeep than does the steam locomotive and will operate for at least twice the mileage without requiring overhauling in the shop. The saving in operating costs of electric over steam railroads would be from 30 to 35 per cent with a decided increase in output and independence of outside sources of fuel. However, the high initial cost of electrification makes it economical only if operations are to extend over several years. There is no doubt that the next few years will witness an era of electrification on those logging operations where favorable conditions obtain, in keeping with the present rate of progress to be noted in main line railroad electrification.

# Some Thoughts on Long-Span Bridge Design

## Architectural Considerations Controlling—Aesthetics and the East River Bridges—Towers for Delaware River Bridge Too Utilitarian—Wire Cable Problems and Eyebar Chain Possibilities

By Gustav Lindenthal
Consulting Engineer, New York

*JUST before the calling of bids on construction of piers for the Delaware River suspension bridge, the Philadelphia section of the American Society of Civil Engineers on Nov. 7 devoted a meeting to that enterprise. At that meeting Gustav Lindenthal, the noted builder of the Hell Gate arch and now chief engineer of the Hudson River bridge project, presented a discussion in which he criticized one or two features of the design as published in "Engineering News-Record" of June 23, 1921, p. 1086, notably the unprecedently large wire cables and the towers. The views he expressed constitute a remarkable outline of fundamentals in the design of long-span bridges, particularly suspension bridges. They are given with slight condensation.*—ED.

EVERY unusually large bridge project offers new problems of construction, and it is a laudable although infrequent practice to offer up the plans for discussion by engineers before they are carried out. In this wise more or less valuable views and experiences on the subject may be exchanged or contributed that may be of benefit to the project and so also to the whole profession.

### Architectural Features of Long-Span Bridges

Any large bridge should be designed with a view to fine architectural appearance. That much at least is due to a civilized age and it is particularly important in a city bridge. Every large bridge, even when it is unsightly, has a monumental character from its very hugeness, and causes wonderment. But it should do more than that: it should also give the beholder a feeling of pleasure and enjoyment. That is the essence of architectural art, and the more perfectly it is attained the greater the merit of the work and the greater the regard for the sciences and the arts and for their disciples, who create and leave it to posterity as a proof of culture and progress.

In the case of the proposed Delaware River bridge at Philadelphia the studies seem to have been confined to the cantilever form and the suspension form of bridge.

*Cantilever and Arch Bridges*—A cantilever bridge is the least adaptable to artistic treatment, but a large span can be given an imposing architectural appearance by the thoughtful engineer, through choosing a pleasing silhouette and through adroit differentiation of the bridge members so that they will express in their form and massiveness the forces they resist. A satisfying aesthetic form for a very long cantilever span as in this case would, however, require the arching of the lower or compression line of the superstructure below the line of roadway, as was done in the two large spans of the Firth of Forth bridge in Scotland, having about the same length as the river span in the Delaware bridge. In the well-known Quebec cantilever bridge, the bottom edge of the structure also descends below the floor line, but unfortunately in straight lines, thus giving the bridge an amateurish appearance and unnecessary ugliness. It is regrettable that the graceful lines of the first Quebec cantilever design were not retained, because it was in its outlines and conception a meritorious design, but collapsed under its own weight; not enough metal had been put into it.

An arch bridge is the next in aesthetic value. From arch designs of nearly 3,000 ft. span (over the Straits of Messina) worked out in considerable detail it is known that arch bridges of very long span offer decided advantages over cantilever bridges, where the shores offer good abutments. But in the case of the Delaware River bridge, for which the government required unobstructed width above the river, it was plain from the first that some type of suspension bridge would best satisfy local conditions. No time should have been wasted on a cantilever design.

It was then a question what kind of suspension bridge. One should think that nearly any kind of suspension bridge would satisfy aesthetic demands, because the graceful curves of suspended cables, nature's beauty line, could not be spoiled by the callousness of man. But that such can be the case, was the experience in the Williamsburgh Bridge, the second bridge built over the East River. No architect was consulted in the shaping of the bandy-legged towers or in the clumsy anchorages, nor were the stiffening trusses made sightly with any thought of forming a harmonious combination with the cables. The result is an unnecessary ugliness which even the untutored mind beholds with surprise. That structure has the distinction of proving how unsightly even a suspension bridge can be made if you try.

*Towers*—It should be the aim of the bridge architect designing a large suspension bridge, especially in city surroundings, to emphasize its monumental character in its most prominent feature, that is, the towers. They should satisfy the innate desire to give dignity to the structure. It has found expression in all larger suspension bridges, some of them built a century ago. Stone was invariably used for the towers. To this fact all the old suspension bridges owe their reputation for beauty, whether it was of the rugged kind as in the early English and American structures or of the more refined and ornamental kind as in some of the Continental suspension bridges.

The Brooklyn Bridge, completed 38 years ago, was the last suspension bridge with stone towers. The explanation is simple. High stone towers for very long spans are heavy and require big foundations, which are costly when they must be placed under water on deep rock. Metal towers are lighter and cheaper. But up to fifty years ago, cast iron was the only metal that could have been used as a substitute for stone towers and that only for limited heights. Only after the iron rolling mills became capable of producing heavier rolled shapes was it feasible to fabricate large metal towers of rolled iron and steel to take the place of stone towers. The designing of large metal towers as an art is therefore rather young, and only a few good examples of artistic metal bridge towers exist in smaller bridges.

*Steel versus Stone*—From the aesthetic point of view, metal towers, no matter how finely designed, will never equal stone towers. The finest example of an artistic metal tower is the Eiffel Tower in Paris, which carries no load but its own weight. And yet as an architectural creation it does not impress the beholder with that feeling of dignity and majesty which he experiences at the sight of any of the great spires in famous cathedrals. Although the highest inspiration of the architect as also the cunning skill of the artisan will probably always prefer stone to metal as building material for monumental work, the modern architect is obliged to also use steel and iron. He must create his own precedents in that material, and a large suspension bridge is one of the occasions for it.

The writer held this view when, as Commissioner of Bridges of New York, he took charge of the East River

bridges, nearly 20 years ago. But he found that he could do nothing in that respect during his short term of office. The Williamsburgh Bridge was building, the steel towers and anchorages were completed, the cables and its superstructure were contracted for and in process of erection. For the Manhattan Bridge the narrow tower foundations were already sunk. Such was the case also with the Queensborough Bridge. The revised designs for all these bridges were fitted to conditions that could not be changed. These designs were either mutilated or thrown away by succeeding administrations, involving a loss of many millions of dollars.

*Beauty and Utilarianism* — Particular effort should be made to dseign the metal towers of a large suspension bridge on artistic lines. The engineer who thinks merely of stresses must combine with the architect, who deals with artistic forms. The thousand-foot Eiffel Tower already mentioned may illustrate the point. When in a discussion with a prominent structural engineer he had pointed out to him the beautiful lines and elegant details of that great metal shaft as a fine example of French artistic skill, it was not a little surprising to hear him denounce that structure as wasteful, exhibiting poor engineering of which no American engineer would be guilty. In fact not long after, an American design, a typical shop-creation, for a very high steel tower was published as an example of what such a structure should look like. Ugliness is rational beauty to minds who see merit only in geometrical figures and in cheap fabrication. It is not unsual for an engineer to be derided by his fellow engineers as wasteful and unscientific if he uses a few extra pounds of metal or a few extra yards of masonry to make his structure more durable or more sightly. If such notions prevail, we may ask ourselves, of what effect are our boasted academies of art and schools of architecture? We have no record of any such institutions existing for the benefit of the architectural geniuses in Greece and Rome, or among the god-inspired medieval cathedral builders of Europe, or among the ancient Babylonian, Indian and Moorish architects, whose wonderful work compels our admiration to this day. We know that they did not get their inspiration from dry mathematical formulas, for they had very little of such knowledge, but they all had in them a spark of that creative supreme force and mind which molds and directs the universe and with it that innate love for the beautiful which like a flame tends always heavenward. The fine arts, which include architecture, will forever remain the true measure and index of human progress and intelligence. Future generations, wiser than ours, will judge our civilization by its achievements in monumental constructions, and for this reason we should feel it as a solemn duty and an obligation to the community to do our best in that field.

Viewed from that point, the towers of the proposed Delaware River bridge do not present a good design. They are too much on the utilitarian principle of braced telegraph poles or derricks, holding up ropes. The few architectural touches and articulations in the surface of the columns and caps are not visible from a distance and do not relieve the unpleasant impression of naked utilitarianism. The steel towers should have at least four columns to express stability and power and should have a form and bracing for which the French school of architecture, for instance, furnished fine examples of artistic treatment in the buildings of the Paris International Exhibition in 1900. From designs studied in that manner a choice could be made that would testify to the pride and good taste of opulent cities like Philadelphia and Camden, just as some of the beautiful bridges in Paris and London do for those cities.

Such towers, provided with stairways or elevators to reach the top [illegible] accessible to sightseers, would require a wider base, but not necessarily a more expensive foundation, nor would they on the whole cost much more than the proposed towers. They would give the bridge its true monumental character and take it out of the commonplace. The towers should be fully designed and considered before the foundations for them are commenced. Because if the proposed narrow foundations were commenced, it would make the designing of more beautiful towers impossible. This happened in the case of the Manhattan Bridge (of which the proposed structure is an imitation), where the narrow foundations prevented a design for monumental towers and a wider bridge. This bridge, only a few years old, is already too small, so that it is used only as a one-way bridge in rush hours mornings and evenings. So is also the old Brooklyn Bridge.

As the high anchorages for the Delaware Bridge will be visible from a long distance on the river and from the shores, their silhouette and architecture should be fitted to that of the towers. That applies of course also to the suspended structure. Each has its proper share in the harmonious whole of a monumental bridge. The dominating feature however, will always be the towers.

### Some Construction Details of Suspension Bridges

Wire, because of its greater tensile strength than bars or rods, found early use in suspension bridges. French engineers (Dufour in 1823 at Geneva) were the first ones to use it, while English engineers (Telford 1820) had a preference for chains of iron, in the form of forged eyebars. The difficulty found in straining the wires to uniform tension made the French engineers cautious, and so they preferred the method of construction which consisted in composing the wires into strands of parallel wires (occasionally also in the form of wire ropes). They were made on land. The strands hung side by side in vertical planes. The suspenders hung from crossbars on top of the strands and were lashed to them. This was also the construction of the first wire suspension bridge (1,100 ft. span) built over the Ohio River (1846) at Wheeling by the French engineer Ellett. The twelve strands for it were completed on land and hung on the towers. Shortly after its completion, a tornado turned the bridge upside down. John A. Roebling, who had already built a few smaller wire bridges, repaired the Wheeling Bridge. He disentangled the strands, and compacted them into two cables. Corroded wires in the anchorage were cut out and replaced. The bridge is kept in good repair and still in use, while most of the early wire bridges in France broke down from neglect and corrosion.

Roebling subsequently introduced the method of spinning the cables in the air and compacting the wires into cylindrical form by wrapping them with a continuous softer wire. This was the method followed in most American wire cable bridges. Only for two wire cable bridges over the Ohio River (at East Liverpool and Portsmouth) were the strands for the wire cables made on land.

All the early suspension bridges everywhere were built with flat catenaries, to which they owed their comparative rigidity in the absence of adequate stiffening frames to prevent undulation in the cables and chains from loads and wind. To the flat catenary (with a deflection $\frac{1}{8}$ to $\frac{1}{9}$ of the span) must also be ascribed the success of air spinning and compacting the wires under nearly uniform tension into solid cables, so that loose wires in them were rare and, in small cables, easily discovered and rectified. The last cables with flat catenaries, $\frac{1}{13}$ of the span, were those of the Brooklyn Bridge. The wires were laid up on a still flatter catenary than that of the finished cables, by moving the saddles on the stone towers toward the anchorages and thus increasing the tension in the wires during erection of the cables; this method was a great help to the better adjustment of tension in the wires before they were compacted.

The four Brooklyn Bridge cables, each 15¾ in. in diameter, were completed in 21 months. The next large cables, in the Williamsburgh Bridge, with about $\frac{1}{9}$ deflection, were finished in 7 months, and the wire cables in the Manhattan Bridge, with $\frac{1}{8}$ deflection, were finished in 4 months. The successive shorter finishing times indicate the progress made in rapidity of cable construction, but it is a moot question whether the quality of the cables, as regards evenness in tension of wires, is as good in the latter as in the Brooklyn and earlier bridges.

Many loose wires near the towers were observed during the compacting of the cables in the Williamsburgh Bridge.

and they occurred also in the Manhattan Bridge. The compacting and wrapping machines, starting from the middle and working towards the towers, compact the carefully laid wires so tightly that it would be impossible to pull out a single wire from the compacted portion only a few feet long. Loose wires can be adjusted in length only by cutting them and inserting a little turnbuckle splice, with which to tighten the spliced wires if possible to the same tension as the other wires. The trouble is, however, that with all possible care in laying the wires, each adjusted in length with the guide wire, their length is constantly changing from changing temperature conditions in open-air work, exposed to sun and winds. There always occur wires a few degrees warmer than others, producing local differences in tension and position in the same wire when in part already gripped in the compacted part of the cable. The compacted wires cannot slide on each other between the bearings on the towers, where they are held fast by their pressure. So the wires with less tension are forced together and compacted with those of higher tension. But where the wires are not yet confined and compacted, they will bulge out, particularly as the compacting machines are nearing the towers. If the tension in the parallel wires at any one section of the cable differed even as much as 25 per cent, it would mean no more than that some wires are stressed more than others, but that on the whole they are pulling together. The modulus of elasticity for the cables would of course be much lower than for the simple wires, but in the aggregate the entire cable section may have a sufficient margin of strength and safety. If the unequal tension in the wires can be controlled and kept between certain limits by careful work in the compacting of the cables, the total effective elastic strength of the cable, the only thing that counts, will be lowered, but still will be high enough to include maximum stresses from loads and temperature. But this condition can be attained by simple methods only in smaller cables, in which the loose wires can be discovered and adjusted. As the diameter of the cable and the number of wires increase, such adjustment becomes increasingly difficult if not impossible.

### Manhattan Cables Near Limit

The cables in the Manhattan Bridge, 21 in. in diameter, may be considered as the limit of size for such work, and it is not at all certain that the limit for safe air work was not already then exceeded. There exist no reports on the condition of the cables, during erection, except the observation of many loose wires forced into position by the compacting machines. If large cables, before being compacted, could be uniformly loaded with a large part of the suspended load, which would produce in the wires between bearings greater tension and stretch than that due to their own weight plus the elongation from the highest summer temperature, and allowed to slide freely upon each other during their elongation, and then compacted in that condition, each wire in the cable between bearings would be under uniform tension although the many wires may differ slightly in tension one with the other. The aggregate strength of the cable would be brought nearer to the theoretical strength, which is equal to the sum of the wires. This method would require special preparation and would obviously be costly, and slow. A less effective alternative method would consist in starting the compacting machines on the empty cables from each tower down towards the center and ends, instead of the reverse, which latter is the accepted practice. The bulging of loose wires would then occur in the middle of the river span and near the anchorages instead of near the towers. Their adjustment and resplicing would occur at those parts of the cable where they have a surplus of strength and so would be less harmful. But the difficulty, if not impossibility, of reaching loose wires in the interior of a large cable would remain.

Thus, we do not lack methods and means for making large wire cables of reliable strength, if they have to be made irrespective of cost, and if we have enough faith in their durability, which is not however justified to the extent of believing them as durable as eyebar chains. The engineer should prefer that construction which for the same money is the best and affords the greatest permanence.

This leads to the subject of *maintenance of cables*. The best practice to preserve the wires against corrosion is undoubtedly galvanizing, i.e., covering them with a zinc coating. That practice was followed in the Brooklyn and Manhattan Bridges, but not in the cables for the Williamsburgh Bridge. The wires here were covered by a thick mineral oil paste expected to fill the interstices between the wires to make them water- and air-tight. That expectation was not fulfilled. Moisture condensed from the air penetrated the interior of the cables, which are enclosed in thin steel mantles. Corrosion started and repairs became necessary within a few years. Thick white lead paint filling up all hollow spaces is the best protection for that purpose.

### Dangers Which May Develop

But there is nothing permanently perfect in this world. As the zinc covering of wires may in the handling of them become abraded in spots and leave bare spaces, protection cannot be absolute. Some accidental stray electrical current may find the weak spots and by electrolysis start corrosion where it cannot be known or got at. In this connection we must keep in mind that the great strength of the wire is in the outer layers of metal near the surface, which is the reason why small wires are proportionately much stronger than large wires. If the surface corrodes away, the wire breaks easily. Several French suspension wire bridges hardly twenty years old fell down, some 60 to 70 years ago, one after another, rather suddenly, because there had been neglect in painting. The outside painting of cables can of course not stop corrosion inside and hold up a bridge. We see plain fence wire after a few years literally disappear like dust, particularly in smoke-laden air. Galvanized wire will last longer, but when corrosion does get a start, the wire seems to vanish even faster than plain wire. It is so with tin roofs and tin cans.

The writer had been a strong advocate of wire cables for large suspension bridges for many years. They appeared to be an ideal method of construction for very long spans at lower cost than other bridge types. But when on closer study and observation he discovered the practical difficulties arising from greater span and larger size of parallel wire cables, he came to the same conclusion as other observing engineers, among them the late Geo. S. Morison, certainly a high authority. In his paper, (A. S. C. E., Vol. XXXVI, 1896) on a study for a large suspension bridge, Mr. Morison had chosen for his 30-in. cables coiled wire strands, finished in the shops to accurate length and submitted to a proof-stress before erection, as preferable to cables with parallel wires.

The writer had about the same time examined into the practicability of fabricating wire links, (to be enclosed in a roomy shell of noncorrodible metal), with which to compose chains for suspension bridges. His first design for a suspension bridge at Quebec (1899) included that construction. The links were to be made of rectangular wire with corners rounded off, each link submitted to a proof stress. They were guaranteed as to strength and quality under rigid specifications by the large wire firm of Felten & Guilleaume of Cologne. There would have been absolute certainty as to the strength of chains of this construction. This same firm as well as other firms manufacture several forms of patented coiled wire cables, which have been used in suspension bridges of moderate spans with great success. These were at first proposed also for the new Budapest suspension bridge in 1894. But the engineers for that bridge decided finally, after long deliberation, in favor of chains of eyebars cut out of wide plates. There are no plants in Europe for making forged eyebars. The finer architectural appearance of huge eyebar chains and their greater durability were the final deciding factors.

The questionable condition and apparent uncertainty of strength of the large wire cables in the Williamsburgh Bridge induced the writer, as Commissioner of Bridges for the city of New York, to avoid large wire cables in the plans for the Manhattan Bridge. The design provided, therefore, for chains of forged eyebars of nickel steel,

which appeared to have many advantages over chains of wire links. That design was submitted to a board of five eminent bridge engineers and approved by them. Their report has been published (Trans. A. S. C. E., Vol. LV, 1905, pp. 89-93, Report by Geo. S. Morison, C. C. Schneider, Mansfield Merriman, Henry W. Hodge, Theodore Cooper). In comparing chains and wire cables their first report to Mayor Seth Low set forth:

The chains have decided advantages in the accessibility of all parts for inspection and protection as well as in economy and rapidity of erection. They are to be preferred to wire cables whenever the cost of chains is not materially greater. The cost of eyebar chains and wire cables in this bridge would be about the same.

In their final report they said,

We deferred our final report, relating to the quality of the material to be used for the eyebar cables, until additional tests could be had and we should be satisfied, by correspondence with the leading manufacturers of structural steel, that the desired material could be obtained at reasonable price and in open competition. In our preliminary report, March 9, (1903), we reported favorably on all features relating to the design of this bridge, subject only to the uncertainty of obtaining this quality of material. This uncertainty is now removed. In this final report, we unanimously recommend the adoption and execution of the proposed design of the Manhattan Bridge, as submitted to us by the Commissioner of Bridges.

The reason why the Manhattan Bridge was not built on the approved plans is well known. Before the contracts could be let, another city administration was elected, which also changed the management of the Bridge Department. The approved plans were thrown away, and new plans were made for a wire cable bridge, costing several million dollars more than the chain bridge. No board of engineers was called into report on these new plans, or compare them with those already approved. The character of bridge management can be judged from the fact that the courts were appealed to by outwitted bidders to stop fraud in awarding contracts on manipulated bridge specifications. That a management of this kind would be very much concerned about the quality of the work or about progress in the art of bridge building was not to be expected and it is for this reason that we are without reliable scientific information or records on many details of erection and maintenance of the East River Bridges of that period. Among these are the actual condition of the big wire cables, erected in the unprecedented short time of 4 months, a very creditable performance, provided it was not at the cost of quality.

### 30-In. Wire Cables Big Advance

In any event, there is no reliable basis or safe precedent for a leap from 20-in. cables to 30-in. cables with parallel wires, as now proposed for the Delaware River bridge. It would be a great achievement, most desirable also from the architectural point of view, to have big wire cables. In the writer's studies for the North River bridge they would have been 60 in. in diameter. But it is one thing to design them and another thing to be assured of their safe obtainment.

That there are large secondary stresses in large stiff wire cables is now better understood than when the East River bridges were built, where they were not considered. The largest stresses from tension and bending occur at the towers, just in that part of the cable liable to have the most wire splices from adjustment of wires. Safe provision can of course be made for secondary stresses by increasing the cable section and leaving 150 to 200 ft. of cable at the towers uncompacted, so that the wires can slide on each other for that length to prevent excessive stresses from the bending of the cables. All this can be done, but it adds to weight and cost of cables and is poor construction.

In chains of eyebars no uncertainties of stresses can occur, as all determination of length and all fitting are done in the shops with great accuracy, which must be one of the determining elements in any great metal bridge. This feature was well considered in the design made for the Pennsylvania Steel Co. for an eyebar suspension railroad structure at Quebec in 1910. In *Engineering News* of Nov. 23, 1911, the comparison of weight is given with the official equivalent cantilever design. The competition in this case did not decide the merit of any competing designs, as the contract was awarded to a cantilever structure not complying with specifications and therefore 30 per cent lighter than any other design, including the so-called official design. The length of the river span (1,756 ft.) in this design was practically the same as in the proposed Delware Bridge (1,750 ft.), so that the two are readily comparable when transposed to the different load conditions and the higher unit stresses would would be justified with the present higher steels.

In this connection the report above mentioned on the chain design for the Manhattan Bridge, a carefully considered judgment from engineers of great experience and high attainments, is worth thoughtful consideration. The cost of eyebar chains and wire cables is mentioned as being about the same (in 1903). The comparison was based on nickel-steel eyebars with 48,000 lb. elastic limit and 85,000 lb. ultimate strength. That was also the basis for the chain design for the Quebec Bridge, 12 years ago. But since then progress has been made in the metallurgy of steel, and large eyebars can be obtained of high steel with elastic limit and ultimate exceeding 80,000 and 110,000 lb. respectively. With such material an eyebar suspension bridge cannot help but be superior in quality to a wire cable design, and also cheaper in total cost, when properly designed. It is surprising that improvements in the art are ignored and that no studies for chain designs have been made by which the merit and economy of the proposed wire cable bridge could be tested. That could probably be best done by a competition of designs, but not of the kind had on the Quebec Bridge.

Studies for a large bridge cannot be considered complete until every phase of it has been examined in the light of progressive scientific knowledge. But in all or any designs for a large city bridge, architectural considerations should prevail, for the reasons already stated. That much its builders owe to the public and our age.

## Railway Electrification in England

REGULATIONS recommended to the British ministry of transport in the final report of the technical committee on electrification of railways, in order to promote standard practice, provide for a direct-current system of 1,500 volts, but permit higher voltage in multiples of the standard pressure and also 750 volts where sufficient advantage can be shown. Continuance of existing 600-and 1,200-volt systems is approved, however, mainly for the reason that the London, Brighton & South Coast Ry. long ago adopted a single-phase alternating-current system for its suburban lines and is intending to extend this system on its 50-mile main line to Brighton.

Both overhead and third-rail collecting systems are permitted. For third-rail conductors either the top or bottom contact system may be used, but the latter is considered to have advantages in regard to snow and ice accumulation and to protection of men working on the track. In either case, the contact rail is to have its center line 16 in. from the gage side of the track rail, the contact surface being 3 in. or 1½ in. above the track rail for top and bottom contact rails respectively. Where overhead conductors are used, the distance between the conductor and the clearance line of equipment is to be 36 in. on the open line and 10 in. in tunnels; at grade crossings the conductor must be 18 ft. above the rails, and at points where men may have to work on top of the cars the height must be 20 ft. Overhead conductors must be 21 in. from the center line of track at 4 in. above the equipment clearance line, and 15 in. at a height of 18 ft. above rail level.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Improving the Terminology of Mechanics

Sir—I offer a few suggestions respecting the nomenclature and notation of mechanics, or dynamics, as it has been designated in recent years.

It is quite generally known that *dynamics* is the science which treats of the action of forces upon bodies and that it is subdivided into statics and kinetics, *statics* applying to bodies in equilibrium and *kinetics* to those in motion. The older term *mechanics*, according to modern usage, should apply exclusively to the structures of transmission of force, whether these be machines and other mechanisms, trusses, or matter structures. The expression *dynamic loading* should be superseded by *kinetic loading*, since the Greek root for kinetic signifies to move, whereas dynamic applies equally well to conditions of rest or motion.

The best definition for stress was once given by Professor I. P. Church—distributed force. It is force per unit of area. The expressions *unit stress* and *total stress*, literally signifying unit-unit and total-unit, should be superseded by the terms *stress* and *force* or *traction* respectively, or their equivalents, the term traction being already used in dynamics for the latter purpose. A pressure is a negative traction.

The term *strain* is a unit and had best replace such redundant expressions as unit deformation, deformation in inches per inch, unit elongation, unit shearing distortion and the like.

*Ultimate stress* should be understood to mean the last recorded stress applied during a test. It should not be confounded with the expression *maximum stress*, which should be used in its strict mathematical sense as "peak of the load" or greatest.

The expressions *bending stress* and *torsion stress* should be replaced by *bending couple* and *twisting couple* or *torque*, as, strictly, there are no such stresses. Works, torques and bending moments should be stated as pounds-inches, etc., instead of the reverse, as the idea of force by distance is fundamental.

There is no scientific basis for the use of such terms as *true* and *apparent stresses*. A lateral stress is not induced when a bar is stretched in the direction of its axis and this cannot be shown analytically or by tests. It would therefore seem advisable to omit a consideration of these "stresses" in texts and engineering pocket books, as they are not recognized in the standard dynamical treatises and are generally misleading to young engineers and students.

It would seem advisable to introduce into engineering texts the modern notations and methods of combining stresses and strains as given in dynamics, abandoning the notations and methods based on the older authorities, Rankine, Lamé, and Townsend, which have outlived their usefulness. An engineer using the strict dynamical methods of obtaining principal stresses, combined stresses and resultants can solve his problems more effectively than by the older methods, which are cumbersome. Again, where the particular ellipse-of-stress method of Rankine is used considerable time is required in reducing the problem and its conceptions to paper. The standard dynamical method is easier and more expeditious, in that it can be worked out quickly by slide rule.

As regards notations for stress and strain, Kirchhoff's is to be preferred. It conveys at a glance the meaning of each symbol, one may say automatically, in a somewhat analogous way as is done by the well-known notation of Bow in graphical analysis of structures. Capital letters corresponding to the co-ordinate directions suffice for the stresses, while subscripts to these letters indicate the planes on which the stresses act. The terms $X_x$, $Y_y$, and $Z_z$, for example, indicate stresses pointing in the respective co-ordinate directions on planes perpendicular to these directions. The term $Y_z$ is the stress acting in the direction of $y$ on a plane whose normal points in the $z$ direction, and so on. The corresponding strains are indicated similarly, but with a lower-case letter and subscript. A further desideratum exists in the fact that cyclic symmetry prevails throughout in equations for stress, this symmetry being absent in the engineering notations. It renders formulas of more general utility and easier to memorize.

J. H. GRIFFITH,
Professor of Experimental Engineering, Iowa State College.

Ames, Iowa,
Oct. 29.

## Detecting Flash Setting Cements

Sir—We have read the article in your Oct. 27 issue by C. L. Jenkin on the setting time of cement with appreciative interest as it touches on a feature of the testing and use of cement which we think deserves far more serious attention than it usually receives.

In our cement testing department we have frequently noted the conditions described by Mr. Jenkin and have come to the conclusion that some cements have a latent tendency to flash setting which is difficult to detect by the conventional test for setting time. We tried various means of revealing a tendency to flash setting which the cement test did not disclose and found three methods which apparently were of equal effectiveness. We sometimes heated the cement and water to 100 deg. F. while on other occasions a cement that was under suspicion would be exposed to the air in a thin layer for 24 hours. The third expedient consisted in allowing the cement, after adding the water for the setting time determination, to remain undisturbed for five minutes before mixing into a paste. If a tendency to flash setting exists in cement it is usually impossible to mix it to a paste if allowed to stand for five minutes after adding the water. The two methods first mentioned are frequently effective in so exaggerating the tendency to flash setting as to make it clearly apparent by the cement test.

Curious beliefs spring up in the trade concerning cements. On a recent day we heard a certain brand of cement bitterly criticised by one contractor for slowness in hardening and by another contractor for setting so quickly as to present difficulty in getting the concrete into the forms before setting occurred. This apparent inconsistency is probably due to the fact that the cement in question almost always tends to become flash setting or else has the ability to develop what might be termed a false initial set. The slow hardening complaint was probably due to the fact that the set was broken during the mixing with resultant slow hardening while the party who found that it hardened too quickly was probably mixing too short a time to break the set so that setting commenced in the buggies and chutes.

While for many purposes the presence of a flash setting tendency in cement may be ignored, it is of vital importance that cement for concrete floors, sidewalks, roads and many other uses be normal as to setting time.

E. L. CONWELL,
President, E. L. Conwell & Co., Inc.

Philadelphia, Pa.
November 1.

## Stresses in Eyebar Heads

Sir—I have read with interest Josef Beke's article "A Study of Stresses in Eyebar Heads" in your issue of Aug. 11, p. 234. However, the formulas for $X_o$ and $M_o$, which I have checked by an independent derivation, impress me as too theoretical, by which I mean that the assumptions on which they are based do not cover important points of the existing conditions with sufficient approximation, so that the finely worked-out formula after all gives only a rough approximation.

The eyebar head is not a ring, as the body of the bar is continuous with the head and restrains the deflections and angular deviations of the head. The actual stress in the head must lie somewhere between the stress in a ring as computed by Mr. Beke and the stress in a bar with the body as wide as the head. By taking 50 per cent of each stress and adding them together the result must be nearer the correct value. It is questionable, also,

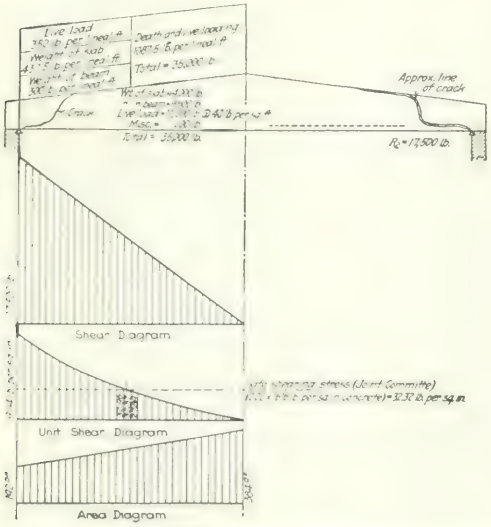
whether radial plane sections will remain plane; I believe that the transfer of the direct stress from the bar to the head does not take place on the middle line of the head but is crowded nearer to the pin hole.

However, I believe that a value for the tension at the inner edge on a transverse diameter, $S_r = 2.5T$, where T is the unit stress in the body of the bar, is approximately correct. By a much simpler method I have arrived at a value for $S_r$ equal to 2.4T. I do not give this method as it is nothing but an application of the moment area method to a fixed beam. It is with this as with Euler's formula where the assumption of an ideal column (a thing never found) necessitates the use of higher mathematics, while an approximate method gives the same result with a difference of a few per cent. C. L. CHRISTENSEN.

Detroit, Oct. 25.

## Another Concrete Failure Due to Poor Design

Sir—We are continually hearing of failures in concrete structures due to what "after the accident investigators" call "poor design," or a design fundamentally inadequate in strength, but the real reason may be more truly stated to be either ignorance or gross negligence on the part of the designer.




REINFORCED-CONCRETE ROOF GIRDER WITH NO SHEAR REINFORCEMENT—IT FAILED

I am showing herewith another glaring example of what we may call, for politeness sake, "poor design" made by a firm of industrial engineers in New York City. On the drawing is shown one of the typical roof beams which failed. This beam was built to support the roof of a pump house and the lines of failure are as shown on each side of the beam. These beams were spaced 8 ft. 9 in. c. to c. The length of beam was 32 ft. The height of beam varies from 2 ft. to 4 ft. high by 8 in. wide. The steel allowed was two 1¾-in. longitudinal straight bars, placed at a distance of 5 in. up from the bottom of beam. This was to carry a total loading of 35,000 lb. Under the sketch is shown a table, a shear diagram, an area diagram, and also a unit-shear diagram. And it will be noted that from stresses due to moment the steel is being asked to take 21,400 lb. per square inch with the concrete at 975 lb. per square inch. This is excessive, and good engineering practice would have called for stirrups or other web reinforcing where the shear exceeds 32 lb. as shown in the sketch.

Is it not therefore to be wondered, in viewing the above from the designer's point of view, why these beams did not fail long ago? The beam was poured monolithically with the concrete side walls, and there was therefore a tendency for cantilever action, and further, the tops of the beams at the ends were in tension with a negative bending moment, as is the case in continuous beams. The steel was placed at a distance of 5 in. above the bottom of the beam, which is too great for good engineering practice. Only enough covering is required to ensure bond and fire protection, which is surely not as much as 5 in.

The high shear and diagonal tension stresses which set up in this beam near the ends were not properly taken care of by shear reinforcement and we have therefore failure in the beams along lines of structural weakness as the natural and logical result. HERBERT CANTWELL.

Espanola, Ont., Oct. 26.

## Locomotives and Railway Bridge Strength In China

Sir—P. H. Chen's article on the relative impact from American versus European locomotives, in *Engineering News-Record* of July 14, p. 58, has caused much comment both here in China and in America; over here offering an opportunity to deliver encomiums on American locomotives and hurl abuse at European bridges, without much endeavor to analyze the matter.

Certain observations simplify the matter somewhat. Since the impact from American locomotives was brought under suspicion, many have insisted on imputing the rather large difference in weight between American and European bridges to provision for such impact. As a matter of fact the difference is largely accounted for on other grounds, the American designs providing for greater permissible overloading, and for less rapid wearing out of the structures. The American bridges could undoubtedly be made lighter and hold up their loads, but usually the regret is that they were not made even heavier on account of unexpected load increases.

The problem has been discussed from the too narrow viewpoint of the bridge engineer over here. Of course the question of locomotive design was bound to be injected into the discussion, but the effect of locomotives on bridges (all-important in bridge design) counts for but little in the broad considerations involved in selecting locomotive types. By exaggerating the place of bridges in a railway system we have attempted to rate the excellence of locomotive according to their effect on bridges. Now, locomotives are not designed simply to provide loads for bridges, but bridges are designed to carry locomotives, and to carry such locomotives as are necessary to handle the traffic economically. If the American locomotive types are the best to carry the traffic, then the bridges must be designed to carry them, and if China's traffic conditions are coming to resemble America's, and if China wants American motive-power efficiency (the few American locomotives in use here are more than proving their work), then China should adopt American locomotives with the bridges they entail, and not complain of a few extra pounds of steel, if necessary, especially since they provide for a reasonable overloading, which may prove of great value under unexpected increases in traffic.

The tests made, aside from their insufficient number to draw any conclusions from, may be questioned as to their validity, as other factors besides locomotive weight must be considered before we can make any general statements about excessive impact; for example, the operating speed designed for, extra strength in reciprocating parts to permit of being operated at maximum capacity all the time and minimize repairs (requiring different counterbalancing), requirements that necessarily and justifiably give one locomotive greater impact than another of about equal weight.

One fact probably may be revealed, namely, that American locomotive builders are looking into Chinese operating requirements less carefully than the Eureopean firms, for example, in regard to providing extra strength so that it will be permissible to shift crews on the locomotive as necessary in America, while in China one crew stays with a locomotive and takes pride in its upkeep.

On account of the great effect of the period of vibration

of the structure and of different kinds of piers on impact, valid comparisons cannot be made between experiments made in Europe and those made in America. The same bridges ought to be used for all the kinds of locomotives tested, and here in China there is abundant opportunity for looking into the matter. The tests should be continued not so much to see whether American or European locomotives produce the greater impact, which is after all a less important matter (as locomotives are selected on broader economic considerations) but to decide whether the European type of bridges now used on many lines can longer be tolerated on the Chinese railroads.

Tientsin, China, Oct. 12. JOSEPH H. EHLERS,
Professor of Structural Engineering,
Pei Yang University.

## Figuring Stresses in Concrete Chimneys

Sir—In the article in your issue of Sept. 29, p. 512, entitled "Short Cut Design of Concrete Chimneys," the method of determining the vertical steel required in a concrete chimney by designing a steel chimney is in error. The vertical tension in any chimney is due to the wind pressure less the weight of the chimney. It is quite apparent that the weight of a concrete chimney is much greater than that of a steel chimney, and the net tension is therefore much less.

In regard to the foundation, the center of gravity of the pressure diagram is of course at the point of application of the resultant. The pressure diagram extends from the edge of the base nearer to the resultant to some point determined by the shape of the base. In a square base with the wind pressure parallel to two sides, this point is three times the distances of the resultant from the nearer edge, provided of course, the diagram does not extend past the further edge of the base. There cannot be any tension on the soil whether the diagram extends entirely over the base or not. In the case of small steel stacks, the pressure diagram very rarely extends entirely over the base.

The problem of finding the pressure diagram is very simple in the case of a square base with two sides parallel to the wind pressure. It is much more complicated with an octagonal base. It may be found, however, by the prismoidal formula, and a formula derived which makes calculations simple. The object of finding the pressure diagram is of course to determine the maximum soil pressure on the leeward side, which is the critical point of the design. J. T. N. HOYT.

## Roof-Shield Work and the East Boston Tunnel

Sir—The article of W. C. Briggs, "Timbered and Roof-Shield Tunneling in Deep Loose-Ground Subway Section," published in *Engineering News-Record*, Oct. 27, p. 676, describes the construction of a section of Brooklyn subway by means of a roof-shield. It is claimed the roof-shield was unique because of the fact that the shield was shoved directly after placing of a ring of concrete, the shield jacks depending for their reaction upon push-rods embedded in continuous lines in the concrete of the tunnel shell. Mr. Briggs adds that so far as the author is aware the combination of a shield, concrete forms and wet concrete immediately behind the shield had never before been used.

It seems to me that the same method has been used in the construction of some sections of the Boston subway, described in the reports of the Boston Transit Commission, Howard A. Carson, chief engineer, and also in *Engineering Record*, Feb. 26, 1898. The same method was exclusively employed in the construction of the East Boston tunnel, the description of which is found in the reports of Boston Transit Commission for the years 1901 and 1902, in *Engineering Record*, March 23, 1901, in *Engineering News*, Jan. 23, 1902, and illustrated by myself in *Traction and Transmission* (London), in March, 1902.

New York, Oct. 28. CHARLES PRELINI.

(Mr. Briggs' reply to the above comment follows.—EDITOR.)

Sir—In reply to Mr. Prelini I have to say that apparently he is in error in his reference to the Boston Tunnel described in *Engineering Record*, Feb. 26, 1898. which has a brick arch lining instead of concrete. His other reference, however, is correct, so much so, in fact, that as soon as I examined it, I was convinced that the Brooklyn construction was copied from it. In following the matter up, I learned (as I had already guessed) that Robert A. Shailer, consulting engineer, Boston, Mass., who has always been thoroughly conversant with Boston tunnel construction and has been identified with some of it, recommended the shield plan, about as adopted, to the Degnon Contracting Co.

Except for making up an independent proposal in 1916 for the Brooklyn work described, I had no connection with it whatever until after my predecessor had left it; consequently, I knew one of the details relative to the adoption of the shield method. In connection with the proposal referred to, I had a library search made covering certain types of tunnel construction; it just happens that the particular Boston tunnel section referred to by Mr. Prelini was not mentioned in the search, although other sections of the Boston tunnel were.

It pleases me to have the error corrected and I am thankful to Mr. Prelini for his interest in the matter.

Brooklyn, Nov. 14. WALDO C. BRIGGS.

## In Defense of the Engineer

Sir—The extract of Mr. Cabot's speech headed "The Engineer a Failure as a Manager," in *Engineering News-Record*, Oct. 27, p. 692, certainly requires rebuttal. Not that Mr. Cabot's opinion (which he states as an accepted fact) is generally held either in or out of the profession so far as I can determine, but merely on the ground that a statement, no matter how erroneous, will gain credence from unchallenged repetition.

At the outset we must admit that if to have one's feet on the solid ground, to know and weigh the obstacles to be overcome, to not fail in the critical hour, be faults, then the engineer is damned. But with Mr. Cabot's major premise that the engineer is born without imagination and has his idealism throttled in infancy we do take issue. No aesthete can be crassly material nor devoid of imagination.

True it is that the engineer of fifty finds his enthusiasm of the twenties somewhat damped, his idealism somewhat dazed by the glare of a commercialized world, and his imagination perhaps dulled by the necessity of keeping his nose to the grindstone. So also does the lawyer, the manufacturer, the statesman and the hod-carrier. I have never heard a banker accused of having either enthusiasm or imagination, so cannot say if this applies to them. In citing instances to justify his conclusions Mr. Cabot begs the question by admitting that the banker "yearning for a sure thing," picked the engineer. The inference that in such selection the qualities under discussion would be a bar is inescapable. Though the profession lays no claim to a monopoly of imagination and idealism it would probably be rank heresy to suggest that the banker was in any wise to blame for a poor selection from a good field.

For the rest Mr. Cabot's argument appears to be a disjointed attempt to saddle the blame for the failure of sundry trusts onto the profession though no engineers were connected with them; and to hold the railways up as a horrible example when, by his own admission, the politicians and bankers are responsible for their condition insofar as it is not attributable to economic conditions brought on in part by these same trusts.

The statement that the engineer's "natural position is that of the hand which executes rather than the mind that conceives. Leadership is not native to him," is a bald slur which is probably father to the wish and needs only to be stated alone to fall of it's own weight.

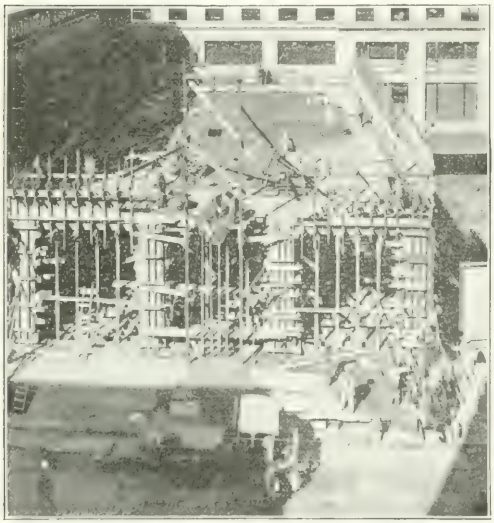
In short, Mr. Cabot's complaint in so far as it can be analyzed boils down to this: The banker entrusted his enterprises to engineers carefully selected for lack of imagination and their readiness to "take orders," and now, dissatisfied with the result, tries to indict the profession for his own fault. C. E. MUHS.

Chicago, Ill., Nov. 5.

# HINTS FOR THE CONTRACTOR

## Motor Truck Supplants Concrete Buggy Hoist on Small Job

ON JOBS in which a comparatively small amount of concrete has to be elevated, particularly in the construction of one-story buildings, Barrett & Hilp, contractors of San Francisco, Cal., have several times found it economical to use a light motor truck instead of bringing a motor driven hoist to the job. The truck is usually operated up and down on the street in front of the work. By means of a single line running from the truck through snatch blocks on the ground and over a sheave above the landing platform, as the truck moves backward and forward it raises batches of concrete or lowers empty containers.



MOTOR TRUCK REPLACING HOIST ON SMALL JOB

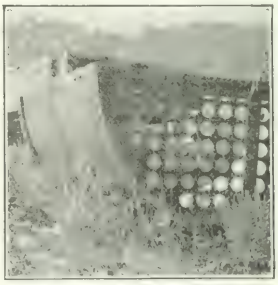
In the accompanying picture this plan is shown in operation on a building where concrete was raised in hand buggies about 18 ft. above street level. On this job it was possible to locate the truck runway so that the driver would at all times face his work. The support for the hoisting sheave here consisted of two uprights (each made of two 2 x 6-in. timbers spiked together) placed vertically 8 ft. apart, and set so the cross tie between them overhung the face of the building by about 30 in. The cross tie was placed high enough so it would handle concrete to be delivered by gravity into the top of the parapet wall. These uprights require guy wires to insure stability.

With this arrangement 90 cu.yd. of concrete was hoisted per 8-hour day, using the regulation 6-cu.ft. concrete hand buggies and a mixer whose charge would provide the proper load for two buggies. The buggies had ½-in. iron bars welded diagonally across their tops for convenience in attaching the hook by which they were hoisted. On this job the buggies were handled at the rate of 36 seconds per round trip, i.e., one full buggy hoisted and one empty buggy lowered. This rate of delivering material was maintained with a crew of six or seven men and the truck driver, distributed as follows: two men landing buckets on the upper level, two buggy men on the ground between mixer and hoist and two buggy men on the upper level delivering to forms. Three buggy men were required on the upper level when the forms to be filled were well away from the hoist.

With the arrangement as shown in the picture, if the attendant on the ground is careless or lazy the descending empty buggy is likely to strike a full buggy which is standing in position ready for hoisting. Danger of breakage due to this cause would be lessened, it has been pointed out, by the use of a runway hung alongside the hoist frame on a horizontal axle and set so the top of the runway could be tilted out under the descending buggy, deflecting it to one side, preferably toward the mixer. By attaching a counterweight on the bottom of such a runway, it would automatically return to vertical position when released, thus leaving no obstruction in the way of the ascending buggy.

## Rockskip Made From Boiler

A UNIQUE piece of equipment for handling rock is being used by the Hugh Nawn Contracting Company on the Gilboa dam, New York. It is a rock skip, illustrated in the accompanying photograph, and made of a vertical tubular boiler. The boiler shell was cut in half, a new iron strip was bolted to the inside of the tube head at the top, and another strip with a hook, at each end. The whole formed a skip for handling rock hoisted either by derricks or by cableways.



IMPROVISED ROCK SKIP

The information contained herein was furnished by Theodore Hanan, Flory Manufacturing Co., Bangor, Pa.

## Bituminous Filler for Granite Block

Asphalt mastic filler for granite block pavement has proved so satisfactory, states C. D. Pollock, consulting engineer, New York City, in a paper presented at the City Paving Conference in Philadelphia, Pa., Oct. 20-21, 1921, that the crude methods of use which now prevail should be eliminated. The present hand mixing methods are inexact. Mechanical mixing is an improvement, but of measuring the materials in order that the amount of sand used shall be uniform. It is also desirable that tests be made to determine more accurately the proper amount of sand to use. This amount should be as great as possible and still permit the mixture to flow readily into the joints.

# NEWS OF THE WEEK

New York, November 24, 1921

## Jubilee of American Public Health Association

**Founder Present and Honored—Sanitary Engineering Section Meets With Am. Soc. C. E.**

The semi-centennial celebration of the American Public Health Association was held in New York City, Nov. 14-18. Coincident with this meeting was the Health Exhibition and preceding it by a week was the Public Health Institute, both previously announced in these columns. The institute, which was largely attended, consisted of demonstrations of many and various lines of public health activity and of sanitary engineering works in New York City and vicinity.

A unique feature of the convention was the presence of Dr. Stephen Smith, one of the founders and the first president of the association, who is now in his ninety-ninth year, as noted in a biographical sketch elsewhere in these columns.

As has been customary, the association, as a whole, met in a few general sessions, but the vast mass of work was done through numerous section meetings—sanitary engineering, laboratory, vital statistics, public health administration, sociological, industrial hygiene, food and drugs, child hygiene, and health education and publicity.

### Two Main Features

Features of the two main general sessions were (1) reviews of public health history during the last fifty years, in which sanitary engineering was presented by George W. Fuller, consulting engineer, New York City; quarantine, by Hugh S. Cumming, Surgeon-General, U. S. Public Health Service; bacteriology, by Edwin O. Jordan, professor of hygiene and bacteriology, University of Chicago; and public health work in Cuba, Mexico and Canada, by representatives of those countries. (2) An address on "European Health Conditions" by Prof. C. E. A. Winslow of Yale University.

Among the many business items affecting the whole association of chief interest were the announcement of the choice for new president of Dr. A. J. McLaughlin, of the U. S. Public Health Service, Washington, D. C.; the selection of Cleveland, Ohio, as the next meeting place; and a revision of the constitution of the association.

### Sanitary Section Officers

The officers for the ensuing year chosen by the Sanitary Engineering Section include W. H. Dittoe, chief engineer, Ohio State Department of Health, as chairman; C. A. Emerson, Jr., engineer, Pennsylvania State Department of Health, vice-chairman; E. B. Rich, engineer, State Board of Health, Lansing, Mich., secretary (re-elected); and Theodore Horton, chief, Sanitary Engineering Bureau, Office of State Engineer, Albany, N. Y., section representative on the board of directors of the association.

(Continued on p. 870)

## California to Offer Road Bond Issue of $7,000,000 At Once

**The California state highway finance board has announced that $7,000,000 worth of state highway bonds will be offered for sale at Sacramento, Cal., Dec. 22. Because of the high premium commanded by the $5,000,000 block recently sold, as reported elsewhere, the interest on the new issue will be only 5 per cent. The proceeds of this sale will be used as part of the 1922 construction program which is expected to amount to a total of $18,500,000.**

## Rejects Commission-Manager Plan at Lockport, N. Y.

The commission-manager plan was defeated at Lockport, N. Y., Nov. 8, by a popular vote of 2,662 to 2,325, this being the third adverse vote.

## Buffalo Votes for Water Filters

Buffalo, N. Y., on Nov. 8, voted 39,381 to 26,509 for a water filtration plant "at an estimated cost of $4,000,000, not to exceed $4,500,000." The plant will have a capacity of 160 m.g.d. and will be located near the Francis G. Ward pumping station. It will probably be six or eight months before plans will be ready for bidders. George C. Andrews is water commissioner and Arthur W. Kreinheider is commissioner of public works.

## To Relieve New York Transit Jam By Staggered Work Hours

Following a report by Daniel L. Turner, its consulting engineer, the New York Transit Commission last week announced a plan of relieving traffic congestion on the city's rapid transit lines during the rush hours by urging employers to adopt a "staggered" schedule of opening and closing hours for their stores and offices. A classification of industries is to be made.

Summarizing the need of facilities sufficient to increase the capacity of the transit lines 60 per cent, Mr. Turner says:

"Contracts covering all of the city-owned rapid transit lines in operation have cost the city and companies together to produce to date approximately $454,000,000. Sixty per cent of this is $272,000,000. A large portion of these facilities were constructed under pre-war prices. To reproduce them now would probably cost at least $500,000,000. Therefore, spreading the traffic peak evenly over two hours, morning and night, would in this sense increase the capacity of the existing facilities as much as new facilities costing perhaps from $200,000,000 to $300,000,000 would represent."

But Mr. Turner says that a 40-per cent increase in capacity would be sufficient to meet a 5-year traffic increase.

## Agree on Variety Limits for Paving Brick

**Eleven Varieties Out of Sixty-six Believed Ample for Most Needs, Manufacturers' Report Shows**

Responding to an invitation of the Department of Commerce, representatives of paving brick manufacturers and engineering societies met in Washington Nov. 15 and agreed upon limiting the number of varieties of paving brick to 11. These 11 standard varieties are to be presented for approval to the organizations represented. The conference agreed on the formation of a permanent committee, with its executive member in the Department of Commerce, to which will be entrusted the duty of following up the action taken at the meeting and also of furnishing machinery whereby questions of further simplification may be considered.

Among the organizations represented were the National Paving Brick Manufacturers Association, the American Society of Civil Engineers (by Col. W. D. Uhler), the American Society for Testing Materials (by W. E. Emley), the American Society for Municipal Improvements (by George F. Fish), the American Association of State Highway Officials (by Leon C. Herrick), Western Society of Engineers (by John A. Dailey), a number of government bureaus, and half a dozen other engineering societies.

### Report Gives Facts

An excellent survey of current varieties of paving brick made by the secretary of the paving brick association, M. B. Greenough, formed the groundwork of the meeting. The survey disclosed 66 current varieties. A summary of the more important facts disclosed is printed elsewhere in this issue.

In the plain wire-cut class 92½ per cent of all shipments this year was in two sizes—4 x 3 x 8½ in. and 4 x 3½ x 8½ in. The other 7½ per cent of the shipments was in the remaining six varieties. In the repressed lug class 79½ per cent was in the 3½ x 4 x 8½-in. variety, and 20½ per cent in the 22 other varieties. Shipments were also strong in the 3 x 4 x 8½-in. and the 3½ x 3½ x 8½-in. varieties.

In the other classes of brick the sharp demarcations shown in the class already referred to did not obtain.

In preliminary deliberations in the full conference the elimination of 46 varieties was agreed upon. These went out as a result of resolutions eliminating all brick which were less than 3 or more than 4 in. in depth, less than 3 in. in width, and which were not 8½ in. in length. The matter of further eliminations were then referred to a committee with instructions to report at the afternoon session.

The committee's report eliminated 9 varieties in addition to those which had been eliminated in the full conference. The committee stated that it had

approached the subject with the desire of eliminating all sizes except those which could be cut from a 3-in. or a 4-in. clay column. On discussion, however, it was apparent that engineering practice is running rather strongly in the direction of using a brick 3½ in. deep, and the committee therefore concluded that brick of a 3½-in. depth would have to be provided for. State highway departments, for example, while finding that a 3-in. brick is too light for their use, find it unnecessary to go to the 4-in. depth which city paving practice demands.

In recommending the elimination of a 3 x 4 x 8½-in. repressed lug brick, the committee explained that while 5,000,000 of this brick were shipped this year, up to Aug. 1, its elimination was recommended because no hardship was imposed by asking users of this brick henceforth to substitute the 3½ x 4 x 8½-in. brick instead. No saving in freight is made by the use of the smaller size, which is identical in depth but is ½ in. narrower than one of the standards approved.

The committee recommended that all special brick, with two exceptions, be non-standard. The exceptions are one standard size in the Dunn hillside brick and one in the repressed hillside brick.

### Eliminations

Before discussing the varieties in detail the conference unanimously adopted a resolution to the effect that reduction in number of varieties was in the interest of both consumer and manufacturer.

The sizes recommended for adoption by the committee and approved by the conference are as follows:

Plain wire-cut (vertical fiber lugless): 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Repressed lug: 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Vertical fiber lug: 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Dunn wire-cut lug: 3½ x 3 x 8½ in., 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Dunn hillside: 3½ x 4 x 8½ in.

Repressed hillside: 3½ x 4 x 8½ in.

The manufacturers' representatives stated that the manufacturers would stand ready to supply the necessary eliminated sizes and varieties required for repair work.

The committee believed that, eventually, additional elminations should be made, but that it was undesirable to attempt to reduce the number of varieties further at the present time.

### Permanent Committee

It was voted that the following organizations be asked to designate representatives to serve upon the permanent committee.: American Society of Civil Engineers, American Society for Testing Materials, National Paving Brick Manufacturers Association, American Society for Municipal Improvements, American Association of State Highway Officials, Federated American Engineering Societies, Bureau of Standards, Department of Commerce, Bureau of Public Roads, U. S. Chamber of Commerce.

At the conclusion of the meeting general satisfaction with the character of the proceedings was expressed by Mr. Greenough on the part of the paving brick manufacturers, by R. Keith Compton (sitting for American Engineering Council) representing the engineers, and by F. M. Feiker, assistant to the Secretary of Commerce, on the part of the Department of Commerce. Frank B. Dunn, president of the Dunn Wire-Cut Brick Co., in expressing his approval of the work of the conference, stated that if the royalty on the Dunn patents stood in the way of further simplification he was ready to put the question as to what constituted a proper royalty into the hand of a committee for decision.

## Centenarian First President of Public Health Association

Dr. Stephen Smith, founder and first president of the American Public Health Association, who lacks one year of being 100 years old, was the center of interest on several occasions during the fiftieth annual convention of the American Public Health Association in New York City last week.

Dr. Smith was born in Onondago County, N. Y., Feb. 19, 1823, and received the degree of M.D. from the College of Physicians and Surgeons (Columbia), New York City, in 1850. For some years after graduation he was surgeon and later consulting surgeon to hospitals in New York City. Between 1861 and 1874 he occupied various chairs of surgery and anatomy in medical schools in New York City, and during the last part of that period he was the editor of two different New York medical journals.

In 1865 Dr. Smith made a notable report on sanitary conditions in New York City. Following the submission of this report to the State Legislature Dr. Smith was appointed on the New York Metropolitan Board of Health, which for several years had jurisdiction over New York City and adjacent territory. Subsequently Dr. Smith was Commissioner of Health for New York City alone, and also a member of the short-lived National Board of Health. Besides some medical books, Dr. Smith wrote "The City That Was," which was devoted largely to the sanitary campaign in New York City that resulted in the creation of the Metropolitan Board of Health already mentioned (reviewed in *Engineering News*, Oct. 17, 1912, p. 744).

A bronze medal was presented to Dr. Smith at a banquet given in his honor at the convention of the American Public Health Association in New York City last week.

## Highway Progress in Washington

According to a recent statement by James Allen, state highway commissioner for the state of Washington, plans and estimates have been prepared, and 60 contracts have been let for a total of 323.58 miles of improvements in the Washington State Highway system since the adjournment of legislature last March 10. The sum total of the contracts is $6,630,000, including 95.69 miles of paving, 197.07 miles of grading and graveling, 46.82 miles of graveling and eight bridges, practically completing the state road program for the year.

## Bascule Bridge Failure at Soo

On Oct. 6 the double-leaf Strauss bascule bridge of the Canadian Pacific Ry. over the canal at Sault Ste. Marie, Mich., developed a rupture of the bottom chord of one of the counterweight parallelogram trusses. Railway traffic was interrupted for six days while the leaf was being brought back to closed position by jacking the counterweight. Navigation has since been maintained through the undamaged leaf.

The engineers of the railway company and of the Strauss company are making a joint examination to determine all the facts in the case and decide upon the nature of the permanent repairs. The latter will be carried out when navigation closes.

## Survey Canadian Drainage Project from Airplane

The Reclamation Service of the Canadian Government has just completed a survey, by airplane, of a drainage project in the region of the Carrot River, on the boundary between Northern Manitoba and Saskatchewan. The project involves the reclamation of 800,000 to 900,000 acres of land. Much of the area was said to be inaccessible on account of floods.

The engineers of the service are said to have been impressed with the large amount of valuable data secured from the airplane pictures in a comparatively short time. Such surveys, the Canadian authorities point out, are mainly for reconnaissance purposes, and are not to be considered as superceding ground surveys with the usual engineering instruments.

## Public Health Convention

(Continued from p. 869)

Committee chairmen of the Sanitary Engineering Section for the ensuing year are: Water Supply and Purification, George W. Fuller; Sewerage and Sewage Treatment, W. L. Stevenson; Waterways Sanitation, C. A. Emerson, Jr.; Refuse Disposal, M. N. Baker, Mosquito Extermination, M. Z. Baer; Bathing Places, G. W. Symonds, Jr.; Milk Supplies, H. A. Whittaker; Air, George A. Soper; Constitution, Paul Hansen.

Besides its own technical papers and committee reports, the members of the Sanitary Engineering Section shared in the proceedings of the health conference of the American Society of Civil Engineers, which occupied an afternoon and two evening sessions, at which a large number of addresses, remarkable for their conciseness and comprehensiveness, were presented by specialists in the fields of sewage treatment, the control of offensive odors, and water supply and treatment. Notwithstanding the number of addresses on these subjects, there was ample time for general discussion, so well did the authors of the addresses confine themselves to the time limit set. A stenographic record of the general discussion was made, so presumably the addresses and the general discussion will be published by the American Society of Civil Engineers. A summary of the health conference proceedings, and of some of the technical papers before the Sanitary Engineering Section of the American Public Health Association, will be printed in *Engineering News-Record* next week.

## Begin Work Under New Federal Road Act

**U. S. Bureau of Public Roads Active in Starting Machinery For Highway Program**

*(Washington Correspondence)*

No sooner had the federal-aid highway bill become a law on Nov. 9 than work was begun at once by the U. S. Bureau of Public Roads to complete the necessary preliminaries for certain important highway projects in an effort to relieve unemployment. All red-tape was cut and the details are to be worked out later after the regulations for the administration of the new law will have been perfected.

The work on the regulations is being hurried so that a complete draft may be ready to submit to the American Association of State Highway Officials at its convention, in Omaha Dec. 5-8. It is the intention to secure the criticisms and suggestions of these officials and others interested before promulgating the regulations. Thomas H. MacDonald, chief of the bureau, states that the highway program is a partnership arrangement between the federal government and the several states, and that there will be no high-handed efforts on the part of the federal government in administering the new act. He points out that the states are furnishing half of the funds and have direct supervision of all the work and as a result they will have every opportunity to be heard before any administrative regulations are promulgated.

### Maps of Systems Called For

The principal work in preparing the regulations relates to maintenance and classification of roads; all the states have been called upon to furnish a map showing their tentative road program.

Mr. MacDonald takes issue with the publication of statements that the new law was enacted just in time to save millions of dollars worth of federal-aid roads from going to pieces, due to lack of maintenance. He declares that in no single instance has any federal-aid road "gone to pot," as is being stated. The maintenance feature of the new law was inserted to meet a condition which might arise rather than to correct an existing situation. He attributes no small part of the maintenance work done under the old law to the fact that the facilities of the states to do repair work were enlarged materially by the distribution of $130,000,000 worth of the War Department's surplus property.

## New Jersey Defeats $14,000,000 Bonds for Institutions

The voters of New Jersey voted down a bond issue of $14,000,000 for the improvement and enlargement of state institutions on Nov. 8.

## Belle Isle Bridge Progressing

Pier construction for the Belle Isle bridge at Detroit is progressing at a rate that promises the completion of six piers by Jan. 1, according to H. H. Esselstyn, representing the designers for the bridge. Pier 15 has been completed up to the base of the steel work, the cofferdam of pier 16 has been unwatered ready for concreting the pier body, and the cofferdam for pier 14 has been sealed ready for pumping. Work on pier 18 is about to begin. In the two piers already unwatered, Mr. Esselstyn states, very little trouble was experienced in leakage through the cofferdams, and there was no indication of any trouble in sealing the bottom against the cofferdam walls, with 4½-ft. concrete base on top of the piles.

## National Conference of A. G. C.

The annual conference of the Associated General Contractors of America is to be held in Cleveland on Jan. 17, 18 and 19, 1922. The program has not yet been announced.

## Detroit Bridge Authorized By State Utilities Commission

Authority was granted Nov. 17 by the Michigan Public Utilities Commission for the sale of Detroit Bridge securities in the state, on the basis of a total issue of $5,000,000 stock and $15,000,000 bonds of 7 per cent, running 30 years, the stock to be sold at par and the bonds not below 87.

The American Transit Co, which will build the bridge in co-operation with a similar Canadian company working under a Dominion charter, has contracted with the R. T. Scott Co. of Toronto for the sale of the securities. Work on right-of-way surveys, triangulation and borings will go ahead at once. Pier construction is expected to begin next season, by which time also the review of the preliminary superstructure plans will be completed.

The structure to be built is an eight-cable suspension bridge of 1,803 ft. main span, with two decks, for highway and railway traffic respectively, of which only one deck is to be built at the start. W. B. Gregory, of Gregory, Mayer & Thom, is president of the company, and Charles Evan Fowler is chief engineer.

## Specifications for Large Bridge in Australia Are Issued

Elaborate specifications have arrived in this country for the construction of a cantilever bridge across Sydney harbor, Australia, from Dawes Point to Milsons Point, bids on which will be received up to Oct. 31, 1922. The specifications and attendant data, in addition to a number of large drawings, fill a book of 115 legal-sized pages which cover even minutest details, including the composition and tests of materials as well as the erection of the bridge itself. However, all stress sheets, working drawings, etc., are to be prepared by the contractor. Announcement is made that J. J. C. Bradfield, chief engineer of the Department of Public Works, New South Wales, will travel through Canada in April and May, 1922, so that prospective bidders may consult with him.

The contract calls for "the manufacture, supply, delivery, construction and erection complete and ready for traffic" of a bridge with a total length of 3,816 ft. The main span is to consist of two 500-ft. cantilever arms and a central section, 600 ft. long, suspended from the ends of the arms, making a total length of main span of 1,600 ft. between pier centers. The height of the trusses over the main piers will be 270 ft. and the height of the central suspended section 100 ft. There will be no movable span, the clearance above high water level being 170 ft.

## City Manager Progress and Problems Reviewed

**Record Attendance at Chicago Meeting —Now 257 Manager Cities—Bond Limits—Revenue Sources**

Almost everything that a public official encounters except engineering was discussed at the eighth annual meeting of the City Managers' Association held Nov. 14 to 16 in Chicago. Police, general administration, finance, welfare, general complaints and ideal attributes of a manager, together with a most spirited debate for and against the city-manager plan for large cities by opposing leaders in the recent Cleveland campaign, were the main topics.

The meeting was the largest yet held, more than 100 being in attendance, of whom about 50 were managers. The movement has gone forward consistently, said Harrison G. Otis, secretary, and now 257 cities, representing a population of 4,630,000, have adopted this plan. Six of the cities are in Canada; 184 operate under charters and 67 by ordinance. Cleveland is the largest city on the list but 49 cities have populations in excess of 20,000 and 103 range from 5,000 to 20,000. Forty cities having the commission form have changed to the commission-manager form. Only two cities, both small, have gone back to the mayor-council form; Brownwood, Tex., which did not have a standard manager form, and Hot Springs, Ark., which had acrid local political difficulties, large debt and an unsolvable liquor problem. Three city-manager charters have been put in force without a referendum: Nashville, Tenn., Clarksburg, Va., and Brunswick, Ga. There is no doubt as to how well they will turn out. Only three cities have home-town managers, the others obtaining out-of-town talent, which is considered far preferable since the manager then has not local prejudices or affiliations to bias his judgment or to hamper his activities.

### Organization Aims

While the association assists those interested in the movement and acts as a clearing house for cities seeking managers, Mr. Otis was emphatic in his remarks that the principal aim and work of the organization is to help the members to a better performance of their duties through an interchange of information. In this work 19,000 pieces of mail were sent out by the executive secretary, including 4,500 letters, 2,000 year books, and 4,600 bulletins.

### Bonds and Revenue Sources

In a brief paper on "Public Finance" by Charles E. Ashburner, Norfolk, Va., the manager longest in service, it was stated that there is practically no difference in principle between public and private financing. Particularly was he insistent on making the life of bonds co-terminous with the life of the improvements, classifications of which he gave as follows:

"Improvements of short life should in all cases be made from cash or short-term bonds. If from the latter, the bonds should be so arranged that the expiration period of the last bond does not occur at a date subsequent to the life of the improvement. For such equipment as fire apparatus, which soon becomes obsolete, bonds should run for from 5 to 10 years only. High grade

## To Complete Alaska Railway

By a vote of 198 to 76 the House of Representatives Nov. 2, passed and sent to the Senate a bill carrying an appropriation of $4,000,000 to complete the construction of the Alaska Ry. A total of $52,000,000 has already been appropriated for construction of this road.

## Federal Road Engineers To Meet

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has called a meeting of the district engineers of the bureau to take place in Omaha during the week of Nov. 28. At that time the district Engineers will discuss the new highway act with Mr. MacDonald and the division chiefs in the Washington bureau. Most of the officials expect to stay in Omaha for the meeting of the American Association of State Highway Officials which begins Dec. 5.

## City Managers' Convention

(*Continued from page 871*)

pavements with car tracks might be listed in the 15-year class while similar improvement without car tracks could easily stand a 20-year obligation. Sewers, buildings and bridges could be financed with 30-year bonds. Land, docks and water-works might very well carry a 50-year bond issue because land should always increase in value if purchased with proper foresight and no city would think of building either docks or water-works that would not have a value at any time during the 50 years at least equal to the outstanding obligation."

At the joint meeting with the National Municipal League, Luther Gulick, chairman of the League's Committee On Sources of Revenue, indicated that taxes rose from $11.50 per $1,000 in 1909 to $21.50 in 1919. The present problem is to "secure the most feathers with the least squawk." Points recommended by the committee are as follows: (1) While it is impossible to separate state and local sources, cities which do four-fifths of the service for the citizen should get a larger part of the taxes than they now do. (2) The extension of occupational taxes would be absurd but inspection fees should be increased. (3) Special assessments are sound and should be extended. (4) Taxing sign boards is sound. (5) With few exceptions limitation of taxes by state legislation is unsatisfactory. (6) In assessments of property 100 per cent of present day value should be used.

William A. Hough, a member of the Indiana tax commission, explained the operation of the 1920 laws by which the commission controls all bond issues. An engineering force is maintained by the commission to check up all issues as to cost and necessity. With reference to road bond issues by counties, townships or districts, Mr. Hough stated that the commission refused permission to their issue when it considered that the estimates were too high. He indicated that contractors' associations are promoting roads merely for the sake of the contracts to be obtained.

The newly elected officers of the City Managers' Association are as follows: President, C. M. Osborn, manager of East Cleveland, O.; vice-presidents, Charles E. Hewes, R. W. Rigsby and Fred H. Locke; executive secretary, H. H. Freeman, Kalamazoo, Mich.

## Samuel M. Gray

Samuel M. Gray, consulting engineer, of Providence, R. I., whose death Nov. 5 was noted in these columns last week, was a widely recognized authority in the field of water-works, sewerage and hydraulics. While the later years of his professional experience had been devoted exclusively to consulting work, Mr. Gray had served for 13 years as city engineer of Providence, and for 30 years was a member of the State Board of Health of Rhode Island.

A list of the works designed and constructed by him covers scores of cities, not only in the United States, but in Mexico and Canada, among his most important assignments being the design of the reconstructed water-works at Baltimore costing $2,000,000, the remodeling of the sewage treatment plant at Worcester, Mass., the design of Baltimore's large sewage treatment works and sewerage system, on which Mr. Gray was one of a board of three consulting engineers, the design of a complete system of intercepting sewers for the District of Columbia, and the investigation of the contamination of the water supply of Philadelphia, involving slow sand filtration works at a cost of $30,000,000.

### Was Assistant to J. H. Shedd

Mr. Gray was born in Andover, Mass., in 1842 and after leaving school began his engineering career on railroad construction in Connecticut. Going to Providence in the early sixties, he secured a position as assistant to the late J. Herbert Shedd, then chief engineer for the new water supply for Providence.

His work received favorable notice and in 1877 he was selected city engineer of Providence, a position which he held for more than 13 years. His duties included also supervision over the departments of water-works, sewerage, bridges, and highways. While in that position the city sent him on an extended European trip for the study of sewage disposal methods, and he visited England, France, Germany, Italy, and Holland.

Mr. Gray resigned as city engineer of Providence in 1890 and opened an office as consulting engineer, specializing in municipal and sanitary work, and continued in this field almost up to the time of his death. During his thirty-one years of consulting practice he has been retained on water or sewerage works for Baltimore, Louisville, Ky., Havana, Monterey, Mexico, Toronto, San Antonio, Philadelphia, Worcester, Mass., Syracuse, N. Y., Binghamton, N. Y., and other cities.

In 1913, when over 70 years old, Mr. Gray was selected as engineer for the study of a new water supply for Providence and held that position until the general plans for the new work were developed. He was then retained as chief consultant up to the time of his death. In 1892 Mr. Gray served as vice-president of the American Society of Civil Engineers.

## Railroads Cut Rates on Farm and Dairy Products 10 Per Cent

A reduction of 10 per cent in carload freight rates on farm products is to be put into effect immediately and without waiting for a reduction in wages, according to a recent announcement made from the offices of the Association of Railway Executives. The reduction is to apply throughout the United States, except on traffic moving wholly within New England. The reduction applies to certain grain and grain products, fruits, vegetables, cattle and hogs, and dairy products. Any reduction that has been made in such rates since Sept. 1, 1920, is to constitute a part of the 10 per cent reduction.

## Federation's Annual Meeting To Be Held Jan. 5 and 6

The annual meeting of the American Engineering Council of the Federated American Engineering Societies will be held in Washington, D. C., Jan. 5 and 6, according to an announcement just made by L. W. Wallace, executive secretary, who says in part:

"The Executive Board should give serious consideration to methods of informing engineers as to the aims, policies and activities of the federation. Some member societies have been and are now, perhaps, rather indifferent to a continuation of their affiliation. As far as we have been able to ascertain, this condition is due to the officials and the members of such organizations not being fully informed.

"While it may be true that during the first years the federation has not been able to accomplish all that was expected on the part of some and that it has not fully found itself, so to speak, yet the progress has been such as to justify optimism rather than pessimism as to the future usefulness of the federation. The federation has been fairly well established in the minds of the public and in government circles. This is evidenced by the character and quantity of publicity that the federation has received."

### General Activities

The general activities of the federation during the year, according to Mr. Wallace, have included the following: Assistance in organizing a conference of engineers to consider the advisability of fall letting of highway construction contracts; co-operation in arranging for the Unemployment Conference; promoting the movement for a National Department of Public Works; appointment of a committee to frame a plan for a permanent employment service; adoption of a policy to avoid confusion and antagonism on the question of licensing of engineers; conferences with a committee of the American Association of Engineers; investigation by Committee on Elimination of Waste in Industry; establishment of a federation bulletin and digest service.

The federation has now more than 43,000 members. President Mortimer E. Cooley and Mr. Wallace are now carrying out plans for more intensive organization, aiming particularly to link up the member societies in a more cohesive scheme of action so that the influence and benefits of the federation may be more directly and systematically communicated to the societies.

## Indianapolis Plans Public Works Program Under New Engineer

Lew Shank, mayor-elect of Indianapolis, has directed John L. Elliott who, he has announced, will be city civil engineer in the next administration, to make a survey of the city and determine what public improvements are most needed. Many additions to the city's sewer system in both the downtown and residence districts will be necessary soon, according to Mr. Elliott, and this may be a part of the work determined on for the next four years, The rapid growth of the city to the north has given too great a load for the capacity of the sewer system in the central part of the city. It may be necessary to construct relief sewers in the downtown district, or provide for storm overflows into Pogue's Run sewer. Within the next year a large new sewer system in the northern part of the city and Broad Ripple, will be placed in use, and this will add to the overload now carried in the central part of the city.

The general program of track elevation for the east, south and west parts of the city, Mr. Elliott believes, should be pushed as rapidly as the financial condition of the railroads will permit.

## Associations Call Conference on Standard Contracts

Means for bringing about uniform contracting practice and standard contracts will be discussed at a conference in Washington, D. C., Dec. 15, 1921, in which leading engineering and contracting associations will participate. In the call for the conference it is urged that standard contracts will reduce legal expenses, decrease duplication of work, eliminate dispute, safeguard owners, increase public confidence and raise the standard of construction service.

It is thought that standardization can be approached by a segregation of general and special contract principles, placing those which pertain to all work in a standard document. Such a primary document would convey to everyone the main governing principles of construction obligations, leaving the secondary and complementary document the special stipulations. The first can be selected and approved by all of the technical societies and the second can be drafted by those best able to speak for an individual field of construction.

When the process of standardization has been carried out the field of construction contracts would then be covered by (1)) The universal document for all work, preferably called The Agreement; (2) several sets of special principles, one for each type of work, for example, one set for railways, another for buildings, another for waterworks, and so on to the desired extent. These documents might preferably be designated "The General Conditions" of each type.

The associations co-operating in the conference are: The American Association of State Highway Officials; the American Engineering Council; the American Institute of Architects; the American Railway Engineering Association; the American Society of Civil Engineers; the American Water Works Association; the Associated General Contractors of America; the National Association of Builders' Exchanges; and the Western Society of Engineers.

## Further Amendments to Civil Engineers' Constitution

The American Society of Civil Engineers is sending to its corporate members notice of the proposal of amendments to the new constitution, which was adopted by letter ballot last month. The amendments are in two groups, those fathered by the Board of Direction and the now expired Committee on Referred Amendments, and those proposed by a number of members headed by Richard L. Humphrey and made up largely of men from Philadelphia.

The first group, three in number, merely provides for formally taking care of omissions in the constitution as adopted, and, with reference to the nomination of officers, for definitely limiting the counting of ballots by district and zone limitations to the first and second canvasses, thereby preventing the possible interpretation that such limitation applies also to the final ballot.

The amendments fathered by the group headed by Mr. Humphrey would, (1) remove the members not residing in North America from District No. 1; (2) substitute for the ballot primaries a series of district and zone nominating boards; (3) establish an annual conference of representatives of local sections, to which mileage would be paid by the parent society for one representative from each section; (4) allocate each member of the society to some local section and make it obligatory on the Board of Direction to allocate to each section an annual sum from the funds of the society.

In the proposed new method of election the candidates nominated by the district and zone nominating boards, plus additional nominations made by declaration on which local sections would have voting power in proportion to their respective memberships, would be voted upon by the corporate members in the respective districts and zones. The candidate getting the highest number of votes would be certified to the annual convention of representatives of local sections, which convention would nominate the candidate for the presidency.

## Trucks Start to Destroy Test Concrete Road

### Thirty-six 5-Ton Units Begin Journey Around Track at Pittsburg, Cal.

Traffic was started Nov. 9 on the experimental concrete road at Pittsburg, Cal., which is to be tested to destruction by motor trucks. For use in the test the U. S. Bureau of Public Roads supplied 18 trucks with drivers and another 18 trucks were donated by the California Highway Commission. Two California highway commissioners, representatives of automobile associations, and about one thousand spectators, including a large percentage of engineers, witnessed the start of the test. A description of the experimental road and its purpose appeared in *Engineering News-Record*, Aug. 18, 1921, p. 276.

All the trucks were of 5-ton capacity, equipped with solid tires and loaded with pig iron to give a gross weight of 14,500 lb. each. They are to be operated 8 hours per day until the life of the thirteen various types of pavement is determined. Eighteen of the trucks travel around the elliptical roadway in one direction and the other eighteen in the opposite direction at an average rate of 10 miles per hour, thus each truck makes about 40 trips per hour and each section of the pavement will be traversed 11,520 times per 8 hours.

By means of gages and integrating devices in tunnels beneath the pavement, records are being made of the deflections in various sections of the concrete slab and subgrade, temperature readings are being recorded and by means of lines dividing the entire pavement area into 6-ft. squares a progressive record will be kept of surface conditions

## Trend of Engineering Employment Shows Improvement

A tangible indication that the demand for engineering services is increasing comes from the employment report for October of the American Association of Engineers. During the month almost the same number of men registered for employment as during September but of these only 45 per cent were actually unemployed, which is 10 per cent less than for September. More positions were received and more men placed all over the country than in the previous month. The following table shows the trend.

| | October, 1921 | September, 1921 | October, 1920 |
|---|---|---|---|
| Applicants for employment | 1,877 | 1,749 | 1,602 |
| Positions received | 384 | 348 | 694 |
| Men referred | 1,731 | 1,861 | 3,357 |
| Men placed | 240 | 213 | 301 |

The average salary of positions filled in October was $186, or $2 more than last month. For the same month last year it was $203. The oldest man that registered was 68 and the youngest 18. The average age was 36 and the average years of engineering experience was more than 10. The highest salary desired was $12,000 and the lowest $90 a month. The average salary applicants would consider was $210 a month. Of the men registered for employment 61 per cent were university graduates; 40 per cent were classified under civil engineering positions. The greatest demand for engineers was in appraisals, industrial and public utilities, structural and architectural designing. The demand for construction engineers was small.

## California Highway Bonds Sold At Premium

A $5,000,000 block of California State highway bonds bearing 5½ per cent interest were offered for sale at public auction in Sacramento, on Oct. 27. A large number of San Francisco banking houses were represented and after spirited bidding the bonds were sold to the Anglo & London Paris National Bank of San Francisco at a premium of $476,-

000. After the sale state officers stated that under present conditions these bonds would have found a market if their interest rate had been as low as 5½ per cent.

The interest rate on each block of California highway bonds is now fixed by a commission just before the block is put on the market. The plan was described in *Engineering News-Record*, Nov. 11, 1920, p. 962.

## Road Builders Elect Officers and Change Constitution

At the annual meeting the American Road Builders' Association held in New York City, Nov. 15, officers for the ensuing year were elected as follows:

President, H. L. Bowlby, chief, War Materials Division, U. S. Bureau of Public Roads; vice-presidents, Charles J. Bennett, State Highway Commissioner of Connecticut, New Haven, Conn.; Frank Page, chairman, North Carolina State Highway Commission, Raleigh, N. C.; A. R. Hirst, State Highway Engineer of Wisconsin, Madison, Wis.; W. W. Crosby, National Park Service, Estes Park, Colo.; secretary, E. L. Powers, Editor, *Good Roads*, New York, N. Y.; Treasurer, Senator James H. MacDonald, former State Highway Commissioner of Connecticut, New Haven, Conn.

Several changes to the constitution and by-laws of the association were approved, the most important being a change in the date of the annual meeting from November to May and a change in the method of electing officers. Under the new provisions officers will be elected from among the directors by the directors. Vacancies on the board will be filled each year by a nominating committee of seven selected from the board of directors. Another change makes the president eligible for re-election. By holding the annual meeting in May, the new officers will have a longer time in which to lay plans for the annual convention and exposition. Arrangements were made to hold the next good roads congress and show at the Coliseum in Chicago, Jan. 17 to 20, 1922.

## Department of Commerce Names Zoning Committee

In order to make available a concensus of opinion regarding good practice in zoning ordinances the U. S. Department of Commerce has organized a committee to inquire into and report on the subject. Its importance is indicated by the adoption of zoning laws by 40 cities and towns and the consideration of such laws by 70 additional municipalities.

The membership of the committee and the organizations represented follow:

Louis A. Moses, National Association of Real Estate Boards; J. Horace MacFarland, American Civic Association; Nelson P. Lewis, National Municipal League and National City Planning Conference; Lawrence Veiller, National Housing Association; Morris Knowles, of Pittsburgh; Edward M. Bassett, chairman Zoning Committee of New York; Frederick Law Olmstead, president, Society of Landscape Architects; and John Ihlder, U. S. Chamber of Commerce.

John M. Gries is chief of the department's Division of Building and Housing, under which the committee acts.

## Discussion of Joint Committee's Concrete Specifications

The program of the two-day discussion of the Standard Specifications on Concrete of the Joint Committee of Concrete and Reinforced Concrete, is as follows:

Dec. 7
- 9 a.m. Chap. IX. Waterproofing and protective treatment. Chap. X. Surface finish.
- 2 p.m. Chap. VI. Depositing concrete. Chap. VII. Forms. Chap. VIII. Details of construction.
- 8 p.m. Chap. XI. Design.

Dec. 8.
- 9 a.m. Continuation of discussion of Chaps. VIII and XI.
- 2 p.m. General discussion of the tentative specifications for concrete and reinforced concrete and of the scope of the Joint Committee's work.
- 8 p.m. Chap. III. Quality of concrete. Chap. IV. Materials. Chap. V. Proportion and mixing concrete.

Under the auspices of the American Society of Civil Engineers.

PLACE. — Engineering Societies Bldg., New York City.

TIME. — December 7 and 8.

## California Road Contract Sought By Twenty-Two Firms

Sharp competition characterized the bidding for the first 7½-mile section of the Ocean Boulevard, which, when completed throughout, will connect the coast highway between Oxnard and San Juan Capistrano, and give Southern California 250 miles of uninterrupted coast-line highway. Twenty-two contracting firms submitted bids to the California Highway Commission for this work, which included grading a 40-ft. section and paving with cement concrete 20 ft. wide 6 in. thick, reinforced with steel rods. The bids ranged from $445,864 to $260,739. The engineer's net estimate on this section was $286,227.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington D. C. Annual Conference Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C. Annual Meeting, Washington, D. C., Jan. 5 and 6.

**The Colorado Section, Am. Soc. C. E.,** at its monthly dinner and meeting in Denver, Nov. 14 heard H. L. Thackwell propose a plan for the construction of a ten-story Engineers Building in Denver for the use of consulting engineers and architects. A committee was appointed to investigate the feasibility and outline a scheme for financing the project. The meeting also endorsed the bill now pending in Congress providing for the commissioning of sanitary engineers in the U. S. Public Health Service. R. H. Fox, expert on bearings, gave a lantern slide lecture on the "Development and Application of the Ball Bearing."

**The Providence (R. I.) Engineering Society,** at its meeting Nov. 15 was addressed by Alfred D. Flinn, secretary, United Engineering Society and Engineering Foundation and chairman, Division of Engineering, National Research Council, on "The Engineer's Road to Peace: Co-operation, Past, Present and Future."

**The Engineers' Club of Cincinnati and the Cincinnati Section, Am. Soc. C. E.,** held a joint meeting Nov. 17 which was addressed by Ralph N. Begien, general manager, Baltimore & Ohio R.R., whose subject was "The Immediate Future of Railroad Development."

**The Jackson (Mich.) Engineering Society,** at its meeting Nov. 7, was addressed by Prof. A. C. White, director of engineering research at the University of Michigan.

**The New York Assembly, A.A.E.,** at its meeting Nov. 12 in Albany, elected the following officers: President, Germain P. Graham; vice-president, G. P. Hevenor; second vice-president, W. L. Everett; secretary-treasurer, J. G. Brennan.

**The New Jersey Association of County Engineers** held its Fall meeting and inspection Nov. 18 and 19, with Delaware, Pennsylvania and New Jersey state highway engineers as guests. Highways in Mercer, Middlesex, Monmouth and Burlington counties were inspected. One of the subjects under discussion at the evening session Nov. 18 was the advisability of counties building part of state highway system under the reimbursement act, as proposed by State Highway Commission.

**The Eastern Paving Brick Manufacturers Association** will hold its annual meeting at the Pennsylvania Hotel, New York City, Dec. 13 and 14.

**The Utah Society of Engineers,** at its meeting Nov. 16, in Salt Lake City, was addressed by B. J. Finch on "Utah's Highway Needs."

**The Iowa Section, Americal Water Works Association** at its annual meeting Nov. 1, 2 and 3 in Omaha, elected the following officers: Chairman, J. Chris Jensen; vice-chairman, Peter Kern; directors, Harvey P. Letton and C. L. Ehrhart; secretary-treasurer, Jack J. Hinman, Jr., Iowa City.

**The Municipal Engineers of the City of New York,** at a meeting Nov. 22, was addressed by Daniel L. Turner, consulting engineer to the New York Transit Commission on "Moving Platforms." He discussed the problem of relieving transfer congestion between the east and the west side subways at 42nd Street, New York. H. S. Putnam, consulting electrical engineer discussed the electrical carrier system as adapted to the operation of moving platforms.

# PERSONAL NOTES

L. E. BARKER, formerly engineer for the Pima County (Ariz.), Highway Commission, has been appointed engineer with the Yavapai County Highway Commission.

GEORGE A. MCCLELLAND, formerly district engineer of the Texas Highway Commission, has been appointed engineer of Harrison County, Tex.

IRA W. MCCONNELL, vice-president and chief engineer for Dwight P. Robinson & Co., Inc., engineers and contractors of New York, is in South America, where he will be engaged for a number of months on the company's construction projects in Brazil. The work includes the construction of a number of dams.

H. E. SURMAN, formerly district engineer at Dixon, Ill., with the Highway Division of Illinois Department of Public Works and Buildings, in charge of the planning, construction and maintenance of state roads in the district, has been appointed engineer of design with the department, succeeding Frank T. Sheets, and will have charge of the planning of all state roads, with headquarters at Springfield. Mr. Sheets' promotion to superintendent of highways was noted in these columns Sept. 29, p. 542.

HOWARD M. SMITTEN, assistant engineer in the valuation department of the Southern Pacific, has been appointed bridge engineers of the Western Pacific R.R., with headquarters at San Francisco.

HARRY P. GRIER, of Statesville, N. C., county engineer for Iredell and Alexander counties, has been appointed district engineer for the Asphalt Association, with headquarters in Raleigh, N. C.

JOHN P. LEO, has resigned as commissioner, Department of Street Cleaning, New York.

E. P. JOHNSON, formerly division engineer, Section 1, Welland Ship Canal, has been appointed division engineer, Section 5, in which capacity he will also have supervision of survey work and plans for Sections 6 and 7. His headquarters will be at Welland.

BARTON M. JONES, for 7 years connected with the Miami Conservancy District at Dayton, Ohio, recently as division engineer having direct supervision of the construction of the Lockington dam, has been given local charge, by the Dayton Morgan Engineering Co., of the flood prevention work at Pueblo, Col.

CARL T. BOWEN, for the past two years connected with the Michigan State Highway Department, has been appointed engineer and superintendent of roads in Ottawa County, Mich.

H. E. BRENCHLEY, structural contracting manager of the Minneapolis Steel & Machinery Co., New York, has been elected vice-president of the Structural Steel Society at its meeting in Chicago, Nov. 8.

HERBERT ABRAHAM, chemical engineer and chairman of the Technical Committee of the Prepared Roofing Association, Chicago, has been appointed a member of the technical committee of the Asphalt Association, New York.

F. A. DAVIDSON, of the Dwight P. Robinson Co., of New York City, has been elected chairman of the construction section of the National Safety Council.

H. W. FORSTER, of the Independence Bureau, Philadelphia, has been elected chairman of the engineering section of the National Safety Council.

J. W. BEARDSLEY has resigned as engineer member of the Highway Commission of the Republic of Panama. This position includes the duties of chief engineer and of executive officer of the commission. He was formerly director of public works, P. I., and chief engineer of the Porto Rico Irrigation Service.

JOHN L. ELLIOTT, now senior assistant city civil engineer, of Indianapolis, has been appointed city civil engineer by Lew Shank newly elected mayor. Mr. Elliott replaces Frank C. Lingenfelter, for whom no place has been provided in the Shank administration.

ERNEST F. NICHOLS, president of the Massachusetts Institute of Technology, has resigned his office because of ill health, and his resignation has been accepted by the executive committee of the corporation. He has been given a leave of absence until Jan. 4, 1922, when the next meeting of the corporation will be held and the action of the executive committee will be ratified.

MOSELEY & FOUNTAIN is a firm of consulting, designing and supervising engineers recently organized with offices in Dallas, Tex., by Hal Moseley, for two years city engineer of Dallas, and, later, commissioner of public works of Dallas, and by Thomas L. Fountain, for five years senior member of the firm, The Fountain-Shaw Engineering Co., Dallas, for two years engineer of sewerage for Dallas, and recently principal assistant engineer with J. D. Trammell, consulting engineer, Fort Worth, Tex. Both members of the new firm served as captains, Engineers, with the A. E. F. in France.

R. K. WEST, formerly principal assistant engineer California Highway Commission, and later chief engineer of highways of Nevada and, during the war, captain, Engineers, A. E. F., has been appointed acting chief engineer of the highway commission, Republic of Panama.

# OBITUARY

I. T. GOODWIN, JR., of Athens, Ga., division engineer, Georgia Highway Department, was killed in an automobile accident, Nov. 9, while on an inspection tour of roads near Covington, Ga. He was graduated from the University of Georgia in 1912 and was a veteran of the World War.

WILLIAM GRACE, president William Grace Co., contractors, Chicago, died Nov. 6, at Barrington, Ill. He was borne in Hull, England, in 1847 and came to this country in 1871. Early in life he was associated in Chicago with John Griffiths and F. D. Hyde. Mr. Grace built the La Salle St. station, the county building, and many other large buildings in Chicago and New York.

G. PRESTON BRADY, civil engineer, at one time connected with Campbell & Lattimore, contractors on the foundation work for the High Level Bridge at St. Catherines, Ont., and later engaged in drafting work for the Pere Marquette Ry. in connection with valuation work was killed in a street accident in Troy, N. Y., recently.

# EQUIPMENT AND MATERIALS

## Motor Truck with Scraper Blade

A scraper attachment for maintaining gravel roads is being attached to its 2½-ton special road maintenance truck by the Republic Truck Sales Corporation of Alma, Mich. Lighter trucks can be equipped but the size

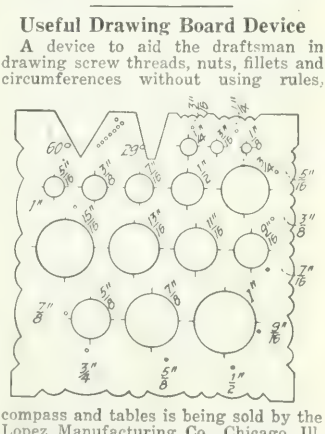
named has the pulling power and weight which seem best suited to efficient operation of the scraper.

The scraper is a blade edged with ⅝ x 2 in. steel mounted on four steel springs 6 in. wide, which are mounted on a round, hollow bar which is adjustable by means of a chain and ratchet post. The bar is mounted on a 2 x 6 in. oak timber through adjustable brackets, and this timber is then mounted on the chassis frame, with brackets and braces. When not in use the scraper is raised and gives a clearance of 8 in. under the lowest point.

An operating speed of 8 to 12 miles per hour gives the best results. Several of these trucks have been working this season on gravel roads in Kent County, Michigan.

## Useful Drawing Board Device

A device to aid the draftsman in drawing screw threads, nuts, fillets and circumferences without using rules,



compass and tables is being sold by the Lopez Manufacturing Co., Chicago, Ill. With the device, screw nuts from 1/16 to 1 in.; circumferences from ⅛ to 9 15/16 in.; 60 deg. screw threads; 29 deg. Acme threads, and radius and fillets corresponding to the circumferences, can be drawn directly. The device is made of transparent material and is 4¾ in. square.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Engineering News-Record's Cost Index for 1920 and 1921

*Engineering News-Record's* Construction Cost Index Number is being computed monthly back to 1913, and each week a year's figures will be published in these pages. The Numbers from January, 1920, to November, 1921, are given in the following tabulation, and the figures are plotted in the chart accompanying the article on this page, entitled "Construction Industry Has Been Waiting for Steady Prices." The Numbers for the months of 1919 will be presented next week.

| | Eng. News-Record Construction Cost Index Number |
|---|---|
| 1913 | 100.00 |
| 1920 | |
| January | 206.55 |
| February | 225.10 |
| March | 240.85 |
| April | 265.20 |
| May | 268.90 |
| June | 273.80 |
| July | 265.65 |
| August | 252.00 |
| September | 255.20 |
| October | 255.20 |
| November | 255.32 |
| December | 251.62 |
| 1921 | |
| January | 230.87 |
| February | 230.67 |
| March | 224.27 |
| April | 213.02 |
| May | 210.82 |
| June | 209.82 |
| July | 203.82 |
| August | 193.07 |
| September | 188.27 |
| October | 182.57 |
| November | 166.32 |

## Chicago Determines to Rid Itself Of Building Restrictions

So far as the carpenters, plumbers and five other trades are concerned Chicago is to be an open-shop city unless they accede to the Landis award. At a huge mass meeting sponsored by the Chicago Association of Commerce, T. E. Donnelly of the citizens committee to enforce the award and other representative business men, clearly indicated what would take place.

Only seven of the fifty-one unions and 15 per cent of the contractors have refused to abide by the award. The carpenters' union cannot now negotiate contracts. An employment bureau has been started and will furnish men to the contractors and see that they are protected. From 1,100 to 1,200 non-union carpenters are at work, 200 of whom were supplied by the committee. The contractors, who do not abide by the award, will find contracts for material cancelled and financial backing withheld. Other contractors will be brought in if necessary. On the other hand, unions and contractors that live up to the decision will be backed up.

"Almost as much money as was paid in graft in one year is being asked of the business men by the citizens committee to clean up the situation," said Mr. Donnelly.

*We'll make this section what you want it to be—provided you tell us frankly what you want.*

# Construction Industry Has Been Waiting for Steady Prices

### Contracts Let Shown in Terms of 1913 Purchasing Power—Chart Includes E. N. R. Cost Index Number

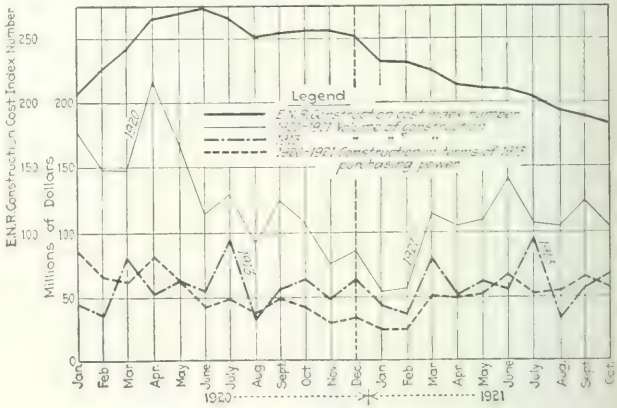
It is agreed that except for industrial works the country is underbuilt. It is generally believed that 1921 is an off year for construction. A definite reason for this paradox is the price situation.

Prices have fallen steadily since the peak in the summer of 1920. The *Engineering News-Record* Construction Cost Index Number shows this decline—fairly evenly downward in 1921. The chart giving the cost index number also carries the monthly volume of contracts let on all classes of engineering construction in 1920, 1921 and 1913.

Comparison of the actual volume of contracts let in 1920 and 1921 with 1913—as differing from a mere comparison of amounts of money—may be made by using the cost index number. By this means the actual volume of construction in 1920, computed from the total of contracts let, was 9 per cent less than the 1913 volume. Construction, or contracts let, in 1921 to Nov. 1 is 15 per cent less than in the ten months of 1913. This means that the amount of construction this year is 85 per cent of the amount in 1913.

Uncertainty as to future prices has been a major factor in this falling off of construction. Construction cost has declined 39 per cent since the peak in June, 1920, and is now about 66 per cent above the 1913 level. These figures include also the cost of labor. For the entire country common labor has fallen from 64 cents per hour to an average of 45 cents. In certain sections rate-cutting has been radical, while elsewhere, as in New York, peak rates are still in force. Common labor can be hired in the South for as low as 15 to 20 cents per hour. The 1913 average for the country may be taken as 22 cents per hour. It is therefore probable that labor cost will continue to decline in 1922, and this will work to draw certain materials below present levels.

If prices thus continue their decline there will remain a measureable uncertainty in the construction industry. It must be borne in mind, however, that any future decline in prices will not be from a peak, but from levels that are already satisfactory in many instances. Therefore, there should not be anything like the uncertainty that has prevailed since the summer of 1920 to date. Furthermore, the volume of construction of an urgent nature is steadily swelling and a certain proportion of this must be released, irrespective of market conditions. It seems safe to predict that 1922 will be a considerably better construction year than the present, and that the years following will show the Construction Industry really catching up.




TWO YEARS OF E. N. R. COST INDEX AND CONSTRUCTION VOLUME FOR 1913, 1920 AND 1921

## Cement Output Up in October

Cement shipments for October exceeded production and were the largest recorded for a single month. Stocks of finished cement at the mills at the end of October were approximately 5,348,000 bbl., compared with 6,953,000 bbl. at the beginning of the month. The production of clinker, or unground cement, in October was approximately 9,891,000 bbl. Clinker production for the ten months amounted to approximately 82,419,000 bbl., or an average of 8,241,900 bbl. per month.

## Reliable Pine Pile Prices

This list of current prices covering the sizes and lengths of pine piles used in the New York district has been compiled for *Engineering News-Record* by Conwell & Co., Norfolk, Va., which company will hereafter supply the pine pile quotations in the Monthly Prices of Construction Materials—next issue Dec. 1. Says W. W. Conwell, president:

"In making this schedule we have exercised the same care as we would had we been bidding on a project requiring timber of the lengths and sizes mentioned, and in fact they are the same prices we would quote to any of our customers in the above noted territory. We trust that the data will serve the purpose intended, at any rate we know that it is sufficiently comprehensive to enable any contractor to use it making estimates. We are really pleased to be of service to you in this matter, for we feel that these prices may serve as an inspiration to people who have prospective work to do and to get them started to doing it is a consumation to be devoutly hoped for."

PRICES PER LINEAL FOOT, PINE PILES WITH BARK ON, F.O.B. NEW YORK

| Diameters | Points | Length | Large | Rail |
|---|---|---|---|---|
| 12 in. at butt. | 6 in | 30 to 50 ft. | $0 14 | $0 19 |
| 12 in.–2 ft. from butt. | 6 in | 59 to 59 ft. | 18 | 25 |
| 12 in.–2 ft. from butt. | 6 in. | 60 to 69 ft. | 21 | 27 |
| 14 in.–2 ft. from butt. | 6 in. | 50 to 69 ft. | .24 | .23½ |
| 14 in.–2 ft. from butt. | 6 in. | 70 to 79 ft. | 28 | 34½ |
| 14 in.–2 ft. from butt. | 5 in. | 80 to 89 ft. | 35 | 42 |

## Lumber Shipments Equal Orders

Figures for production, stocks and shipments furnished by the Southern Pine Association show that in the forty-two weeks ending Oct. 22 there were orders for 3,112,881,817 ft. b.m. of lumber. Total shipments reached 3,058,102,397 ft. b.m., of which 2,914,-838,279 ft. b.m. were actually cut during that period. The West Coast Lumbermen's Association reports for the same period orders for 2,321,762,205 ft. b.m.; shipments, 2,268,825,776 ft. b.m. and production, 2,167,219,909 ft. b.m.

For the period ending Oct. 22, the combined report of these two associations showed shipments as great as the demand; indicating an increase in shipments and a decrease in demand in certain centers, from the recent high point. Production for the week ending Oct. 22 is the highest recorded this year. Recent price advances have stimulated the opening up of more mills.

**Latest News**—Orders for southern pine have fallen off during the last two weeks from the high period of the year established during September and October. Orders for the week ended Nov. 14 were only 68,000,000 ft. b.m. or about 8 per cent below the production for that week. Shipments have not fallen so greatly, the average shipment per mill since the first week in September being in excess of 600.000 ft. b.m., the figure attained the week ended Nov. 14.

The actual production for the week of Nov. 14 was 74,000,000 ft. b.m. or 18 per cent below normal. The total orders on hand amounted to 255,000,000 ft. b.m.

The West Coast Lumbermen's Association has started its long deferred litigation for lower rail freight rates and simplified tariffs. Shippers of West Coast forest products have tried out the increased rates now for more than a year, with the result that lumbermen are losing markets and the railroads are losing revenue. The governing board of the West Coast Lumbermen's Association is convinced that lower rates would have a tendency toward earning more revenue for the railroads, at the same time giving the East access to an abundant supply of lumber with which to meet its housing situation. The Association claims its attitude is co-operative.

## Trend of Business

**Stock Market**—More activity last week than the week before, with rising prices; but business is chiefly of a professional nature. With money more plentiful there is the possibility of a bull market developing in the course of several months; ungoverned speculation, however, is not likely, stocks being in strong hands.

**Bonds**—Public interest centered in new flotations, which frequently are disposed of a few days after offering. Subscriptions to the $50,-000,000 New York Telephone Co. refunding mortgage 6s totaled over $450,000,000, at about 100, despite the fact that a week before a similar investment with the same company was available at 98. The tremendous interest in this issue helped the high-grade public utility bonds. Municipals retained strength despite many new issue. Railroad bonds advanced, though trading was light.

**Money**—Call loans 4 to 5½ per cent, with as low as 3½ reported outside New York; time money at 5 per cent.

**Foreign Exchange**—Sterling rose to $4.50, the high price of the year, the previous record being $4.25 on May 19.

**Textiles**—Extremely small demand, with falling prices.

**Steel**—Ingot production at 40 to 45 per cent capacity, against 44 per cent for October, and an increase hardly expected before Feb. 1. The total annual capacity is about 52,-000,000 gross tons of ingots, 40,000,-000 gross tons of finished rolled steel. Armament making takes less than one per cent of capacity, so a naval holiday should not seriously affect the industry. Railroad buying in October estimated at $50,-000,000, and prospects for still heavier buying are good.

## West Coast Lumber for Coney Island Broadwalk

The lumber contract for surfacing Coney Island's new boardwalk has just been awarded a San Francisco concern on specifications calling for 1,660,000 ft. b.m. of 2 x 4-in. vertical grain Douglas fir of the decking grade. The contract calls for 760,000 ft.b.m. of Douglas fir in 23-ft. lengths; 650,000 ft.b.m. in 18-ft. lengths; and 250,000 ft.b.m. in lengths of 12 ft. and up.

## Engineering News-Record's Materials Prices

**Weekly Market Compiled by Nine Reporters; Monthly List the Work of Twenty**

One of the chief difficulties in the way of presenting accurate and definite price information useful to engineers, contractors and sellers of construction materials, is the fact that a price in itself means next to nothing. Quotations always require explanation. It is not enough to say that cement costs $2.40 per bbl. in New York. Cement also costs $2.10 in New York. It all depends whether the contractor or dealer is buying. Again, if the charge for bags is added, cement then costs $2.80 and $2.50, to contractor and dealer, respectively. Carrying the explanation further, the contractor's price includes delivery on the job, while the price to dealers is "alongside dock."

As in the case of cement, so with lumber, sand, gravel, crushed stone, brick, lime, and the rest. Methods of basing quotations vary with the different classes of materials, and the methods prevailing in one city may be entirely different from those in another center. In New York *Engineering News-Record* quotes sand, gravel and stone alongside dock, because contractors are permitted to purchase these materials on that basis. Cement, on the other hand, must be bought through dealers, who quote only delivered prices. In certain other cities, where cement may be obtained directly from the manufacturer, we quote f.o.b. City.

The fullest use of the prices of construction materials published by *Engineering News-Record* requires that the quotations be thoroughly understood. The weekly market of basic materials carries a complete explanation in small type directly under the tabulation of prices from nine important cities. The complete list, published in the first issue of each month, contains as much explanation as is possible without making the price section cumbersome. Also, a rapid, skeleton review entitled "Ups and Downs of the Market" leads the monthly list of prices.

Turn the page and study the Weekly Construction Market. It is as accurate as watchfulness and nine price reporters can make it. Next week's issue, Dec. 1, will carry the monthly labor article and the full list of prices of construction materials.

## Recent Municipal Bond Sales Total $60,890,970

More than $60,000,000 in municipal bonds have been sold recently in thirteen states and more than $34,000,000 in addition have been offered for sale. Besides, $10,000,000 in state bonds have been sold and an equal amount has been offered for sale. These statistics have been compiled as a part of a study being made regarding public works and the possibility for hastening construction to relieve in some measure the nation's unemployment. The statistics were compiled by the President's Conference on Unemployment. Public works, which it is hoped will be erected or extended by these municipal bonds, include highways, schools, sewers, filtration plants, water works, hospitals, parks, forest reserves, bridges, lights,

paving, court houses, fire department and street department equipment, streets and sidewalks, beach improvements and memorial playgrounds.

Col. Arthur Woods, chairman of the committee on civic and emergency measures of the President's Conference on Unemployment, is in correspondence with mayors of cities of more than 20,000 inhabitants to learn the status of their unemployment and what emergency measures are being taken to provide employment for men and women who need it.

## Vanderlip on a World Bank

The temptation to enter upon a process of depreciation by issuing too much paper money on the theory that what has seemed to help German industry might do something for manufacturers in other countries was declared by Frank A. Vanderlip, the American banker, recently, to be a certain path to national bankruptcy. As a means of stabilizing international finance he has put forward the idea of a world bank, with an international dollar.

According to Mr. Vanderlip the plan would leave every finance free to go on printing as many notes of his own national currency as he please; it would merely establish a double currency, such as already exists in some of the South American countries and in the Far East. In brief, the proposition is to organize a banking corporation with a paid-in capital of $1,000,000,000 in gold, with power to increase, the capital to be divided into shares of $100 each. Subscription to these shares would be open to anyone able to buy with gold.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | −$2.78 | $4.00 | $4.00 | $2.88 | $3.06 | $3.75 | $3.70 | $4.00 | $4.00 |
| Structural rivets, 100 lb | 3.70 | 5.25 | 5.50 | 3.43 | 4.15 | 4.25 | 5.50 | −4.25 | 5.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | −2.68 | 3.20 | 3.50 | 2.68 | 3.08½ | 3.57½ | 2.90 | 3.75 | 3.25 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 51% | −57.65% | 45% | 57% | 58.9–5% | 38% | 51.8% | 50% | 35.10 |
| Cast-iron pipe, 6in. and over, ton | 47.30@48.30 | +45.00 | 54.30 | 42.60@44.10 | 47.80 | +72.00 | 50.00 | 53.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | 2.40 | +2.69 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.12 |
| Gravel, ¾ in., cu.yd | 1.75 | −1.85 | 2.25 | 1.65 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | −1.00 | −1.25 | 2.25 | 1.65 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | −2.00 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | +47.50 | 38.00 | 37.00 | 48.00 | 35.00 | 50.00 | 30.00 | 24.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | −27.00 | 21.00 |
| Lime common, lump, per bbl | −3.39@3.69 | −1.50 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | +3.25 | 15.00 |
| Common brick, delivered, 1,000 | 18.40 | −9.00 | 12.72 | 11.00 | 17 00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | −.0675 | .124 | .0821 | .092 | .09 | .12½ | .10 | .08@.29 |
| Hollow partition tile 4x12x12, block | .11120 | −.0675 | .124 | .0657 | .... | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal | .72 | −.79 | −.85 | +.76 | .80 | +.92 | .83 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | .35 | ..... | 72½ | 50 | .50@.55 | .75 | .50@.60 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .35@.40 | 50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45% 5 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 250-lb. net; hard lump sand; hydrated quoted f.o.b. cars. New York. Sand, gravel and crushed stone are most all over side dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars, $2.10 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net, what is $1.70 for kelly Island and $1 . . for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel f.o.b. cars, delivered on job. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir in lieu of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered. Sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

## Changes Since Last Week

The only advances in prices of construction materials, reported from eight representative American cities, occur in cast-iron pipe, cement, lumber and linseed oil. Cast-iron pipe is quoted in Atlanta at $45 as against $40.50. Cement has advanced 9c. per bbl. in Atlanta. Pine lumber is quoted at $42.50, wholesale, as against $40 per M ft. in New York. Linseed oil advanced 2c. in Denver and Chicago, but dropped 8c. in Dallas and 6c. per gal. in Atlanta. Increased demands in these four commodities have been reflected in stimulated prices; while twelve of the other principle materials in the construction market show a downward trend in price.

The minimum of $1.50 on steel shapes and bars continues to be quoted, on large tonnages, at the Pittsburgh mills; small tonnages 5c.@10c. per 100-lb. higher. Regardless of the stability of the mill price on large tonnages, the New York warehouses quote a drop of 10c. per 100-lb. on structural shapes and reinforcing bars. Shapes are quoted at $2.78 as against $2.88 and bars at $2.68 as compared with $2.78 per 100-lb., previously.

Structural rivets are quoted in Seattle at $4.25 as against $4.50 per 100-lb. Atlanta quotes reductions ranging from 10c to 15c. per cu. yd. in all concreting materials excepting cement; a drop of 10c. per bbl. in common lump lime; a decrease of $1.50 per 1000 in common brick and a slight reduction in hollow tile. New York quotes sand at $1 as against $1.25 per cu.yd. and common lump lime at $3.39@$3.69 as compared with $3.69 per bbl., formerly.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, DECEMBER 1, 1921 — Number 22

## *Bringing Pressure for an Economic Conference*

INSISTENT are the demands that the disarmament conference resolve itself, when its naval and Far Eastern programs are disposed of, into an economic conference. Rumor has it that this will be Lloyd George's proposal should he come here. But it should not be Lloyd George's proposal merely; it should be the proposal of every American business man and engineer as well.

We need naval disarmament, we need a settlement of Far Eastern questions, but we need above all—because of their immediate pressing importance—a solution of the problems that flow out of the financial difficulties of continental Europe. This economic breakdown is daily unsettling international trade, and the dire consequences of the possible bankruptcy of Germany no man can clearly forsee. No single nation can stop the downward course of things; it must be done by international agreement.

Preceding an economic discussion, however, whose end result would be the stabilization of exchanges, must come the balancing of budgets, for otherwise the printing of paper money cannot be stopped. The balancing of the budgets, then, is the crux of the situation and their unbalancing is due to the maintenance of their land armaments. In fact, the cost of these land armaments is almost exactly equal to the amount by which the budgets are out of balance.

The first step, then, is to resolve the Washington conference, after the naval and Far Eastern questions are out of the way, into a land-disarmament meeting. Land disarmament is, indeed, on the present agenda, but unless the influence of the public is brought to bear it may not be taken up. If substantial land disarmament be agreed to, the budget balancing will not be exceedingly difficult, and stabilization, necessarily involving a temporary respite in German indemnity payments, will be easy.

American business men then—and the engineers with them, as an integral part of the business structure—should being their influence to bear upon the President and his cabinet to secure a consideration of land disarmament and then of the European economic ills which are unsettling the world. These are the foremost business questions—and business hindrances—of the day. It is the duty of American business men to demand that these hindrances be removed by international co-operation, flowing out of international conference.

It is a time to act.

### November Highway Contracts

WHETHER the general appeal that highway contracts be let early as a part of the unemployment relief program has been heeded, or whether the volume of highway construction in 1922 is to surpass any preceding year, is difficult of determination from available figures. But the fact remains that during November the value of highway contracts was almost double in volume that of any previous year. A multiplicity of forecasts and explanations may be deduced from the comparative figures of the past three years. Here they are: 1919, $11,270,000; 1920, $12,443,000; and 1921, $20,750,000.

### Volume of Construction

CONTRACT values for all classes of construction have been as high as for street and road work. In money involved the figures for November, 1920 and 1921 are, in round numbers, $76,000,000 and $97,000,000 respectively. However, in comparative volume, the past month has doubled the same month of 1920, for the *Engineering News-Record* Construction Volume Index Number is 101 for this November as against 51 for last. Reiteration of a former assertion that the construction industry is not in as bad a state as the popular mind would have it, seems pertinent. Even though 1913 may have been a slightly subnormal construction year, the index number for November shows a volume of building done equal to the average month of 1913. Part of the cry that construction conditions are bad may be explained by the inability of business men to forget the fat war years. Like the ghost of Banquo, its shade will not down.

### Jail for Material Ring

AT LAST members of a material ring in the building industry have got their just deserts. A federal judge sitting at New York passed sentence last week upon four tile and mantel contractors who had pleaded guilty to violations of the Sherman anti-trust law. They had been guilty of restraint of trade and the judge deemed their cases so flagrant that he refused to let them off with fines. This is the proper medicine to apply in these cases. The building material rings—both on the part of the material dealers and on the part of labor—have been extremely flagrant at New York. Severe punishment is called for, and Judge Van Fleet proved equal to the occasion in four cases last week. Fifty-two of the offenders, however, were let off with fines of from $500 to $5,000.

### To the Point

BECAUSE a time limit was set and observed for the score or more of papers at the meetings on sanitation problems held by the American Society of Civil Engineers in recognition of the Jubilee convention of the American Public Health Association two weeks ago, the papers themselves were unusually interesting and ample time for discussion was afforded and utilized. The three main topics—sewage, odor, water—were

ably presented from various aspects by well chosen speakers, not one of whom droned on far beyond his time limit, regardless of the rights of other chosen speakers and of those who wished to take part in the general discussion. Program framers and speakers alike for other technical society meetings may well heed this object lesson.

### Virgin Fields

ALERT-MINDED listeners at the meetings just noted, as well as those of the sanitary engineering section of the American Public Health Association (see brief abstracts of papers before each, elsewhere in this issue) were impressed with the many almost virgin fields for sanitary engineers and allied workers now open or awaiting the pioneer. These opportunities are most evident in connection with water and sewage treatment, because the much that has been accomplished here shows more clearly every day no end of unsolved problems. The same is true of garbage disposal, although this may not be so clearly evident to more than a very few, because as yet not all sanitary engineers—much less city officials and the general public realize that garbage disposal is an important branch of sanitary engineering, or else there would be more than the present half dozen engineers specializing in that field.

### Odor Engineering

NEWEST AND FREEST from able competition is the field of odor engineering. This is so closely associated with the sanitary control of other nuisances, that nuisance engineering might be a better although a less catching term. Besides being intimately connected with sewage and garbage disposal, particularly the latter, there has of late been a large and rapidly growing volume of complaints and litigation over the odors produced by a variety of industrial plants, notably oil refineries. The control of these and many other odors requires a theoretical and practical knowledge of various branches of civil and mechanical engineering, chemistry, bacteriology in some cases, meteorology and both physiology and psychology. Odor or nuisance engineering should attract the younger engineers because of its novelty and their adaptability to adventure, and also the older engineers having a background of experience, mature judgment and knowledge of men and of courts—for much of odor engineering practice will be before the courts or semi-judicial bodies like state departments of health.

### Diplomacy in Labor Organization

IT HAS been repeatedly pointed out that many of the difficulties between capital and labor are due to the fighting executives on either side. They have been developed in a day when only through a show of strength was it believed that a satisfactory settlement could be secured. As was to be expected upward progress has been more rapid among the employers, and there have been repeated pleadings that there were needed in labor ranks broadminded leaders whose strength lay in their knowledge and diplomacy rather than in their muscles and in their jaws. England, so it is stated by Mr. B. S. Rowntree in a statement to this journal, has worked through its labor experiences to this point. The old style of strong armed and loud voiced labor leaders is disappearing—in fact, has disappeared—from many of the trades unions. Instead there has arisen the conciliator and diplomat, who plays fair and whose strength lies in a showing of facts. With this type of leader, Mr. Rowntree states, it is easy to deal satisfactorily. In his own plant of 7,000 employees, dealing with such leaders, there has never been a strike, while one of the recent labor adjusters assured him that there had never been a strike in any plant in which he had conducted the negotiations and that within two months of the time he was speaking seventeen disputes had been satisfactorily settled. We must recognize, of course, the difference between the situation in England, where labor is much more largely unionized than here, and in the United States. Nevertheless, the method of conciliation of trying to work in fairness should be quite as productive here as abroad. It means a tremendous change, however, in the type of leadership rampant today in the American Federation of Labor and its subsidiary organizations.

### A British View of American Roads

THANKS to the custom of the American daily press in interviewing notable foreign visitors, we have frequently been able to see ourselves and our cities in the mirror of European opinion. Such impressions, however, have generally come from statesmen, opera singers, bankers, soldiers, artists—almost every one except the engineer. Their comments, for the most part, have related to New York—its skyscrapers, hotels, the subway jam—and the personal characteristics of the American woman. We have had very little frank comment on our engineering practice. In this issue, however, Mr. Dryland, county engineer of Middlesex, England, who spent a month in this country last summer, presents a number of interesting and valuable impressions of our roadbuilding methods and problems of highway transport. Backed by forty years of experience in English highway construction and maintenance his views on our work offer much food for thought. American highway engineers, during the last few years, have made no effort to conceal their anxiety over the increasing number of heavy motor trucks. Nevertheless, any one who feels that the present weight and volume of traffic are near the peak of development should heed Mr. Dryland's warning that "our troubles are only beginning." The English road authorities, today, are being called upon to provide for much heavier weights than are American engineers. A disturbing factor in the London suburban districts is the surprising development of traffic by buses and charabancs, the latter passenger-carrying vehicles accommodating about fifty persons and of a type comparable to our "sight-seeing" automobiles. If American experience is to duplicate that of the English counties, our highway engineers have much to think about in planning new road types for heavier loads than are now common. Mr. Dryland's article is valuable chiefly in the stimulus it will give to the study of highway transport problems not only of today but of tomorrow.

## Proposals for Engineering Services

THE iniquity of the practice of engineers bidding against each other in answer to proposals for engineering services lies largely in the temptation to cut fees to such an extent that good work cannot be done. Much of the lay complaint of poor work arises from the fact that the engineer was chosen on a low-price basis rather than on his technical qualifications. Remedial measures have been discussed for many

years, mostly behind closed doors. However, not until each engineer is activated sufficiently to do his bit in educating the public whenever the occasion arises, will the practice of city officials of advertising for engineering service on a bargain-counter basis be eliminated. Engineering society codes of ethics forbidding members from bartering their professional talents purely on a money competitive basis are of little use unless they are applied.

Engineers do improve the opportunity, perhaps more frequently than is realized. When George Champe, a civil engineer of Toledo, was sent a 3-in. advertisement asking for proposals for competent engineers for the preparation of plans, surveys and supervision of the proposed water-works improvement in Wellsville, Ohio, he wrote the director of public service as follows: "I am sure that you would not employ this method of securing a comptent physician for your family, or if you did, the physician who responded would probably not be very competent. Nor would you employ this method of securing an attorney if you had an important case in court. I am, therefore, very much disappointed that you should expect the engineers to enter into unprofessional bidding and that I cannot hope to serve you in the proposed improvements."

When every ad of this kind brings to the advertiser an avalanche of letters like Mr. Champe's, better methods will prevail.

## The Halting Recessional of Russia

RECENTLY reports have been coming out of Russia to the effect that the Bolshevik government had lost faith in the ability of the Communistic era to restore the country's industrial life and was granting private concessions for the development of natural resources and the operation of industries. The reports have been true, but when the circumstances attendant upon the grants—or proposed grants—of these concessions are known it is realized that Russia's re-conversion to a property-rights regime is not whole hearted. Her recessional is halting.

The situation is made clear by a copy, just at hand, of a proposed contract between the Bolshevik government and an English company which was seeking, under the supposed new order, a concession to resume charge of its own mines. After protracted negotiations, in part with Krassin, the Bolshevik representative in London, and in part with Bolshevik officials in Moscow, the English company found it impossible to accept the terms and withdrew from the negotiations.

It should be remembered that the company in question was not an adventurer willing to take long chances in a very greatly disturbed field of operations. It had for years operated the properties, and sought merely to reassume control. Its withdrawal from the negotiations was due to the Soviet insistence upon absolute control of personnel and every feature of the operation.

For example, the clause governing labor was such that no guaranty was to be given to the concessionaire that those employed would be allowed to remain on their jobs. The laws permit of searches, arrests, extraction of papers or documents, etc., to be made at the will of the local authorities, while workmen are subject to labor conscription and may, no matter what their skill, whether manual or intellectual, be put at any class of work. In fact, it is standard practice to put skilled men at quite menial labor.

Again, the Soviet government demanded that the third, and customarily neutral member of the arbitration commission which was to settle disputes as to the meaning or fulfillment of the agreement be a Russian. This the company refused to accept, for it would run the risk of having the third man a Communist, who, for obvious reasons, could not be expected to render justice to a capitalistic organization. Even if he were not a member of the Communist party, no man is free in Russia today and being subject to labor conscription, to every kind of restriction in his home and movements, he is always in a position of subjection to the Communist state. In fact, he and his family are dependent for their daily ration of food on the pleasure of the government.

Moreover, had the company entered into a contract minus an arbitration board, it would have been subject to the operations of the regime as it is. Since this regime does not recognize any obligations between individuals, no contract or obligation between parties can be enforced, nor does the state itself recognize any obligation to individuals or subjects. The only obligation recognized and enforced is the absolute subjection of every individual to the state. The contract, therefore, without an arbitration board would have been a mere scrap of paper. In fact, in the light of Mr. Keeley's characterization of the Bolsheviki in this issue, there is doubt as to the value of any contract.

Finally, engagement of all persons was to be governed by a supplemental agreement made between the company and the All-Russian Council of Professional Unions, a mis-named organization to which all workers, even laborers, must belong. Under this proposed agreement all engagements and discharges were to be subject to the approval of the unions. The consequent restriction upon the freedom of the concessionaire in operating and developing his enterprise is evident. Further, the unions insisted that the concessionaire bring all of the supplies for the personal needs of the workmen and their families from abroad, this to continue for not less than seven years. Though it was pointed out to the unions that this would require the bringing of food from America and that there was surplus food in a neighboring province which the Soviet government was unable to move, the unions insisted upon these terms.

All in all, it was apparent that the contracts proposed by the Soviet government were not drawn in the interests of the workers, nor were they intended to give the concessionaire a sufficiently free hand to enable him to operate the property efficiently. The sole object seemed to be to keep undisputed control of the operations, despite the intent implied by the letting of a contract, in the hands of the Soviet authorities.

It is apparent, then, that while Russia is forced to relinquish something of her strictly Communistic theories, she has not yet gone far enough on the road to make her proposals inviting to outside capital. With the start away from pure Communistic theories, however, it is to be hoped that the time of the break-up is not far away. It is known that Lenin and Trotzky are getting farther apart, the former leaning toward a modification of the ultra-radical doctrines and the latter holding fast to them. The break in the lines cannot come too soon for the good of Russia and for the rest of the world, which needs for healthy trade restoration the consumptive power and the productive ability of the Russian people.

# Driving a 20,000 Sec. Ft. Flood Protection Tunnel

**Turkey Creek Diversion Works at Kansas City Includes 28 x 28-ft. Tunnel Through Bedrock Requiring Grade Change—Shovels Air Driven—Machine Mixed Concrete Placed by Air**

FLOOD prevention measures at Kansas City which have been under way for some years involve among other things the diversion of Turkey Creek with a maximum estimated flow of 20,000 sec.ft. through 500 ft. of open channel, 1,300 ft. of 28 x 28-ft. tunnel and 200 ft. of concrete box "subway." A general description of the flood prevention program appeared in *Engineering News*, December 26, 1912, p. 1194; this article is devoted mainly to the construction operations in driving the tunnel, with particular reference to the grade change to avoid bedrock, the use of air driven shovels and the method of placing the concrete.

PROFILE ON CENTER LINE OF TURKEY CREEK FLOOD DIVERSION TUNNEL

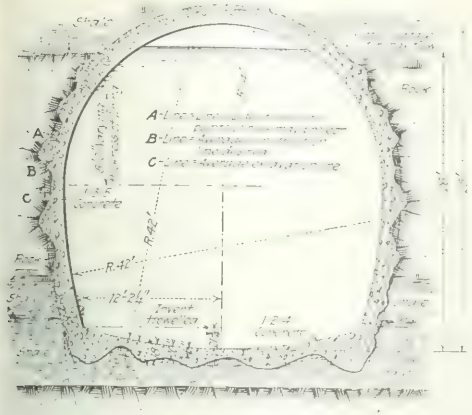
Turkey Creek is a comparatively small stream rising in the hills south of Rosedale, Kan., through which it flows across a corner of Kansas City, Kan., continuing across the state line into Kansas City, Mo., finally crossing the state line again and emptying into the Kaw River within the city of Kansas City, Kan. It drains an area 13 miles long and 2½ miles wide embracing about 15,000 acres. Outside of the cities the drainage area consists in general of rolling lands with precipitous slopes; within the cities the land is much flatter, but the paved streets and sewers occasion equally rapid concentration of rainfall. Ordinarily there is little flow in the creek (less than 10 sec.-ft.) but at high water periods the creek formerly overflowed its banks in its lower reaches and caused large flood damages to residence, business and railroad property adjacent. The principal floods in recent years occurred in 1903, 1906, 1908 and 1914.

The flood of September, 1914, was caused by an excessive rain on Sept. 6 and 7. Government records at Kansas City, Mo., showed a rainfall of 7.02 in. between 11 p.m. Sept. 6 and 10 a.m. the next day. It is thought that the rain was even heavier than this in the Turkey Creek watershed though no data covering this is available. This flood covered the valley to various depths up to 10 ft. and spread out over the low lands south of the mouth of Turkey Creek to sufficient depth to overtop the levee along the Kaw River destroying it in several places. But earlier floods had demonstrated the necessity of protection for overflowed land, and in 1910 Kansas City, Mo., began active work in the development of a suitable plan. Such a plan involved not only the protection of property from floods due to rains over the Turkey Creek watershed but also protection from back water from the Kaw River. Any diversion of Turkey Creek necessarily also involved provision for the sanitary and storm sewage then being discharged into the creek.

A comprehensive plan, generally spoken of as the Ash or Tunnel plan, was accordingly developed during 1910 and 1911 by L. R. Ash, then city engineer. [It is said the original idea came from J. E. Hutchison, general manager, St. Louis-San-Francisco Ry.—EDITOR.] The plan contemplated the diversion of Turkey Creek by a dam across it just below Ely Road (now Packard St.) in the city of Rosedale, Kan., a tunnel through Greystone Heights to carry the diverted stream into the Kaw River and a sewer commencing below the dam to carry the sanitary and storm sewage of this lower reach into the Kaw River. This plan involved also the reclamation of the area in Missouri then occupied by Turkey Creek; more than 11 acres was thus to be made available to the railroads and Stock Yards Co., owning the contiguous property. Owing to the several interests involved sufficient co-operation and funds were not available to start work for eight years after the project was launched, although the damage in the meanwhile had equalled about half the cost. The diversion was completed in 1920.

*Capacity.*—The tunnel and the improved creek channel above the tunnel provide a maximum capacity of 20,000 sec.-ft. corresponding to a run-off of 1¼ in. per hour from the drainage area of 15,000 acres. This amount of water can be discharged for all stages of the Kaw River at the tunnel outlet up to El. 29. (Kansas City, Mo., datum.) During a flood in the Kaw River equivalent to the 1903 flood, with an elevation of water surface in the Kaw River assumed 3 ft. below the top of the levee at El. 37, this capacity will be reduced to 15,000 sec.-ft. Both of these capacities are based on the water surface in the open channel at all points being at least 3 ft. below the top of levee, so that the actual possible discharges before overtopping of levees would occur, are in excess of the given values. El. 29 corresponds to the 1908 flood in the Kaw River which is the flood next highest to the maximum flood of 1903.

The work consists of straightening, enlarging and diking the existing channel of Turkey Creek from the Frisco railroad bridge north of Southwest Boulevard in Rosedale to a point just east of Valley St. about 5,600 ft. downstream. At this point a diversion dam was thrown up in line with the east levee and the new channel, tunnel and "subway," constructed from the diversion dam through Greystone Heights into the Kaw



TYPICAL TUNNEL SECTION

River, a total distance of about 2,000 ft. Beyond the subway, flanking retaining walls were constructed as a protection for the Kaw River levees from Turkey Creek waters.

*Open Channel, Levees and Dam.*—The new open channel follows the general line of the old channel and has substantially the same bottom elevations as the old creek. This bottom is generally in rock which was found at a suitable elevation. Near the dam this rock drops too low and the bottom is in clay. The west bank is high ground thus requiring no levee protection; the east bank is lower and levees were required throughout. These levees were constructed out of the material from the channel excavation and are backed up for a portion of their length by spoil taken from the tunnel. For about 3,000 ft. beginning at the upper end the levees were thrown up adjacent to the existing Frisco railroad tracks instead of following closely the new channel, and were in effect merely a widening and a raising of the existing railroad embankment. The top width of the levee here was made sufficient to serve for a single track railroad with a portion widened with excess channel excavation sufficiently to give double track facilities. The balance of the levee departed from the railroad track, followed the channel and was constructed with a top width of 10 ft. and side slopes of 2 to 1. The upper portion of the levee adjacent to the railroad tracks was not protected but the lower narrower portion was protected throughout with hand laid stone revetment.

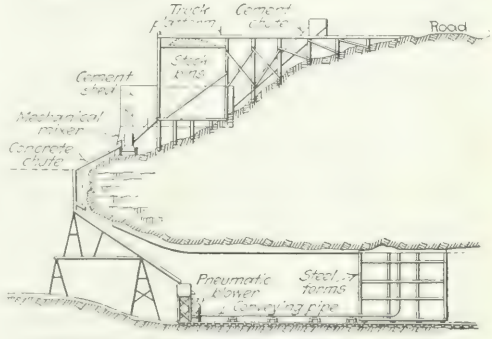
At its upper end the open channel was constructed with a bottom width of 90 ft. and side slopes of 2 to 1. This channel was narrowed and deepened in several stages as the tunnel was approached, and final section just outside the tunnel having a bottom width of only 25 ft. and side slopes in rock of ¼ to 1. Between the dam and the tunnel the channel was lined with concrete both on sides and bottom. The section was largely in rock and shale and the lining was anchored to the rock with anchor bolts.

In effect the dam is merely a part of the levee, but was constructed of more liberal dimensions and is better protected. It is covered by two layers of revetment, hand laid stone revement placed next to the fill, overlaid with a reinforced-concrete lining. The bottom of this lining was protected by concrete walls carried down into rock along the edge of the channel. For 4,750 ft. the channel was excavated with a steam-operated dragline having a 90-ft. boom. In general the material was placed directly by the dragline into the levee but near the upper end some rehandling was required. Near the lower end the channel excavation was insufficient to make the levee and the material was hauled over standard gage track on top of the levee from points of excess excavation. The material was placed in 12-yd. dump cars by the dragline and hauled in trains by a small locomotive.

The northerly portion of the channel was excavated with a steam shovel, teams and wagons being used to place the material in the levees. The channel excavation was deficient to construct the levees so a considerable part of the levees was constructed with material obtained from borrow pits located on adjacent high ground. This borrow pit material was excavated by a steam shovel and hauled to the site with teams and wagons.

### Driving the Tunnel

The concrete lined tunnel is of horseshoe shape, 28 ft. high and 28 ft. wide. It passes through several ledges of limestone and shale, the roof and invert both being in limestone. Changes in tunnel elevations from those originally contemplated were made to secure this re-



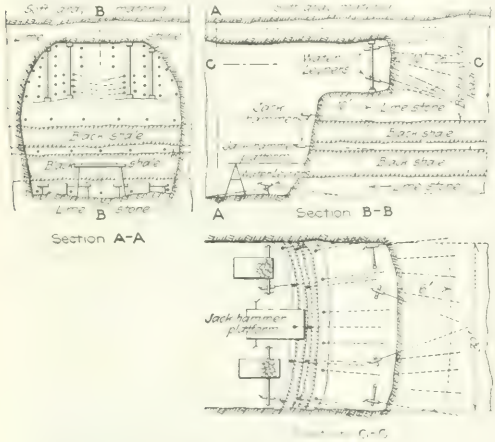

CONCRETE MIXING PLANT LAYOUT ON TURKEY CREEK TUNNEL

sult, thus avoiding the expense that a shale roof would entail. The roof was in a thick ledge of Bethany Falls limestone; the amount of rock cover near the upper end was small but deemed sufficient for the purpose as the rock appeared to be of excellent quality. The rock, however, proved to be very unreliable, especially after standing exposed for some time, and ultimately the upper 760 ft. of tunnel had to be timbered in some fashion to furnish support for the roof. To avoid similar difficulties on the lower end of the tunnel the grade for this portion was lowered some 3 ft. The lower end of the tunnel had been excavated at this time with the roof about 3 ft. low, it having been the intention to remove this section just prior to concreting the lining. To avoid disturbing this roof and at the same time to support it without going to the expense of timbering throughout, the grade was lowered 3 ft. and 20-ft. stretches of concrete lining immediately placed at intervals of about 100 ft. This expedient proved successful in stopping roof troubles.

Tunnel excavation was carried forward in two levels,

the upper level being carried about 12 ft. in advance of the lower, and both levels being advanced the same amount daily. A segmental section in the roof about 3 ft. deep was left in place to be removed just prior to concreting the lining. Excavation was handled in two shifts, the night shift doing the drilling and shooting and the day shift the mucking. An average night crew consisted of a tunnel drill foreman, seven water Leyner operators with one helper each; eight jackhammer operators with one helper each and two general assistants. The crew was practically on piecework and left when the usual 10 ft. had been drilled and blasted, varying in time from 6 to 14 hr. The following notes on this work are taken from the resident engineer's report:

A wedge-shaped set of eight holes was drilled with four holes on each side of the center line in a vertical row 8 ft. apart. The bottom hole, of the two rows, was placed about 1 ft. above the top of the bench and the remaining three holes were spaced on 1-ft. centers. The water Leyner machines, used exclusively in drilling these holes were set

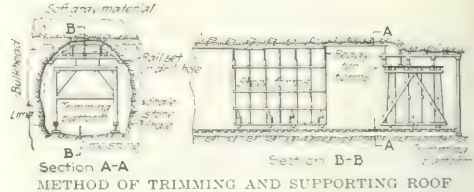



SKETCH SHOWING TUNNEL DRIVING METHOD

at such an angle horizontally that the holes when completed would just about meet at a point 12 ft. back from the face of the heading. Also a vertical dip was made in each set of the wedge holes, or as more properly termed, cut-holes, so that the bottom cut-holes would run down to a point approximately 18 in. below the level of the top of the bench or about 11½ ft. below the neat line of the tunnel roof at a distance of about 12 ft. back of the heading face. The remaining three cut-holes in each row were so drilled that each converged vertically to within about 6 in. of the outer end of each succeeding hole. This position of the cut-holes permitted the greatest effect from the blast as the inclined holes gave the powder a chance to lift the rock as well as to kick out the wedge-shaped piece of rock without serious vibration or shattering of the top of the bench or roof rock.

Owing to the nature of the limestone strata, the foreman had to exercise the very best of judgment in drilling the proper number of holes and locating the position of each, as there were a number of seams and shale pockets in the Bethany Falls ledge that proved detrimental to effective shooting if the proper precautions were not observed.

After completing the drilling and blasting for the cut-holes another series of holes was drilled semi-circling the location of the previous wedge or cut in such a manner as to break down the surrounding rock and gradually work out toward the excavation line desired. These rib-holes differed in number according to the nature of the rock formation, but they were usually placed in vertical rows at points 2, 6 and 8 ft. from the center line each way. The drills were so




METHOD OF TRIMMING AND SUPPORTING ROOF

directed that the holes gradually converged from the line of direction of the cut-holes to a line approximately parallel with the center line of the tunnel.

A set of easer-holes was next drilled between the rib-holes and the neat line of the tunnel section at a point 11 to 12 ft. each side of the center line and one each side of the center down 18 in. from the heading roof. These holes usually numbered five on each side and had a tendency to square up the heading previous to the final set of holes.

The last set of holes was spaced around the sides of the heading opening on the excavation line desired. Also two or four holes were drilled down 6 in. from the heading roof so as gently to break away the remaining rock in the tunnel arch without disturbing the roof of the heading. These finishing-holes were directed slightly outward during the course of the drilling so as to permit ease of operation of the drill. At the same time, the operator did not run any chances of losing the hole due to cramping.

Stope-holes were drilled horizontal to the tunnel section and 1 ft. above the bottom of this formation of rock. Underlying this top part of the bench rock there is a strip of bituminous (black) shale averaging 3.6 ft. in thickness. Next is a thin layer of limestone formation varying in thickness from 1.2 ft. to 1.5 ft. and into this rock were drilled five breast-holes through the center of the layer and horizontal to the tunnel section. Under this limestone there is a strata of blue shale varying from 3.8 ft. to 5 ft. thick. Below this shale formation there is another section of limestone in which the tunnel is seated and it is in this material that the finishing-holes for the bench were located. Usually five more holes were drilled within about 12 in. of the bottom of the tunnel floor.

The cut-holes are drilled first, then the rib-holes, easers and finishing holes for the roof and the sides of the heading, all by means of the water Leyner drills. The cut-holes were loaded with gelatin powder and discharged by means of an electric blasting machine and electric caps. The rib, easer and finishing-holes were loaded with the same kind of powder but were discharged with a time fuse. The stope-holes and the breast-holes were drilled with jackhammers and the finishing-holes in the bottom of the bench with water Leyners. All of these holes were loaded with the same kind of powder and discharged with electric caps and a battery. For a complete round of the blasting 400 lb. of powder was used daily, 80 lb. of which was 60 per cent and 320 lb. 40 per cent. About 28,000 tamping bags were used effectively. The shooting usually began between 1 and 2 a.m. and lasted until 4:30 to 5 a.m., so that everything was ready for the day shift to begin mucking.

The material was loaded into dump cars by a 40-ton shovel operated by compressed air and hauled out of the tunnel by cable by means of two hoists operated by air, one just outside the tunnel portal and one about ½ mile farther up the channel. Suitable pieces were picked out to be crushed for concrete and the remainder used in building up levees and filling depressions adjacent to the levees. After the work was fully organized progress was exceptionally good, about 10 ft. per day being made regularly.

The tunnel lining in roof and sides was placed around collapsible steel forms although a short stretch near the upper portal and isolated 20-ft. strips were placed around timber forms. Concrete was mechanically mixed on the hill above the south portal, chuted down into the

tunnel into a pneumatic mixer and conveyed to place by compressed air through steel pipes.

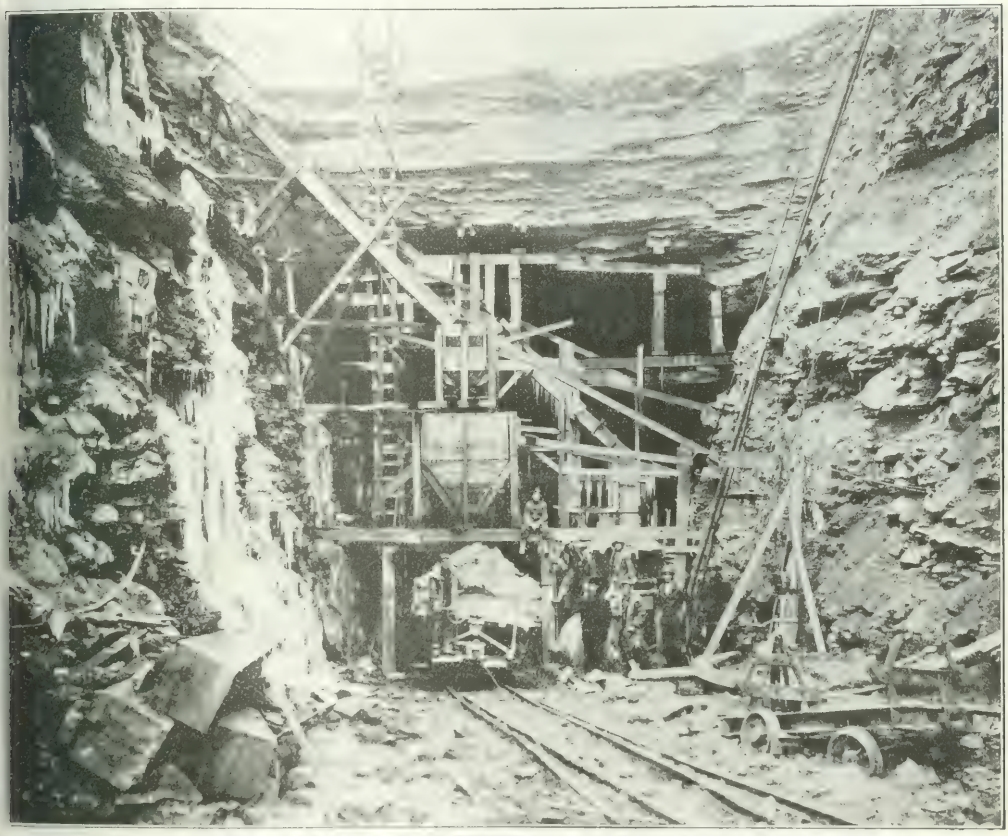
The invert was placed last like a pavement after the remainder of the tunnel was completed and air had been removed. Materials were hauled into the tunnel and concrete mixed at the site.

The subway consists of a reinforced-concrete box under the Santa Fe tracks. The tracks are carried on a heavy reinforced-concrete slab supported on sidewalls founded on rock and shale. A bottom slab is provided to care for earth thrusts on the outside of walls as well as to care for the Turkey Creek flow. This subway was

in building up the Kaw River levees adjacent or in filling adjacent low ground.

An entrance into the Kaw River between the retaining walls was also dredged, this material being excavated with a clam-shell bucket operated from a barge, loaded onto another barge and dumped in the Missouri River.

Construction began in March, 1918. Trouble with floods in the tunnel resulting both from high water in the Kaw River and from high water in Turkey Creek due to rains over its watershed delayed the work considerably. A Turkey Creek flood in August, 1919, broke



PORTAL OF TURKEY CREEK TUNNEL SHOWING SCALING ROCK LEDGE

out in without interruption of traffic, the tracks being temporarily supported on steel beams spanning the excavated area. The walls were placed in narrow sheeted trenches, which at the deepest point were 60 ft. below the tracks. After the wall trenches were excavated and the walls concreted, the top slabs were placed, the final operation being the removal of the excavation between the walls and the putting in of the floor of concrete.

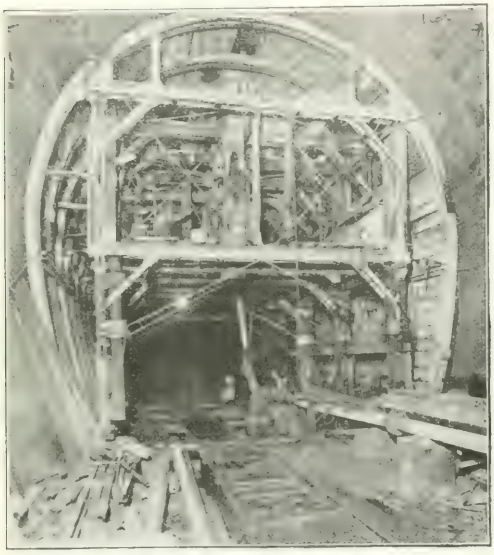
The process of excavating for the subway and retaining walls was the same. The material was excavated by hand and shoveled into steel buckets which were removed from the excavation by stiff-leg derricks, and either dumped alongside the excavated hole or used

through the temporary dam protecting the tunnel at a very critical time in the work. The tunnel and outlet were so nearly completed that the concrete floor was about to be placed when the flood occurred. More than 7,000 cu.yd. of debris out of the temporary dam, out of the rock cut approaching the tunnel and from upstream was carried into the tunnel and deposited there intermingled with pumps, hoisting engines and all manner of equipment. In the face of all these difficulties the work was carried on energetically to completion and acceptance in November, 1920.

The Davidson Construction Co. of Kansas City, Mo., were the general contractors, but sublet the major portion of the work; the tunnel work to the Dock Con-

tractor Co. (now Raymond Concrete Pile Co.), New York City, and the major part of the open channel work to Munn-Reise Construction Co. of Kansas City, Mo. William G. Thompson was general superintendent in charge for the Dock Contractor Co.

The contract between Kansas City, Mo., and Rosedale, Kan., placed the entire charge of the work in the hands of the latter, but outlined particular methods to be followed in administration and also appointed the



MOVABLE STEEL FORM FOR 28-FT. TUNNEL

necessary legal and engineering advisers. Harrington, Howard & Ash were employed as consulting engineers to prepare all plans and specifications and to supervise the work under the general direction of the city engineer of Rosedale. George R. Russell and Paul Hartung successively served in that capacity. Arthur E. Morgan of Dayton, Ohio, was subsequently employed to review the plans and specifications. For the consulting engineers Frank M. Cortelyou and Henry C. Tammen successively served as resident engineer supervising the construction.

### Lumber Production by Species

From the U. S. Bureau of the Census lumber production by species as shown from 30,235 mills in 1919 as compared with the report from 46,584 mills in 1909 are as follows:

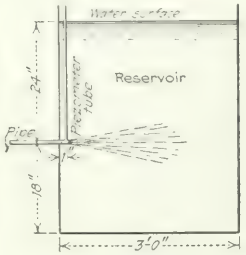
| Kind of Wood | 1919 Feet B. M. | 1919 Per Cent | 1909 Feet B. M. | 1909 Per Cent |
|---|---|---|---|---|
| [illegible] | [illegible] | 17 8 | [illegible] | 16 6 |
| [illegible] | [illegible] | 15 1 | [illegible] | 11 2 |
| [illegible] Fir | [illegible] | 4 9 | [illegible] | 5 3 |
| [illegible] | [illegible] | 7 8 | [illegible] | 4 4 |
| [illegible] Yellow | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 5 4 | [illegible] | 3 4 |
| [illegible] | [illegible] | 4 1 | [illegible] | 6 9 |
| [illegible] | [illegible] | 3 3 | [illegible] | 8 8 |
| [illegible] | [illegible] | 3 3 | [illegible] | 3 9 |
| [illegible] | [illegible] | 2 5 | [illegible] | 2 5 |
| [illegible] | [illegible] | 2 5 | [illegible] | 1 6 |
| [illegible] | [illegible] | 1 9 | [illegible] | 2 1 |
| [illegible] | [illegible] | 1 6 | [illegible] | 1 5 |
| [illegible] | [illegible] | 1 6 | [illegible] | 1 1 |
| Total . . . . | 34 6 | 100 0 | 44 5 | 100 0 |

## Loss of Head for Pipe Discharging Under Water Into Reservoir

By C. O. Wisler
Associate Professor of Hydraulic Engineering, University of Michigan, Ann Arbor

FOR a pipe discharging under water into a reservoir there seems to be a common conception that the entire velocity head is lost at discharge. If this theory were correct the hydraulic gradient for the pipe line should slope down exactly to the water surface in the reservoir. That this is not the case is proved conclusively by recent experiments conducted in the hydraulic laboratory of the University of Michigan.

A ¾-in. pipe was made to discharge into the reservoir as shown in the accompanying figure. A ⅛-in. hole was drilled into the top of the pipe ¼ in. from the discharge end which projected about 1 in. into the tank. Care was taken to drill this hole normal to the axis of the pipe and to remove all burrs from the interior of the pipe so that the flow past the opening would be absolutely undisturbed. This hole was then connected with a ⅜-in. glass piezometer tube extending above the water surface. A small amount of colored oil was poured into the tube so that any difference in level between the liquid inside and outside the tube could be easily noted. Water was then discharged through the pipe into the reservoir with velocities ranging from slightly less than 7 ft. per sec. to about 16 ft. per sec. For these velocities the water level in the piezometer tube fell from about 1 in. to 5½ in. below the water surface in the reservoir. Higher velocities produced correspondingly greater depressions but it was impossible by the method used to measure velocities greater than 16 ft. per second.




Following are the tabulated results of the experiments:

| (1) Number of Experiment | (2) V Per Sec. Ft. | (3) Depression, Ft. | (4) $\frac{V^2}{2g}$ Ft. | (5) Lost Head, Ft. | (6) $\frac{f}{d}\frac{l}{d}\frac{V^2}{2g}$ (See Text), Ft. |
|---|---|---|---|---|---|
| 1 | 9 7 | 0 07 | 0 70 | 0 63 | 0 65 |
| 2 | 7 5 | 0 10 | 0 87 | 0 77 | 0 81 |
| 3 | 10 5 | 0 18 | 1 71 | 1 53 | 1 55 |
| 4 | 13 2 | 0 29 | 2 71 | 2 42 | 2 41 |
| 5 | 14 6 | 0 40 | 3 31 | 2 91 | 2 92 |
| 6 | 16 0 | 0 46 | 3 98 | 3 52 | 3 49 |

It is thus seen that for this range of velocities from 10 to 12 per cent of the velocity head is recovered. A curve of regained head plotted against velocity indicates that for higher velocities increasingly greater percentages are regained.

The practical significance of these results is that when a submerged pipe discharges into still water, as for example in the case of a water supply conduit connecting two reservoirs at different levels, the actual discharging capacity is somewhat greater than that obtained by computations based on the usual assumption that the hydraulic gradient drops only to the water surface in the lower reservoirs. This fact should be taken into consideration especially in connection with experiments to determine frictional losses in pipes since if it were neglected it is obvious that a set of values of "n" or "f" computed from experiments on relatively short pipes discharging under water would not agree with

results obtained from the same pipes discharging into the air.

These experiments controvert the commonly advanced theories which purport to show that the entire velocity head is lost at the outlet of a submerged pipe. These theories are set forth in various well known books on hydraulics and need not be repeated here. (Merriman's Hydraulics, p. 180; Hughes and Safford's Hydraulics, p. 294; Daugherty's Hydraulics, p. 100; et al.) The error in them arises from the assumption that a law of hydrostatics applies to a condition near the end of the pipe where the water is not at rest.

In 1911 and 1912 a series of experiments were conducted at the University of California by W. H. Archer to determine the losses that occur due to sudden enlargement in a pipe. (Trans. Am. Soc. C. E., Vol. 76, pp. 999-1026.) The velocities in the smaller pipe varied from 4 ft. to 32 ft. per sec. approximately, with a range in the diameter of pipes from 1 inch to 3 inches. As a result of these experiments Mr. Archer derived the formula, $h_L = 0.01705 (V_1 - V_2)^{1.919}$. By letting $V_2 = 0$ this formula reduces to $h_L = 0.01705 V^{1.919}$ which should give the loss upon discharge into a large reservoir. Substituting in this formula the experimental values of $V$ shown in Column 2 of the accompanying table the resulting values of $h_L$ are given in Column 6. Considering the fact that the formula was derived from the results of experiments on pipes having a maximum ratio of area of about 9 and is here applied to a case where this ratio is practically infinite the close agreement between the observed and computed values in Columns 5 and 6 is quite remarkable. The small differences are easily within the range of experimental error.

As a result of these experiments the writer believes that the formula proposed by Archer not only gives the correct loss that occurs in a pipe due to sudden enlargement but can also be properly applied to the extreme case of a pipe discharging into a reservoir. The writer would suggest that for practical use Archer's formulas might well be changed to $H_L = 0.017)\ V_1 - V_2)^{1.92}$ for finite enlargements of pipe and $H_L = 0.017\ V^{1.92}$ for discharge into a reservoir, since with this change the resulting error in $H_L$ will always be but a small fraction of 1 per cent for velocities up to 100 ft. per second.

## Cold Weather Records for Fourteen Decades

That there has been no permanent change in temperature since the Revolutionary War, so far as records kept in New Haven, Conn., are concerned, is the conclusion of Clarence J. Root, Meteorologist, U. S. Weather Bureau Office, Springfield, Ill., in a short article published in the *Monthly Weather Review* for January

| the Years | Mean Tempera- | For the 10 Years | Tempera |
|---|---|---|---|
| 1800 | | | 48.9 |
| 1820 | | | |

Weather Bureau, Washington, D. C.). Except for a few months in 1795, Mr. Root states that all available temperature records have been kept at New Haven since Feb., 1780. Up to 1872 the records were kept by various observers and since that date they have been kept by the U. S. Weather Bureau station at New Haven. Early averages in 10-year periods are given above.

# Elimination of Crawfish Borers in a Canal Bank

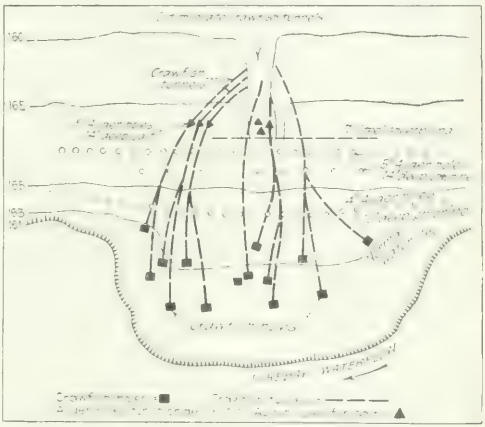
### Soil Impregnated with Chloride of Lime by Light Dynamite Charge in Holes Intercepting the Crawfish Tunnels

By Frank M. Nash

Superintendent, Buckhorn [illegible] Power & Light Co., Cotton, N. C.

SUCCESS in the extermination of crawfish in a canal bank has resulted from an experiment in impregnating the soil with chloride of lime and salt, thus solving the problem noted in *Engineering News-Record* of Aug. 19, 1920, p. 377. The embankment was built by the U. S. Government about 75 years ago and was acquired later by a local lighting company for use in a hydro-electric installation. It is parallel with and about 400 ft. from the Cape Fear River, and is about 7 ft. high with a top width of 10 ft.

A leak of 0.75 sec.-ft. or less had existed at one point for as far back as any records were available, and




PLAN LAID OUT FOR EXTERMINATING CRAWFISH

although the loss of the water was a small consideration there was danger of possible failure of the bank during high-water conditions. Crawfish holes under water on the canal side of the bank and the presence of large black crawfish in this particular section convicted the crawfish of causing the trouble. The crawfish tunnel openings on the forebay side (indicated by dots on the accompanying plan) have always been confined to a 30-ft. length of the bank and have seemed to converge in the one main outlet on the lower side of the bank.

At any time the leak could be checked and sometimes stopped entirely for a few days by lowering the water a few feet and puddling up the crawfish openings. Extensive earth filling in front of the leak would not stop it very long, as the crawfish would work through the fill. At some time in the past a row of 12-ft. tongued and grooved piling 2-in. thick was driven on the center of the bank, but this evidently secured only temporary results.

In October, 1920, a row of 12-ft. interlocking steel sheet piling was driven on the center line of the bank, directly in front of the leak outlet, for a length of 16 ft. (see plan). Each piece of piling was made up of

2- and 3-ft. lengths left over from another job and put together with iron plates and short bolts. This had no effect on the leak, but with the piling as a protection it was decided to explore the bank behind it. Beginning at the outlet of the leak, a trench was dug through the river side of the bank full 7 ft. deep, as shown. It was then found that some of the water was coming through the piling and some around it, but most of it was coming up from a deep hole that extended at least 2 ft. below the piling, or 14 ft. from the top of the bank. It then became evident that nothing short of a 50-ft. row of 20-ft. piling would cut off the leak. But at the same time it seemed reasonable to assume that if the crawfish would work down under the 12-ft. piling, they would also work under piling of a 20-ft. length.

A concrete mattress over the canal side of the infested section would not have prevented the pests from working around it. Methods used in exterminating crawfish on farmlands could not be used here, but on recommendation of the U. S. Biological Survey, it was decided to try impregnating the soil with enough chloride of lime to kill the fish. The difficulty lay in getting the lime down 16 ft. under ground and also in stopping the flow of water through the crawfish holes long enough for the lime to get in its work. To dig a trench 16 ft. deep and 40 or 50 ft. long was out of the question, so the following plan was carried out.

Water was lowered about 4 ft. in the forebay or until the leak stopped. With two post-hole augers (one 4-in. and one 5-in.) fitted with 16-ft. extension handles, 27 holes 14 ft. deep were sunk in front of the steel sheet piling, working from the center towards each end until no tunnels or soft places were encountered or until we got beyond the crawfish region. As each hole was sunk a quart of the lime was poured in and ½-stick of 40 per cent dynamite was fired by a 16-ft. electric fuse to scatter it and to intercept the tunnels. Each hole was then slowly filled and tamped with about 4 ft. of of dirt and another quart of lime and ½-stick of powder used in same way. A pint of lime was put in 5 ft. from the top and the hole tamped full of dirt. Thus the process consisted of laying a barrage of chloride of lime across the path of the crawfish, the charges being 2 ft. apart horizontally and about 4 ft. vertically and the earth being all packed and left free from tunnels across the barrage section.

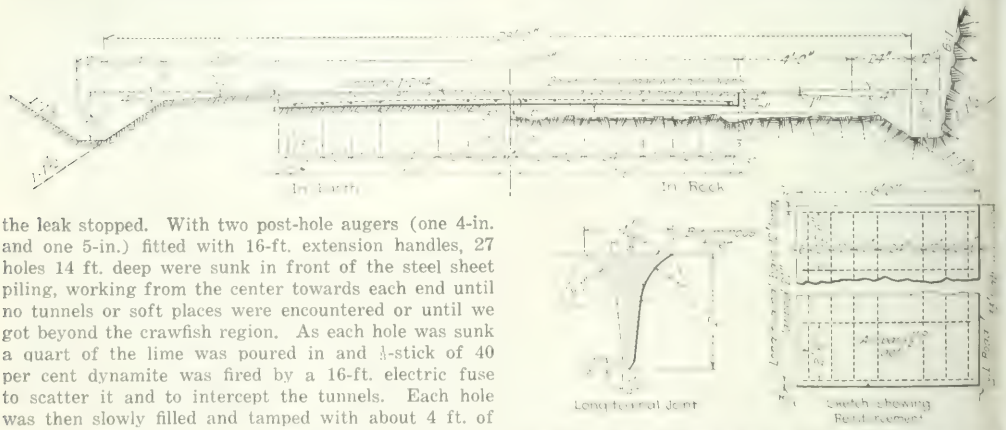
A second and shorter barrage was laid across the soft place some 3 ft. in front of the main barrage. A third barrage was laid in holes that normally were on the contour line of the water in the forebay. These holes were sunk only 8 to 10 ft. deep, as the former tests showed that the tunnels probably did not extend down more than 10 ft. so near the forebay. The lime was placed and scattered with dynamite in the same way. Water was encountered in all the holes in the infested area, but in most instances the digger worked right through, the soil being mostly of a heavy clay.

Finally, six holes were sunk directly into the main tunnels behind the steel piling, as indicated by triangles in the drawing; 50 lb. of common salt was put into each and the holes were tamped full of dirt. Then the experimental trench behind the steel piling was carefully tamped full of dirt and the embankment at this point brought up to grade. This work, done in November, 1920, stopped the leak and up to April, 1921, it had not reappeared. In the plan, the swing towards the forebay of contour lines 161 and 163 is due to some previous effort to stop the leak by filling in dirt.

The cost of the experiment was nominal. The 350-lb. drum of chloride of lime cost about $35 delivered; 50 sticks powder cost $4.50, and four days' labor for a crew of five men amounted to $65, or a total of approximately $100.

## Concrete Roads with Longitudinal Plane of Weakness

A 16-ft. concrete pavement, with a plane of weakness at the center and each half-slab separately reinforced, as shown by the accompanying cross section, has been constructed this season on 4,910 ft. of highway in Madison County, New York. The section is indicative of a movement in the design practice of the New York State Highway department toward a double-slab pavement structure. The feeling is that a pavement slab built a half at a time or, with a defined construction joint at the center, if constructed full width, has structural and construction advantages.

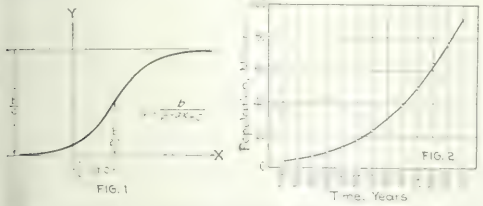



CONCRETE PAVEMENT WITH WEAKENED CENTER ZONE

In the slab section illustrated, a groove about one-third the depth of the slab is molded in the top along the center line and filled with bituminous filler. There is no reinforcement in the 6-in. center zone under this groove. A plane of weakness is thus established which it is expected will crack longitudinally and form virtually a two-slab pavement. The narrow slab structure is expected to have a decided tendency to reduce transverse cracking and to increase the durability of the pavement. L. D. Brownell, division engineer, is responsible for the design illustrated.

## National Population Growth Expressed by a Semi-Rational Formula

IN A STUDY of formulas expressing the population growth in an integral country or nation, Raymond Pearl and Lowell J. Reed of Johns Hopkins University have recently developed an interesting formula, defining a curve of the type sketched in Fig. 1. Fitting the formula to population statistics of the United States and other countries showed a remarkable agreement with the facts. The development of the new equation is set forth in a paper, "On the Rate of Growth of the Population of the United States Since 1790 and Its Mathematical Representation," published in the Proceedings of the National Academy of Sciences, June, 1920, pp. 275-288.




FIGS. 1 AND 2. FORM OF EQUATION OF POPULATION GROWTH AND APPLICATION TO UNITED STATES CENSUS FIGURES

Formulas previously proposed, generally of the exponential type, and a formula developed by the authors in which a logarithmic term was added to the exponential terms, have the peculiarity of indicating a continuous increase in population, regardless of the fact that the ability of a given geographical area to support population is limited. Thus, the equation of the type just mentioned, fitted to the population statistics of the United States from 1790 to 1920, would if extended to the year 3,000 give a value of 11,822,000,000 inhabitants, representing a population density of 6.2 persons per acre for the entire country.

The authors therefore adopted as a premise the condition that population has a maximum limit. Correspondingly they assumed that the rate of population increase at any particular time is proportional (1) to the total population at that time and (2) to the unutilized potentialities of population support existing within the area considered. Expressing these two assumptions in mathematical terms and integrating the rate of population increase, they obtained the formula

$$y = \frac{ke^{bx}}{1 + ce^{bx}}$$

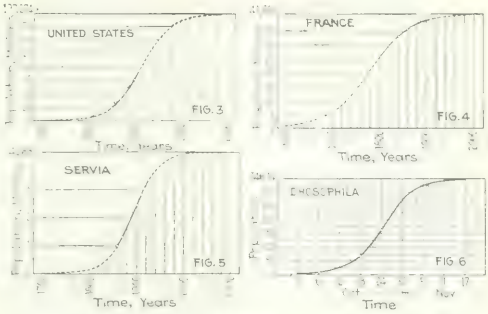
In Fig. 1, where this expression is plotted, the three constants are identified with particular dimensions of the curve.

In Fig. 2 this form of expression is fitted to the decennial population statistics of the United States from 1790 to 1910 by making it pass through the points for 1790, 1850, and 1910. The resulting formula, numerically, is

$$y = \frac{2{,}930.3009}{1 + e^{-0.03134\,(x - 1913.51)}}$$

which formula refers to an origin at the year 1780.

Using this formula, it is found that the upper limit of population, the upper asymptote in Fig. 1, has the value 197,274,000. It is also found that the point of inflection of the curve corresponds to April 1, 1914; in other words, at about 1914 the maximum rate of population increase in the United States had been reached, and the influences tending to retard population increase had begun to dominate over the stimulative ones.




FIGS. 3 TO 6. FOUR APPLICATIONS OF THE POPULATION GROWTH CURVE

While the authors claim that they "attach no particular significance to the numerical results" of the calculation, they do feel sufficient confidence in the method developed to assert that they "believe that the period of most rapid population growth was passed somewhere in the last decade." They point out that the maximum population stated represents a density of 66 per square mile, which is only one-tenth that of Belgium, but they apparently attach no importance to this comparison.

However, in view of the possibility that national population growth will not show entire symmetry above the point of inflection, as does the curve of Fig. 1, they are seeking for an improvement of the formula given, by which such lack of symmetry may be taken into account.

In Fig. 3 are shown three other population plots, together with that of the United States shown on a smaller scale than Fig. 2. The plots for France and for Serbia are considerably less regular than those for the United States, but the curve represented by the equation above given (with numerical constants suitably adjusted, for the several cases) is applied as shown. The fourth plot in Fig. 3 represents the growth of a fruit-fly (*drosophila*) population in a half-pint milk bottle, which, the authors suggest, follows the same general law of growth proportional to population and to unutilized resources.

### Qualifications of a Sewage Attendant

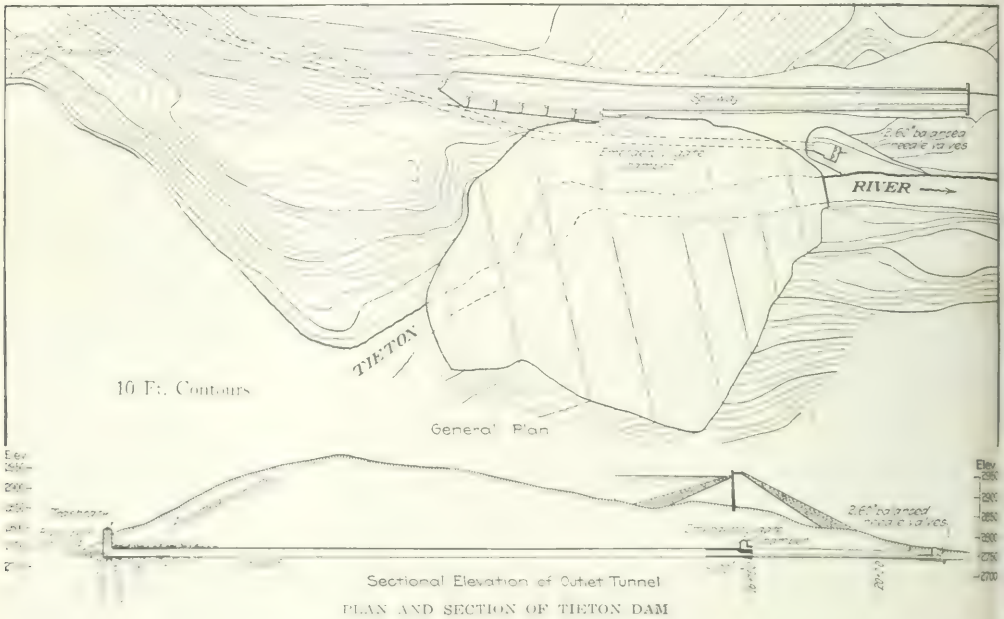
The most important detail in the application of chemicals and removal of sludge from the U. S. Naval Training Camp at Gulfport, Miss., was acquired when there was found and employed a negro who "hain't smelt nothin' for ten yeahs." He found it easiest to remove sludge by removing all clothing and getting down into the septic tank to do his shoveling. He was provided, says Lieut. Commander L. F. Bellinger in the November *Cornell Civil Engineer*, with a garden hose and nozzle for personal use.

# Reclamation Service Building Highest Earth Dam

## Tieton Dam To Be 232 Ft. High With Concrete Core Wall 100 Ft. Into Rock—Core Wall Built by Extraordinary Method

AN EARTH fill dam 232 ft. high—only 8 ft. below the projected height of the ill fated Calaveras dam which would have been the record structure of this type—is now under construction by the U. S. Reclamation Service on the Tieton River about 26 miles above Naches, Wash., as a part of the Yakima Project. Not only is it a record structure but the core wall, a concrete barrier 5 ft. thick extending 100 ft. below the river bed, is being built by sinking shafts to the full depth, running a cross tunnel and extending the wall upward by stoping

TIETON DAM SITE SHOWING PRESENT AND FUTURE CONDITIONS




PLAN AND SECTION OF TIETON DAM

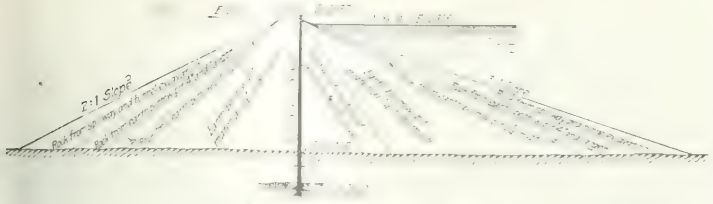
upward and concreting the successive lifts.

The Tieton Dam, as it is called, was started in 1917, but was closed down in 1918 on account of war conditions. Work has now been started again and will be carried through to completion. The dam consists of an earth embankment 232 ft. above the stream bed and 900 ft. long on top, heavily blanketed with rock as shown in the accompanying drawing, and with a concrete core wall approximately 330 ft. high. Its design and the present stage of construction was described as follows by F. T. Crowe, of the U. S. Reclamation Service, in the October *Reclamation Record*:

A diversion tunnel, 2,200 ft. long, is being excavated with a diameter of approximately 21 ft., which will carry the waters of the Tieton River during the construction of the dam and will be used as a portion of the outlet control system when the dam is completed. This tunnel is through a solid cliff of andesite rock, which is being drilled and shot by the top-heading and bench method, the muck being loaded into 4-yd. dump cars by a railroad type steam shovel remodeled with a short boom and A-frame and equipped with a 1-yd. bucket.

The corewall will consist of a concrete diaphragm com pletely crossing the canyon and tied well into bedrock o the base and sides. Below the ground surface it will b 5 ft. thick with no reinforcing. Above the ground surface i will taper to 1-ft. thickness at the top of the dam, b heavily reinforced and have no expansion joints. Th excavation and placing of this corewall below the groun surface is one of the features of work being done durin the present season. In the river bed it is necessary t excavate to a depth of 100 ft. to secure the proper founda tion. The excavation tapers on the east side of the canyo to 35 ft. in depth, whereas on the west side of the canyo the bedrock is exposed and will require simply the cuttin out of a key in the bedrock of about 5 ft. in depth.

The corewall base is being excavated by the stopin method. Three principal shafts are sunk to and into th bedrock. At the base of these shafts a large sump hol is constructed and pumps installed. Drifts 6 ft. high an 5 ft. wide are then driven in each direction along the lin of the corewall and into the bedrock a depth of not less tha 5 ft. and sometimes as high as 30 ft., depending upon th nature of the bedrock, so that the concrete will tie int good substantial foundation. After the lower drift is com pleted the second floor is excavated by dumping the materia

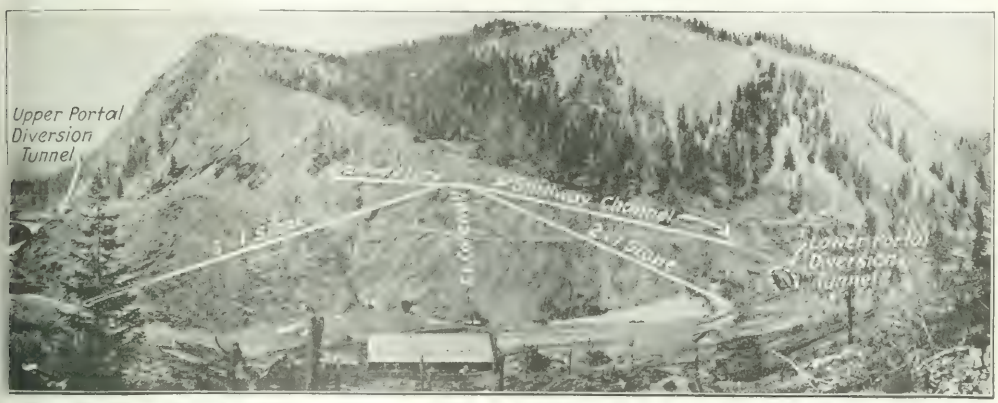


ELEVATION OF TIETON DAM

A spillway will be built in the rock cliff on the west side of the canyon. It will have an overflow lip 420 ft. long equipped with six drum gates of the Arrowrock type, 65 ft. long and 8 ft. high. The Spillway will have a capacity, under normal conditions, of 30,000 sec. ft. with a capacity of 50,000 sec. ft. before the dam would be overtopped. It will discharge through a concrete conduit down the side of the cliff to a pool well below the toe of the dam. The final design of the outlet control works of the dam has not been completed. It is proposed to have outlets to control the water at three stages so that the gates will never have to operate under a greater head than 80 ft. These outlets will each have a capacity of 2,500 sec. ft., the maximum irrigation demand.

It is estimated that the completed reservoir, including the

through the roof of the first floor into mining cars, which are run to the shafts, caged, brought to the surface and dumped. Thus the material above the lower drifts is never touched with a shovel. It is simply picked or shot down and trapped into the cars. After two floors have been excavated the lower floor is filled with concrete from cars running on the completed second floor. The third floor is then excavated, the second floor filled with concrete and




WEST ABUTMENT SHOWING DIVERSION TUNNEL AND SPILLWAY LOCATIONS

similar operation followed out until the ground surface is eached.

Considerable loose and swelling ground is being encountered, together with large quantities of water, making he work very difficult in the section immediately below the iver. However, the method is working out very satisactorily and is the only one thought practicable, considering the deep excavations required and the nature of the naterials encountered, as it would be almost impossible o shore an open trench to such extreme depths.

The embankment will be a hydraulic fill blanketed with ock. It will have a 1 on 3 slope on the upstream side, 5-ft. top width, and a 1 on 2 slope on the downstream ide. It is proposed to convey the material for the embankment to the outer slopes of the dam by cars from borrow its (both above and below the dam) in which shovels will e operated. A 100-ton electric shovel on crawling treads s being purchased for operation in the borrow pit above he dam and a railroad type shovel operated by air will be sed in the borrow pit below the dam. Eight 16-ton steam ocomotives will be provided with 75, 4-yd., 36-in. gage dump ars. The tracks from these borrow pits will be brought to he slopes of the dam over trestles at intervals in elevation f about 30 ft. The material will be dumped from these restles and washed by hydraulic giants to a center pool. This pool will be confined entirely to the section immediately above the corewall. The idea being to place all the tight naterial available above the core and have the core supported on the downstream side by heavy material that will drain out readily. From careful analysis of material available we find 20 per cent will pass the 80 mesh. This is very well graded to very fine clay. Fifty per cent passes the ¼-in. screen and is held on the 80 mesh. Thirty per cent varies from 1¼ in. gravel to large rocks and boulders.

roads, right-of-way and clearing will cost approximately $5,000,000 and will be completed in the fall of 1924. For this fiscal year $675,000 is available.

Electric power for the construction of Tieton Dam is supplied from a hydro-electric plant located three-fourths miles downstream from the dam site. Water is supplied to the plant by means of a wooden flume 8 ft. wide and 6 ft. deep, diverting from the river just below the dam site and running along the river bank for a distance of 4,400 ft. to a forebay and spillway also of timber construction. From the forebay water is supplied to the turbines through two penstocks each 250 ft. long. The penstocks are wood stave pipes 48 in. in diameter supported on timber saddles above ground. Stave timber is untreated douglas fir. Two hundred second-feet of water is supplied to the turbines at a working head of 75 ft.

The work is under the general supervision of the U. S. Reclamation Service of which A. P. Davis is director and F. E. Weymouth is chief engineer. F. T. Crowe is construction engineer in local charge of the job.

## Philadelphia Municipal Bonds Bring Premium

The highest all-or-none bid for about $12,660,000 of Philadelphia 5½ per cent municipal bonds on Oct. 28 was at a premium of 3.399 per cent, from a syndicate headed by the National City Co., New York City. Two other all-or-none bids were at premiums of 2.7312 and 2.58. In all there were about fifty bids, for varying amounts, totaling $40,000,000. Of the $12,660,000 of bonds offered, about two-thirds will run from 20 to 50 years and one-third for 15 years.

# A British View of American Highway Practice

## Our Vehicle Weights Regarded as Light—Bituminous Surfacing for Worn Concrete Roads Suggested—Highway Research Commended

By A. Dryland
County Engineer — Middlesex, England

*To the Editor of "Engineering News-Record":*

SIR—When I was with you in New York in September I promised to give you some account of my impressions of American roads and cognate subjects, but since my return I have been hard pressed with official work and demands from English papers to which I was previously committed, and have not found a favorable opportunity to write to you.

Thanks to your kind assistance in arranging and facilitating my tour I was able to spend a most interesting and instructive 25 days in the states of New York, New Jersey, Maryland, Pennsylvania, Ohio, Illinois, Michigan and Wisconsin. I saw a great deal of your fine cities of New York, Washington, Harrisburg, Cleveland, Detroit, Chicago, Springfield, Ill., and Milwaukee, which I made my resting places, but not nearly so much as I should have liked had time permitted. I spent altogether 33 days in Canada and in the States, during which period I traveled some 4,500 miles by railroad and 2,500 by road. I feel that I am entitled to say that I "sampled" your Eastern states, although I fully realize that with so vast an area it is only possible to "sample," but as I was on the roads practically all of each day, doing my railway journeys mostly by night, I made the best possible use of my available time.

Many American highway engineers had the pleasure of meeting Mr. Dryland during his month's inspection of road-building methods in this country last summer. Before returning to England he was induced by the Editor of "Engineering News-Record" to record his impressions of our practice; his views are set forth in the highly interesting notes published herewith.

Coming from a veteran of 40 years' experience in the road-building field in England, and a past-president of the County Surveyors Society, Mr. Dryland's appraisal of some of the features of the work he saw in the United States is entitled to great weight. Readers of this article will find it worth while to refer to the biographical sketch of Mr. Dryland, which appeared in the Sept. 8th issue of this journal, p. 423.—*Editor.*

When one has seen so much that is interesting and new it is difficult to crystallize, but as you desired that I would be frank in recording my impressions, and free in offering criticisms I will endeavor to do so under the following heads:

*Traffic*—The large number of motor vehicles to be seen in and around your cities was very striking and far exceeded numerically anything we have here. The great difference between your traffic and ours is in heavy motors, of which you have comparatively few. In Britain the number of "heavy" motor cars registered (i.e., cars weighing more than 4,480 lb. unladen) is almost exactly identical with those registered as "light" motor cars, which include motor cycles, of which latter there is a large proportion. As most of the heavies will be in daily use for business purposes while the light cars and cycles are often only in use at weekends, it is common to see more heavy than light vehicles on our roads. Some of your road engineers seemed to think they had large numbers of the heavy type to contend with, but I had to tell them their troubles were only beginning and were comparatively unappreciable at present. It may be that owing to wider spread of population and larger distances between urban areas this kind of traffic will not develop to the same extent as with us; if it does, your roadmakers are up against a much more serious problem than they have yet had to face.

We have a good many traction engines drawing three trailers constituting a gross loaded weight sometimes of as much as 55 tons, also steam tractors drawing one steel-wheeled truck, gross weight 15 tons, many steam wagons drawing trailers aggregating a similar weight, and huge numbers of motor lorries and buses, charabancs and delivery vans linking up the towns and villages throughout the country, substituting road for rail delivery of all kinds of goods except for long journeys.

Another feature which impressed me was the superior tire equipment of many of your motors by means of the giant pneumatic which has so far, I regret to say, hardly put in an appearance here. Your vehicles in every class are of lighter construction than ours, a very favorable feature from the roadmaker's point of view. Bearing all these differences in mind I came to the conclusion that in the nature of traffic your road engineers' lot is an enviable one.

Perhaps I might be permitted to say a word here on traffic regulation. On your country roads your vehicles keep their proper sides far better than with us, where the driver of the heavy vehicle is much inclined to take the center of the road if he can, and keep it, being resolutely deaf to the hootings of speedier cars desiring to pass. In your cities, as with us, the street railways contribute largely to congestion of traffic by a practical monopoly of so large a proportion of the width. Your regulation that no other vehicle shall pass a standing street car appeared to me to exaggerate the obstruction. Here we have no such regulation, and motor drivers carefully thread their way when cars are being discharged and so often avoid a stop. I believe the accidents from this practice are extremely few, as car passengers keep a good lookout and regulate their escape to the footway accordingly.

*Highway Development*—In this country roads were the means of communication for at least a century before railways were thought of and naturally there is a great difference on your side where the railway largely preceded development. Here a complete network of more or less heavily metalled highways permeated to

every part of the country, and practically every rural highway for nearly a century has been surfaced with macadam, and probably for the last 30 years has been steam-rolled. When I penetrated your rural areas and found many highways with only mother earth to carry the traffic the difference was naturally striking. Here we have a primary monetary advantage in having a foundation which we can strengthen and build upon at comparatively small cost; on the other hand your side has the opportunity of putting in a more perfect foundation designed with a fuller knowledge of probable future requirements.

"Some of your road engineers seemed to think that they had large numbers of the heavy type [of motor vehicles] to contend with, but I had to tell them their troubles were only beginning."

*Concrete Roads*—The circumstances referred to in the paragraph above account very largely for the development of this form of construction on your continent. If we today were constructing a new road to carry heavy modern traffic the first consideration would be a firm foundation, and concrete would seem to offer the best solution. That is the line I have myself taken in the construction of new arterial roads passing through the County of Middlesex to the boundaries of the County of London, and, following your practice, I propose to utilize that foundation to carry the traffic so long as it will do so without serious detriment to its use as an ultimate foundation.

That is my view of the probable evolution of the concrete road in this country for the kind of traffic to which I have alluded. It is, I know, contrary to the view held by many of your eminent highway engineers, but not by all. You have out-and-out advocates of the concrete surfaced road as *the* solution of the highway problem, and if your traffic continued to be of the same weight and character as rules today, they may be justified. I saw many hundreds of miles of concrete surfaced road of varying ages in the States rendering admirable service and giving promise of several years further durability. I saw also some earlier constructed lengths which gave evidence of having nearly reached the end of their tether as a surface. Where that is the case I think your problem is to decide whether you will reface with concrete or adopt something of a more resilient character. My own view is that you will eventually find it desirable to take the latter course. In saying that I do not question the wisdom or economy of the course your engineers have pursued in adopting concrete in the first instance; on the contrary, I think they have been absolutely right in doing so. I sincerely hope the out-and-out concrete men will prove right and that concrete surfaces will meet your requirements for an indefinite period, but frankly, "I ha'e ma doubts," as my Scotch friends would say.

In the case of old concrete roads requiring repairs Mr. Dryland says: "Your problem is to decide whether you will reface with concrete or adopt something of a more resilient character. My own view is that you will eventually find it desirable to take the latter course."

The carefulness with which your road engineers deal with concrete road construction, and the organization for speed of laying are, I think, admirable. I found the concrete roads most excellent for speedy travel and to me their general appearance was pleasing, although marred by the unsightliness of joints and cracks which, however, where kept filled, did not affect smooth travel or lead to any serious deterioration. I gave a great deal of attention to the phenomena of cracks, and came to the conclusion that they were almost entirely due to physical causes, such as subsidence or upheaval of subsoil and effects of temperature changes, which are very extensive on your side of the water compared with those experienced here. The investigations your engineers have made into shrinkage and swelling of subsoils due to variations of moisture content are most valuable, and the data already obtained are, I think, quite sufficient to warrant my conclusion that the defects found in concrete roads arise almost entirely from elemental forces. Those which do arise from traffic are being provided against in the later methods of construction by greater thickness of concrete or by steel reinforcement.

*City Pavements*—In this country Baltic or Swedish fir is our favorite and most general "big city" pavement, with granite setts a bad second and asphalt third. Judging by what I saw of your big cities the positions there are exactly reversed, asphalt being largely in the ascendent as a city pavement, and generally, I thought, it was excellent and more free from waves or ripples than ours, notwithstanding your greater range of temperatures. Probably the comparative lightness of your traffic units and the greater resiliency of your tires, accounts in a large measure for this lesser amount of distortion. I also think your asphalt is "harder" than ours, which accounts for the cracks you have, a feature almost unknown here, but the less plastic nature of your mixtures renders it less liable to surface distortion. There must be a happy medium which will neither crack nor push, and I know many of your asphalt experts are experimenting in that direction.

I saw a great deal of stone-filled asphalt pavements both in cities and in their environs, much of it excellent, but some a good deal distorted. On similar roads in this country we have used tar macadam with great success, using mainly as aggregate blast-furnace slag. Here we have had a large, although insufficient, supply of excellent slag; but possibly your blasting processes do not produce slag of the same excellence, for what I saw was light and much honeycombed.

Brick pavements, I observed, are much used in the environs of large cities and in the smaller urban areas, and struck me as having a pleasing appearance and affording quite good traveling surfaces. But where a brick pavement was cement-grouted, and thus rendered practically monolithic, it was subject to a good deal of cracking due to elemental forces and leading to unsightliness and deterioration. An elastic joint filler would, I think, be a great advantage.

*Road Engineers*—I left your country with a large measure of admiration for the men in all ranks to whom you have entrusted your great task of providing a complete system of good highways for your huge country. Your system of training is quite different to ours and I think has great advantages, although we do manage to evolve a quite useful type by our more haphazard

methods. Here our youths serve a period of pupilage, generally of three years' duration, with a practicing engineer, after which they graduate by a series of assistantships and eventually compete, after experience has been so gained, for chief appointments. Most of them study for and pass examinations held by our Institution of Civil Engineers, or the Institution of Municipal and County Engineers, or both. Some few take a course of general engineering at our universities, but this is a comparatively modern development, and so far, unfortunately, we have no chair of highway engineering at any of our universities. While the practical training and experience they gain in our method is valuable, I and many other English engineers think it would be of great advantage in mastering more thoroughly the theory, at any rate, of the profession, if our men had opportunities of university education such as yours enjoy.

I had the privilege of meeting a great number of your engineers and was greatly impressed by the thoroughness and attention to detail they gave to both the theoretical and practical side of their work, while their organization for supervision and testing was of the most complete character. I envied your state bureaus for testing and investigation, a most necessary and desirable feature of organization which is almost entirely neglected in this country, where it is most difficult to convince the public of the value of scientific investigation and research.

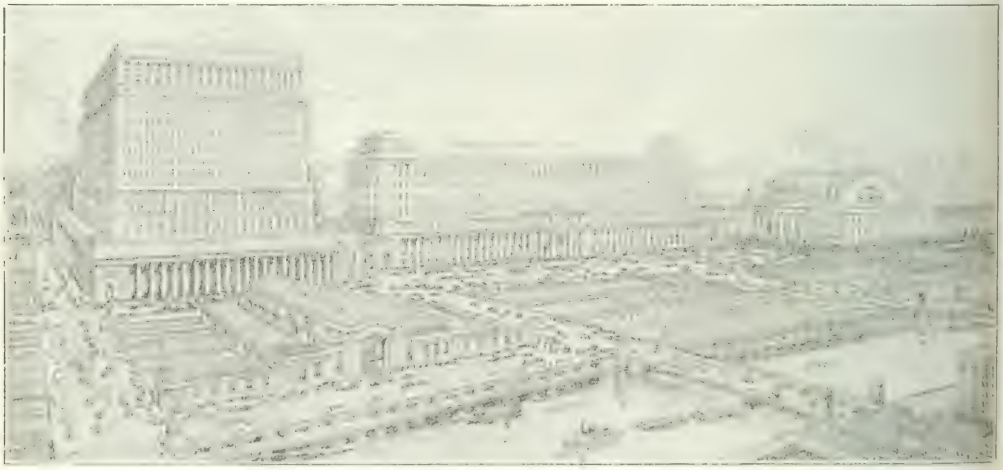
While it is almost invidious to particularize, having experienced such universal kindness, hospitality, and assistance, from everybody in Canada and the United States connected with highway administration, I would like the privilege of your columns to publicly acknowledge and thank them. I had the pleasure and advantage of conferring with the engineers of the Federal Government of the United States and of the state administrators and engineers of New York, New Jersey, Maryland, Pennsylvania, Ohio, Michigan, Illinois and Wisconsin, the engineers of Baltimore, Washington and Chicago, the professors of highway engineering at Maryland and Michigan Universities, and the engineers of the Dominion of Canada, and of the Province of Ontario, and the city engineer of Montreal. Many engineers connected with portland cement and asphalt associations were also of great assistance to me in my investigations. From every source, public and private, information and help was ungrudgingly afforded in the kindest and most complete manner and I owe one and all, both chiefs and staff, a debt of gratitude.

Last, but by no means, least, am I indebted to you for all the trouble you took to render my visit informative and pleasant, in which your Chicago colleague also rendered most valuable assistance. It was my first trip to the Western Continent; it has been a most pleasant and educative experience from beginning to end, and I shall always look back upon it with pleasure, not only for the privilege of viewing the splendid way in which your engineers appear to have tackled the great problems so large and varied a country offers for solution, but with deep gratitude for the universal kindness with which I was received and entertained wherever it was my good fortune to travel.

## New Chicago Union Station Center of Attractive Group

### Architectural Treatment of Station with Office Building Above—Concourse Separates Two Stub Track Terminals

CHICAGO's great union station as it will appear when completed, together with its immediate surroundings, is shown by the accompanying reproduction of a drawing prepared by the architects. Work on various parts of the project, including extensive street alterations and viaduct approaches to the river bridges, has been in progress for the past few years, but the headhouse and station proper have not yet been built. The station is of twin or double-end design, with a transverse concourse between two sets of stub tracks for the railways entering from the north and south respectively, with common facilities for handling passengers and baggage.



CHICAGO'S NEW UNION STATION AND ITS SURROUNDINGS AS SHOWN IN THE ARCHITECTS' PERSPECTIVE

At the left is shown the new headhouse, occupying an entire city block and surmounted by a 20-story office building in order to utilize the air rights for revenue purposes and thus assist in financing the project. This is a revision of the original design, which provided a relatively low building for railway purposes exclusively. In front of the headhouse are the roof and entrances of the transverse concourse, with a river front street on an arcaded portion of the station. In the two blocks north of the station (to the right in the sketch) is the low roof of the trainshed. Behind this is shown the proposed new U. S. Post Office and Federal Building, two blocks in length. This structure has been designed and located as part of the Chicago City Plan, but it has not yet been approved by the Federal Government. Further to the north is the passenger terminal station of the Chicago & Northwestern Ry., which has been in service for some years.

### Station Facilities

South of the concourse will be another low-roof trainshed. Beyond this will be the U. S. Railway Mail Terminal, which is now under construction. Other new railway structures in the vicinity are the freight station and office building of the Chicago & Alton Ry. (*Engineering News-Record*, Oct. 14, 1920, pp. 728 and 732), the freight station and warehouse built by the Pennsylvania R.R. a few years ago, and the freight station of the Chicago, Burlington & Quincy R.R., of which the foundations have been built.

At the new union station and its approaches the tracks have been depressed to about 4 ft. above water level in the river, and streets have been raised and widened to provide adequate approaches. In the south trainshed will be 14 tracks and in the north trainshed 10 tracks, all arranged singly and separated by platforms, alternate platforms being assigned for handling baggage and being connected by inclines with the baggage room under the concourse. A trainshed approximately 25 ft. high will cover the tracks and platforms.

In the headhouse, connected with the station proper by passages beneath Canal St., will be such main facilities as the waiting room, ticket offices, baggage rooms, restaurants and cabstand. Carriages and cars will use inclines from the Clinton St. entrances to the cabstand at track or concourse level. Baggage wagons will use the same entrances and driveways but will proceed by a second incline to a yard about 400 ft. long serving the large baggage room under the concourse. The exterior of the headhouse, office building and concourse entrances will be of buff stone.

This great station, which will supersede the present old and inadequate Union Station, is being built by the Chicago Union Station Co. of which J. D'Esposito is chief engineer and A. J. Hammond is assistant chief engineer. The architects are Graham, Anderson, Probst & White, of Chicago.

## Laboratory Car For Brick Kiln Tests

Arrangements have been made, in connection with the co-operative agreement between the associations of brick manufacturrs and the Bureau of Mines, to fit up a laboratory car which will be used in testing kilns at brick works. This will make possible a more expeditious handling of this phase of the work and will permit its being done in a thorough manner.

## National Help Only to Ports Encouraging American Ships

IN a paper entitled "The Importance of Port Facilities in the Development of a Merchant Marine and Commerce," read before the recent meeting of the Society of Naval Architects and Marine Engineers, Rear-Admiral H. H. Rousseau, Civil Engineer Corps, U. S. Navy, advocated national aid only to such ports as encourage American ships. Among other things he said: "With the existing fierce competition between ports, both for business and for appropriations from the national treasury for the further improvement thereof, it would seem to be proper and consistent that Congress should now give definite notice that hereafter preference will be given in making any appropriations for harbor improvements to those ports that show themselves most interested and most successful in carrying out our national policy that the greater part of our foreign commerce shall be carried in American vessels. Compliance with any such policy by a port, or the giving of satisfactory guarantees to fulfill any conditions like this, could be best undertaken by an organized and unified port authority, and the matter of efficient organization is perhaps our ports' greatest need today. . . . Such an act of Congress relative to water terminals and vesting the Secretary of War with discretion to delay or suspend expenditures for the improvement of any port unless at least 50 per cent of the gross tonnage of vessels engaged in foreign commerce entering and clearing from that port is American tonnage, or until satisfactory assurances are received that that percentage will be secured within a reasonable time and will be thereafter maintained, would instantly broaden competition between our ports beyond the present mere unorganized scramble for business on the part of individual carriers and other interests, and would initiate a competition that would bring concrete results in promoting steps to obtain a unified port authority and in assisting our merchant marine to get much needed cargo, as well as passenger business, that at present is going to foreign vessels. . . Should Congress also direct the Interstate Commerce Commission to exercise its rate-making power so as to give due preference and assistance to those ports where at least 50 per cent of the gross tonnage of vessels engaged in foreign commerce, using that port, is American tonnage, the effect would be striking in enabling our merchant vessels to cope more successfully with foreign competition."

## Wisconsin Builds 2,552 Miles Road in 1921

Construction of roads of all kinds in Wisconsin this season will surpass in mileage any previous year. According to the quarterly report of A. R. Hirst, state highway engineer, 90 per cent of the 349.25 miles of concrete planned was completed by Oct. 1 and practically all of the remaining mileage will be completed this fall. Of the total mileage 105 miles only was Federal Aid. Other types of road constructed are as follows: Gravel, 1,036.9 miles; top soil, 84 miles; earth, 1,009.6 miles; bituminous, macadam, shade and asphalt, 72 miles. By gang maintenance 949 miles were graded; 129 miles, graded and graveled; 115 miles, resurfaced only and 11 miles covered with top soil only. A condition survey of the entire trunk highway system has been undertaken, giving the type and condition of the surfacing as of Nov. 1.

# An American Engineer's Impressions of Industrial Russia

## Intensive Nationalization Coupled with Greed and Executive Impotence Has Destroyed Economic Stability —Industry Ruined by Lack of Production and Misdirected Effort

By Royal R. Keely,
Consulting Management Engineer, New York City

*MANY reports concerning chaotic conditions in all industry, and of the failure of Sovietism as there applied, have come out of Russia. Some of them have been based upon fragmentary knowledge and others doubtless have been intentionally prejudicial. However, the opinion is generally held that Russia today is in the worst condition economically and industrially. This opinion is confirmed by the following article by Mr. Keely.*

*Mr. Keely is a graduate of Cornell University and a member of the American Society of Mechanical Engineers. He has been professor of engineering, served four years with the Westinghouse companies, was four years manager of the Edmonton, Alta., Can., Municipal Industries—designing, building and operating—and for the past ten years has been a consultant in industrial economics, organization and management. Desirous of studying industrial conditions in Russia, Mr. Keely went there in 1919. A year later he was thrown into prison when he was about to return to America, and was released after a year's confinement upon the demand of the American Relief Association.*—EDITOR.

AS a consultant in industrial economics in America my chief interest has been the labor problem. I had long wished to see how labor acted under Bolshevism, to study Russian industrial conditions and to appraise the prospect of resumption in trade relations between this country and Russia. Accordingly I sought out Lomonosoff, a special commissioner of the Soviet government in the United States, and my suggestion that I visit Russia was welcomed enthusiastically. We sailed from New York May 24, 1919, and after many difficulties and delays crossed the border and into Russia Sept. 12 of the same year, arriving in Moscow six days later.

### Entertained Then Imprisoned

For eight months I was given every opportunity to travel about and to study the industrial and economic situation. As long as the Bolsheviki thought there was a possibility of my becoming permanently enlisted in their cause everything that this poverty-striken country could provide was lavished upon me—secretaries, a special car on the railway, the finest hotel accommodations, and food from the Kremil, the stronghold of the Bolsheviki. After having studied conditions in many regions, and after having had numerous interviews with Lenin and other high officers of Soviet Russia, I decided to return to America. Therefore, by May, 1920, all permits and documents had been signed, countersigned and red stamped, and I left Moscow. On May 12 at the border in Yambourg I was seized, five minutes before the train was ready to cross the border, and taken back to Moscow under armed guard and thrown into the Bouterki prison—the Sing Sing of Russia. No official warrant for my arrest was presented nor were there any explanations, charges, hearing, trial, or sentence.

After suffering for a year all the insults and deprivations which they could inflict I was brought with much solemnity into their highest tribunal, and after a few days was sentenced to two years in a concentration camp, sentence dating from the day of arrest. Evidence against me was produced from letters and memoranda written to my relatives in New York. Thus the action of the Bolsheviki in throwing one about to leave the country into prison characterizes the desire of Bolshevik Russia to keep from the rest of the world news of the abject failure of Soviet principles as applied there.

In my sentence I was said to be a spy, that I had collected news of the economic and industrial situation for the American capitalistic press, and that therefore I should be sentenced to two years in prison. A few days later after another solemn court procedure my sentence was changed to two years of compulsory work. That was on May 24, 1921, exactly two years after my departure from New York. Before my compulsory work began there came an order for my freedom and permit to leave Russia due to the demands of the American Relief Association.

### General Impressions

My general impressions of Russia are that (1) it is inhumanly autocratic; (2) that the attempted nationalization of all activities has resulted in the operation of industry—an operation which has steadily diminished—for the benefit of a very few; (3) that nationalization of industry as applied there has been a dismal failure; (4) and that there appears to be in Russia a general belief that Sovietism cannot long survive.

No monarchy was more autocratic than is Soviet Russia. On entering the country one of the first things to attract my attention was the censorship. The government receives in its own hands all foreign news as well as that of local and internal affairs. There is no free press and the Bolsheviki give out such matter as they choose through their two dailies. Most of the leading papers from other nations are received in the foreign office, but they are not for the general public. Of late this censorship has broken down to some extent because of foreign commissions which have uncensored mail privileges and through courier service. The entrance of the American Relief Association has also opened the way for more freedom in communication.

Few in the outside world can realize that in Russia today there is a more strict and destructive autocratic power than has ever existed. Freedom of speech is unknown. Freedom of the press is a joke. Let me quote Lenin's own words, "We have arrived at autocracy and the object of the Communist International is a struggle with force of arms for the suppression of the international bourgeoise and creation of an international Soviet republic as a transition stage for the complete depression of the state. The victory is incomplete until every part of Europe is revolutionized. In the autocracy of the chiefs of communism and the communist domination of the people lies the pledge of our success. There can be no liberty or democracy, but there must be submission to the armed vanguard of the proletariat."

I had several conversations with Lenin. When I first arrived in Moscow Lomonosoff took me to see him. In order to enter the Kremil and Lenin's private sanctum we required special passes which were carefully scrutinized by some ten or fifteen armed guards at various stages of our path of entrance. His outer office was filled with stenographers and clerks and his own office was a large, well-lighted room on the top floor of a six-story building. It was finely furnished and much like an American business man's office. Lenin impressed me as an impractical idealist,

who was to a large extent shut off from the work of the world, and the difficulties and privations of his people, and who had little experience or ability in directing the organization and reconstruction of such a great nation. He was surrounded by men, who, like himself, perhaps, may have been revolutionists, but who had no executive ability for directing the enormous task which they had taken upon themselves.

Lenin repeated to me the invitation of Lomonosoff that I go into all the factories and see the actual conditions and study the psychology of the working force. In return for this freedom he asked me to give him reports on anything I saw which was not in accordance with American practice.

### Other Prominent Soviet Leaders

Trotsky, the other leader of the cause of freedom and liberty for the worker says: "All artisans will be sent into the world and transferred from one place to another according to the indications of the government. We will have no pity for the peasants; we will make labor armies of them, with military discipline and communists as their labor chiefs. The masses of the workmen should be moved about, ordered and sent from place to place in exactly the same manner as soldiers."

The most competent two men among all the high government officials are Krassin, formerly head of the Railway Department and now head of the Department of Foreign Trade, and Ludwig C. A. K. Martens, both said to be Germans, of German origin, German tendencies and German sympathies. Martens was formerly an envoy of the Soviet government in the United States but was deported last year. Before going to Russia Martens, then in New York, had approved Lomonosoff's invitation to me to visit Russia.

The autocracy of Bolshevism is further evidenced by a description of the Soviet government operation. Everything is in the hands of the government, including the entire means of production and ways of communication. It controls all ammunition and arms and enough communist officers to control the soldiers. The agents of Bolshevism enter all buildings at will. They censor the mail and allow no private telegrams. They own the press and publish only what is good propaganda. No private meetings are allowed. All other political parties are suppressed with an iron hand, the leaders are imprisoned and the members scattered and cut off from communication with one another. The All-Russian Commission for the Suppression of Counter Revolution is a great octopus drunk with its power, always robbing, imprisoning and murdering those who oppose its will.

In Russia people are loaded down with documents—an official passport, a compulsory labor book, permits for food and food cards, permits for a place to live, permits to ride on the street car (one to say you are permitted to ride and a second to say you are the person named in the first.) If a trip on a railroad is contemplated five or six or seven documents are required, signed, countersigned, and red stamped, which require from one to two weeks to secure.

Lists are constantly being circulated demanding the full history of each individual. In reply to the question as to political affiliation the usual reply is "non-partisan," for if a signified allegiance to any other party is noted it would lead to persecution and possibly to imprisonment.

The prisons are filled with those who have asserted themselves or in some manner expressed their individuality. They come from all over Russia and the personnel is constantly changing. The foreigners, however, have it far easier than the average Russian, for few of them have been shot while the native is in constant danger.

One of the few things in which Bolshevism has proven successful is that it has destroyed all opposition to its operation.

Despite the fact that Soviet Russia is presumed to be a community wherein equality of interests obtains, the government as operated is decidedly for the benefit of the few.

The central Moscow government has some twenty departments, including the departments of war, state, national economy, etc. The centralized organization plan calls for executive control centering in Moscow. In the matter of production management, for instance, each factory is supposed to have its production manager, supervised by production managers for the city, the government and the whole of Russia. The same applies for all other departments of manufacture, such as accounting, stores, etc.

The function of the Supreme Council of National Economy is to operate, manage and control the entire means of production and communication. Under its control are all factories, railways, telegraphs and telephones. As subdivisions of this council are the departments of railways, metals, automobiles, etc. In Moscow for the machinery of the government alone there were about 230,000 employees getting an average wage of 40,000 to 50,000 rubles monthly although a few get much more. It is interesting to note that in this workers' republic, with equality for all and special privilege for none, 10,000 of these employees are classed, as responsible employees, that is, those who are faithful, loyal servants to the Bolsheviki and who get special food allowances and better wages. The Bolsheviki do not object to a mass of weak, starved, resistless working force as long as they can dominate and control it. That is the object of the 10,000 faithful followers who are better fed, clothed and provided for.

In contradistinction to the mass of small-salaried employees is that of one of the employees of the metals department of which Martens is the head. He is Marten's chief assistant and is a Finnish engineer. He draws about 400,000 rubles monthly together with small quantities of food, clothing and fuel. Even then the members of his family complain that they live only with the greatest difficulty and by drawing on private means. Characteristic of the difficulties which even the better than average government employee has in getting along is the experience of the foreman of the Russian American Tool Co., whom I found one Sunday morning cooking a meal. The previous day he had secured his monthly allowance of a few pounds of meat and a few vegetables and he was preparing them all for a feast. He told me that he had sold all his personal belongings, had no bread, so he had invited some of his friends to bring bread and have dinner. He was cooking his monthly rations at one time and he and his friends would eat it and of the future, well—that was another matter. As to the average employee the great question is to understand how he lives. The great mass of them is always hungry.

The communist theory of economic control is in itself quite ideal but its success presupposes the support of 180,000,000 honest and efficient Russians, all working for the public good and not for private gain. But all who know Russia know how impossible of realization is this prerequisite.

### Factory Production Low

Beside their success in destroying and suppressing all opposition the Bolsheviki have succeeded in bringing down every one to the level of the lowest in pre-revolutionary times and in destroying all the wealth of Russia. Factory production is painfully low. Fine, large, and expensive automatic machines developed in the United States are standing idle for want of competent workmen. I believe there can be no appreciable production in Russia for years to come and the reason is clear: A painful shortage of materials, fuel, transport, trained workmen, clothing and food. Practically all industry is stagnant and what little individual and collective initiative is apparent from time to time is not directed toward activities that will result in economic readjustment. I made trips to Petrograd, Siberia, and many districts in the vicinity of both Petrograd and Moscow and found all industries on an extremely low-production basis and with lower morale. There is no incentive for the workmen. They have no wish to work and the hard conditions make any appreciable physical exertion impossible.

The Bolsheviki wished to have me act as an intermediary in securing American capital for Russian development. As a result I spent three or four weeks in conferences with expert specialists in the "Concessions Department" of the Supreme

Council of National Economy of which Rikoff is the head. With these specialists I went over the details of Russia's natural wealth—the forests of the north, the Don coal fields in the south, the great Kuznetskie coal fields in Siberia, irrigation in Turkestan, water power around Petrograd and in the south, and the Volga-Donn ship canal.

Finally, Rikoff said it was "not enough for you to see the reports and talk with the specialists, you must see these things for yourself." Though transportation is lacking for the ordinary human, for favored individuals it is available. Accordingly, Rikoff sent me to the railway department where I learned instructions had been given to give me the best train Russia could provide, consisting of a new locomotive, American coal cars with coal enough for the round trip, international pullman cars for myself and staff of experts, dining car, food and three train crews for 24-hour operation of the train, and an automobile for side trips.

Trips which I took included that to the Kuznetskie coal basin half way across Siberia, and to irrigation projects in Russian Turkestan. Upon activity in either of these places must depend the development of a market and with industry, the economical foundation and civilization of Russia destroyed as it is, there can be no excuse for such ventures from Americans. I can conceive of no capitalist investing his money so as to put it at the mercy of this robber band.

### One Industry Escapes Nationalization

Of all the industries of Russia I found just one that had never been nationalized, in other words, one of which the owners had not been robbed by the aid of the automatic and the machine gun. This was the plant of the International Harvester Co. of America. The distinctive feature of the factory was that the old manager was left in control and was allowed to manage as best he could under the tremendous difficulty of government control of all labor, fuel, food, clothing, raw material, etc., without means of allotting an adequate supply. The manager, who is of German education and training, has succeeded in maintaining technical control of the plant and while his production was infinitesimally small it was not so bad as compared with other Russian plants.

The industrial situation is fairly well characterized in a letter which I wrote to Lenin in December, 1919, in which I said, "The red army has won at the expense of the industries—the bone and sinew of our modern life. The result is almost complete exhaustion of the ways of communication and production. Most of your men in power in the industries are without experience or technical education. It is hard for me to see how it is possible for them to succeed."

One is surprised by the almost complete absence of traffic on the railroads, both passenger and freight. The commerce of the nation is dead. All the business houses of the cities are closed, except the very small ones that have opened recently. Pavements and sidewalks are in great need of repair. Machinery and equipment are in bad condition and are getting worse daily.

Characteristic of factory production in Russia is that of the Amo automobile factory in Moscow built by private capital by special encouragement from the old government. It is a fine factory with a complete equipment of the best American machinery. There the Bolsheviki have a chance to succeed in factory organization and production except that Russia does not need automobiles as badly as it needs simple farm machinery, clothing, fuel and general household supplies. But Bolshevism will always waste much of its time on some fantastic whim rather than on practical necessity.

### Futility of Bolshevist Endeavor

For full operation the factory would require about 6,000 men. At the time of my personal acquaintance with it, it had about 1,000 men and only two or three skilled mechanics. There was no raw material and very little fuel. A very little repair work was being done. The old government had bought a lot of light trucks for the war. As they were disabled they were sent to the factory, dismantled and the good parts assembled into good trucks again. After a while, however, they ran short of motor parts and had some ninety bodies without motors. They decided to build a motor. They worked all winter trying to get one good motor cylinder casting. They failed every time partly because of lack of skill and partly because of the absence of proper material. The manager at that time was a rather able Russian engineer who was hindered, however, on one side by a management committee of ignorant workmen who had authority over him. He had no power to hire, discharge, or discipline, without their consent. On the other hand he was given conflicting orders from the automobile building department in Moscow, the automobile repair department, the food operating department, the food repair department and the army repair and operating department. All his holidays were spent in hard physical work with a gang of men about the factory on the theory that all should be made to do some physical work.

Bolshevist Russia is visionary, impractical. Former professors, engineers, factory managers, railroad directors—able, honest, and energetic men—I found occupying themselves in electrification schemes, electric plows, electric transmission of power from coal fields, redistribution of the manufacturing industries according to an ideal plan, and writing treatises on such subjects as the automatic coupler for railway cars and elaborately-worked out plans of standardization. When the elaborate plan was made the problem was 99 per cent solved and nobody worried about its realization in practical everyday life.

All over Russia the fuel oil, coke, coal and gas burning furnaces, as well as locomotives, have been converted for wood burning. In the International Harvester plant there was not room for the larger wood-burning furnaces and the change would have completely upset the old arrangement and factory production system. The management insisted upon having coal and coke. Rikoff said, "We are unable to get coal and coke for you, but we think you can. We will give you trains and help and you can try for yourself." So in the spring of 1920 the manager's men made up a train carrying mine props and ran it to the coal basin in Ukrainia with red soldiers as guards and workmen. The trip was not successful.

### The Fever of Locomotive Repair

One day I suggested to Lenin that the fundamental step in betterment should be locomotive repair. That, like electrification later, became a slogan of the administration. An order was issued that locomotives requiring repairs should be taken into all factories and that for every locomotive repaired the crew of workmen should receive a bonus in Soviet cash and be permitted to take the locomotive for a trip into the country and bring food for themselves.

As a result there was the strange spectacle of locomotive repairing shoved into all kinds of plants where previously there had been no spur tracks, no pits, and no proper equipment for skilled workmen. At the same time all the locomotive building and repair plants of Russia were standing practically idle. In the sight of the bonus and the trip to the country the locomotives got only a "lick and a promise" with the further advantage to the workers that they were soon back for a further bonus and another trip to the country.

Finally, one finds everywhere men even in high government offices who have no faith whatever in the ultimate ability of communism to cope with the economic situation. During the last month of my stay I was surprised at the openness of the criticism and expressions of discontent among not only workmen, peasants, and office workers, but also among high officials. In a talk with Martens' chief assistant, his secretary and an able engineer, he said; "When you first came to Russia there was still some hope of saving the industries or some remnant of them, but now it is absolutely lost and we must begin over from the beginning." To hear such statements from prisoners or from open revolutionaries would not be surprising, but from such high officials it sets one thinking, so say the least. In a trip through the Amo automobile factory with Martens I suggested that the building was new and of the finest and completely equipped with the best American machine tools. He replied, "Yes, but dead, absolutely dead."

Krassin, at the time I saw him Commissar of the De-

partment of Ways and Communication, was endeavoring to keep the railroads running though conditions in railway shops, locomotive and car shops, were little better than elsewhere. One day I was talking with one of the former railroad managers about Persia. I remarked that it was to me strange that Persia, a land bigger than the German empire, had no railroads. "Yes," he said, "but here in Russia there is one-sixth of the world's land area with no railroads but we are accustomed to them and feel their loss. Our industrial and economic life is built around our transport and without it we are paralyzed." Krassin saw and understood the situation yet he continued to support his Bolsheviki. It can only be assumed he has other motives. First, it gives him power, which he likes, and a good position, and second, he is in a position to direct the affairs of Russia into German hands. Of one thing I am sure—he is no Bolshevist. He is in the game, like most of the other, for the power and influence which it brings. He is a business man and an executive. Before the revolution he was manager of the big German Siemens-Halske factories in Russia employing 40,000 men.

### Political Division of Russia

For my purpose I divide the population of Soviet Russia into five classes. The first class consists of the political idealist whom you could count on the fingers of your two hands. The second numbers a few thousand bold, unscrupulous, unprincipled bandits who are ruling with an iron hand and riding down all opposition. In these two groups are not over ten men who dominate all and wield the power and shape the policy of the whole mass. The third is composed of the balance of the Bolshevist party and numbers 90 per cent of its entire membership, or say 450,000. They are in the party because they are forced to be there by economic reasons. The fourth class is composed of the former wealthy people, the educated class, the artists and scientists and the politicians other than Bolsheviki. These the Bolsheviki are trying to exterminate. The fifth class is composed of the peasants and numbers more than 90 per cent of the Russian population. They are in general non-political, but at the same time are decidedly against the Bolsheviki. But they are an easy-going, gentle, non-resistant folk and the Bolsheviki have no trouble in dominating them.

I am convinced that Bolshevism must fail, first, because it has no inherent virtue or strength in it. There has been no benefit (except to the few hundred commissars and leaders referred to) to anyone. It has brought to all the people the greatest suffering and hardship with no compensation or prospect of anything better. Second, it has destroyed or is destroying the last remnant of Russia's past civilization. This destruction must go on until the end of the present regime. The first step toward reconstruction can come only with the end of Bolshevism. The Bolsheviki have not the executive ability, the technical skill, or the stability of character to enable them to turn the tide of retrogression. Third, public sentiment is decidedly against them. Nobody, not even the Bolshevist leaders, believes they can succeed. Everyone thinks that anything done on this economic foundation will be wasted effort and therefore no one makes the slightest effort at real conscientious work in support of the existing system.

The moral foundation of the present generation is also undermined. The failure of the educational system lies in bringing no preparation for future work, and therefore most people think it will be two generations before much progress can be made.

Private business has no foundation on which to build. But with a new stabilized government credit might be established and means of transportation rehabilitated which would make possible the opening of the coal and iron mines and the purchase of necessary manufacturing products. In the reconstruction Germany must take a direct hand as she needs Russia's raw material and has the technical and executive ability to carry out the reconstruction plans. America must have a large part in the financing and supplying of the necessary material. I hope to see worked out some plan by which the technical and executive ability of the Germans can be joined with American capital to the advantage of all countries concerned.

## Triangulating Under Difficulties

By Herbert N. Bradstreet
U. S. Mineral Surveyor, Mesa, Ariz.

IN SUBDIVIDING the Hualpai Indian Reservation, whose northern boundary is the Grand Canyon of the Colorado, much difficulty was experienced in setting section and quarter-section posts because of tributary canyons, as high as 2,500 ft. and with almost perpendicular walls. As descent into these canyons was possible in only a few places, it was found necessary to survey the section lines to the edges of the canyons, flag the points and pick them up from the bottom of the canyons. The survey was further complicated by the General Land Office regulations which provide that no section is surveyed in its entirety unless the four mile corners and the four half-mile corners are set, or unless a witness corner for each missing corner is established within prescribed distances.

As a result of these conditions, the party in the canyons developed ability to scale anything but a vertical wall. Many a corner was triangulated into an almost inaccessible position and there established. To expedite these triangulations, the transitman developed a modification of the usual methods of triangulation which saved much time. Instead of occupying his instrument point until the flagman went ahead, lining him in, and then measuring a base and setting up at the other end, he sent his flagman ahead to a point approximately on line, going himself meanwhile with the chainmen to a point from which they could chain to the flagman. By the time the flagman had reached the objective point, the transitman had determined a meridian from solar observation and read the bearing back to the triangulation point, and was ready to read the bearing to the flagman. While the chainmen were chaining to the flagman, the transitman went to the flagman, set up his instrument and read the bearing back to the triangulation point. When the chainmen came up with the distance, it only remained to compute the length of the line triangulated, and to determine its latitude and departure. If the flagman was off line, a short move in one direction or the other put them back on line.

While this method is not particularly accurate, it will give results well within the 1 in 640 limit required by regulations. It saves the time which is usually lost while the flagman goes ahead; it eliminates all backtracking, and keeps the party together. Furthermore it eliminates all possibility of measuring a base and finding upon setting up at the other end, that the objective point is invisible.

## Allowable Salinity in Water Supplies

In a paper discussing salinity in irrigation and potable water supplies, read before the San Francisco Section, Am. Soc. C. E., T. H. Means made the following comment on the allowable salinity:

The amount of salt which is safe in a domestic water supply is variable. What would be regarded as too salty in Massachusetts would be considered excellent water in Arizona. While no exact limits can be set it may be said that with one thousand parts per million, water must be used with caution and when two thousand parts per million are present there is great danger of damage to the crop and the soil. Pure ocean water contains 3½ per cent salt or 35,000 parts per million. A mixture of one part ocean water with one hundred parts fresh water would make a domestic supply questionable, while for irrigation purposes the mixture might be as strong as one to twenty for short periods.

# New York City's Largest Pier Project Near Completion

## Stapleton, Staten Island, Development Involved Huge Construction Program—Good Progress Record Despite Difficulty in Materials Delivery—Methods Employed in Piledriving and Concreting

A STEAMSHIP pier development at Stapleton, Staten Island—the largest yet undertaken by New York City—work on the twelve piers of which commenced in May, 1920, is nearing completion. The development was described in *Engineering News-Record*, May 27, 1920, p. 1047, when it was noted that this was not only New York City's largest pier project to date, but also the first time that the city had undertaken a project on the west side of the harbor with direct rail connection by the railroads from New Jersey. The work that has gone forward in the past sixteen months involved a huge construction program, carried out with a good progress record despite the difficulty

AIRPLANE VIEW OF NEW YORK CITY'S PIER DEVELOPMENT AT STAPLETON, STATEN ISLAND

in securing the delivery of materials during the early stages of the work. The twelve piers are each some 1,100 ft. in length and vary in width from 125 to 209 ft., with 300-ft. slips, and with one- and two-story sheds. Two of the piers—of 209-ft. width and two-story shed—are designed with double marginal tracks and half gantry cranes along each side.

Work on all twelve of the piers was started in May, 1920, under contract by six companies with the New York City Department of Docks. Last April work started on the construction of the sheds under contract with two firms. The Terry & Tench Co., Inc., general contractors, New York City, built piers Nos. 6 to 11, inclusive, and Smith, Hauser and MacIsaac, Inc., built the two large piers Nos. 12 and 13. Other piers were under contract as follows: Pier 15 by George B. Shearin, Inc., work completed Feb. 20, 1921; pier 16 by Snare & Triest Co., completed May 14, 1921; pier 17, Barth S. Cronin Co., completed May 14, 1921; and pier 18 by Phoenix Construction Co., completed July 1, 1921. Smith, Hauser & MacIsaac completed work on the two large piers last September, and the Terry & Tench Co. completed their contract on piers 6 to 11 last May. Work is still in progress, completing construction of the sheds on several of the piers.

At present the two tracks of the Baltimore & Ohio R.R. parallel the shore back of the bulkhead line of the new piers. The new bulkhead was established 100 to 400 ft. from the old shore line. The intervening area is now being filled in to provide for track connections and warehouse development. By connection with the Baltimore & Ohio R.R. over the Arthur Kill, access is had to all of the railroads entering the port from the New Jersey side. Following announcement of plans for the piers there was considerable public criticism of the design with particular respect to pier width and freight-handling machinery. The City of New York takes the position that under existing legal limitations the type of pier, the shed, and the handling equipment must be suited to the lessees previous to the final adoption of the design. In each case these general requirements were determined in advance by the firms leasing the piers.

*Terry & Tench Contract.*—The contract for the six piers by Terry & Tench was signed early in 1920. The piers were about 1,100 ft. long by 125 ft. wide, with 3,000 lin.ft. of bulkhead. In spite of the fact that orders for piles and timber were immediately placed for the earliest possible delivery, congestion on the railroads delayed the commencement of the work until May 5, 1920, when piledriving was started, and then only by getting a small supply of spruce and oak piles locally, although it was originally planned to put six piledrivers on the work. Work was accordingly started with two piledrivers, three derrick boats, one shop scow fitted up as a machine and blacksmith shop, a gasoline tug, and several scows for transporting materials. Later on, as materials began to arrive in quantities, derrick boats and additional piledrivers were added until five were working, the maximum number used. It was originally intended to have practically all materials lightered to the site, but this plan had to be abandoned at the outset on account of congestion in the Jersey City freight terminals. A spur track from the Staten Island Rapid Transit Ry. was constructed, starting at a point opposite pier 10 and paralleling the bulkhead for 1,000 ft., provided with a 300-ft. passing track. It was not until October, 1920, when the railroad situation had improved and the coal trade had released a large number of barges, that it was possible to get enough piles to keep five drivers working. From this time on work was pushed to capacity.

The following quantities of materials are a striking indication of the size of this contract. For the six piers there were required 24,000 piles of 40 to 89-ft. length, 4,000 M.ft.b.m. of timber, 612 tons of fastenings, 26,000 cu.yd. of concrete, and 1,243 tons of reinforcing steel. For the bulkhead there were required 7,000 piles of 45 to 50-ft. length, 1,000 M.ft.b.m. of timber, 105 tons of fastenings, 3,600 yd. of concrete, and 29,000 cu.yd. of riprap. Piledriving was started May 5, 1920, and finished May 12, 1921. Concreting was started Nov. 8, 1920, and finished May 19, 1921, with an interval of one idle month on account of gravel pits being closed. In October, November and

December, 1920, 12,000 piles were driven with five machines.

In order to command the siding and the catamarans in front of the bulkhead, piles delivered by rail were unloaded by two 10-ton stiff-leg derricks at this point, so that piles could be sorted and placed on the catamarans with a minimum of handling. Piles received on barges were unloaded to catamarans direct and sorted later with floating derricks. The offices, storehouses and power plant were established back of the old bulkhead and adjacent to the siding between piers 10 and 11. All fastenings, castings, small lumber, etc., were delivered at this point by trucks or rail, and then handled on small scows to different parts of the work as required. The power plant for pneumatic tools and machinery consisted of two steam driven compressors of 300 cu.ft. per minute capacity and two electrically driven compressors of 600 ft. capacity.

ONE OF THE TWO LARGEST PIERS UNDER CONSTRUCTION. PIER 12 UNDER CONTRACT WITH SMITH, HAUSER & MACISAAC DURING EARLY STAGES OF WORK

To fulfill specifications for pile bearing, it was found necessary to lag about 2,800 of the long piles with 5 x 6-in. timbers bolted on to the lower 30 ft. This work was done mostly on the piers where the concrete deck had been placed, and partly on the bank at one of the unloading derricks.

The new bulkhead on the Terry & Tench contract was located for the most part 100 to 300 ft. off shore. Access to the piers was provided by driving two-pile bents spaced about 18 ft. apart and located about 50 ft. inshore from the new bulkhead location, carrying a boardwalk and pipe lines, and also serving to anchor booms for forming temporary storage of timber. This temporary construction paralleled the location of the new bulkhead for the entire length of the work. Connections between this walk and the piers were made by float stages. Two lines of 3-in. pipe were run on each pier for air and water from the main line that paralleled the bulkhead.

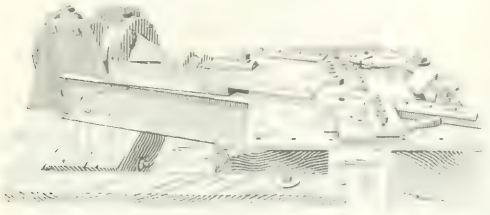
For framing and handling the timber a derrick boat was fitted up with a band saw and a 5-ton derrick, located in the basin inside the boom where the timber was stored. All the timber required for framing was handled by this scow to the saw and then placed in rafts to be towed to different piers. Each of the 12 x 12-in. pile caps had four half splices from 4 ft. to 6 ft. long. The side caps had 4-ft. chip splices. All of this framing was done by the band saw which saved a great deal of labor beside the material sawed out for the splices being made available for scabs, fillers, etc. Since there were over 3,000 splices, with 18-ft. b.m. saved in each, a total saving of over 50,000 ft. b.m. of timber was accomplished. The pile caps were made up into three units, the center section consisting of a 10 x 12-in. timber, 36 ft. long with a 6-ft. half splice on each end. The side sections were about 53 ft. long with a corresponding half splice on one end. These sections were composed of two and sometimes three pieces of timber butted together and spliced with 6 x 12-in. scabs. The splicing of these sections was done in the framing scow and the sections placed in rafts and towed to various points on the work.

The work of placing forms and reinforcing for concrete was on such a large scale as to require standardization of various stages of the work. The forms for the 10-in. deck slabs were made up in panels of 2 ft. 8 in. wide by 9, 12, and 14-ft. long, of 1¾-in. lumber dressed to 1⅝ in. The panels were supported by joists 2 x 8 in. x 9 ft. resting on 2 x 3 strips secured to the sides of the cross-caps by lag screws. A pneumatic wood-boring machine with a suitable socket wrench was used for placing and removing the lag screws. On the entire job some thirty-five pneumatic wood-boring machines were in use at one time in connection with concrete formwork and boring for fastenings in pier construction.

Of the 1,243 tons of reinforcing bars used, about 1,100 tons of ⅝-in. square bars, totaling 79,000 pieces, required bending to the same shape. Two special machines were designed for doing this work, a sketch of one of which appears herewith. They consisted of a 10-in. hydraulic cylinder bolted between two channels about 6 ft. long to the lower flanges of which a 1-in. plate 36 x 36 in. was riveted. To the piston rod was bolted a ¾-in. plate shaped to suit the bend to be made and moved between two guides riveted to the plate. To form a 3-in. hook on the end of bars a heavy bell-crank was secured to the 1-in. plate, one end of which was engaged by the piston at about half stroke. At the end of the stroke the side of the bell crank in contact with the bar was forced around to a position at right angles to the long axis. The machines were operated by compressed air at 90 lb. per sq.in. pressure. They were located on the edge of the bulkhead within reach of one of the unloading derricks. Two machines and three helpers would bend from 1,000 to 1,400 bars in eight hours.

A floating concrete plant built on a derrick boat 30 x 110 ft. was used to give ready access as a large unit to all parts of the work. The plant was equipped with a 75-ft. boom handled by an independent swinging engine and side guys operated by a two-drum hoisting

engine. The plant is shown in the photograph herewith, with the placement of concrete and reinforcement by slabs in the foreground. At the forward end of the boat the 50-ft. wooden tower with a 30-cu.ft. capacity hopper at the top was provided. It was equipped with a 50-ft. steel boom and 48 ft. of standard chute with a 32-ft. counterweight chute. The tower elevator bucket, serving the hopper, was operated by a



HYDRAULIC CYLINDER IMPROVISED TO BEND STEEL REINFORCEMENT

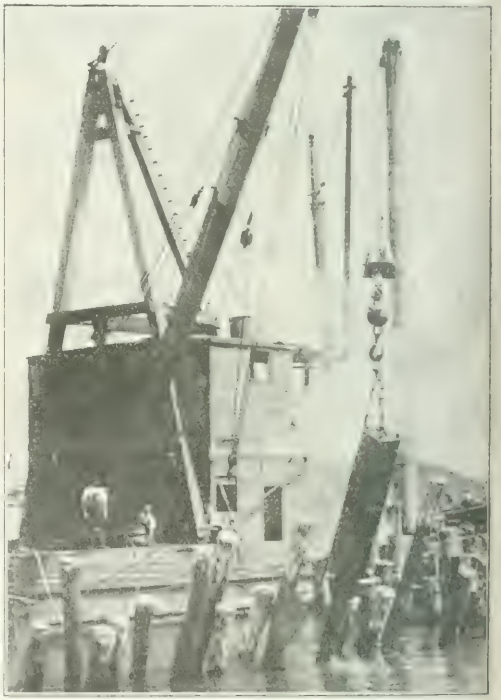
steam hoist. A 1-cu.yd. mixer was placed directly behind the tower. The deck of the scow under the tower was cut out to allow the bucket to be lowered so that its top was even with the deck. The mixer was set on the deck and dumped directly into the bucket. A 25-cu.yd. bin supplied gravel to the mixer. At the elevation of the top of the batch-hopper of the mixer, the mixing floor was laid across the entire width of the scow, and over the area occupied by the mixer and bin, roofed over at the elevation at the top of the bin to provide a large room in which enough cement was stored to tide over any contingencies in handling. Ready-mixed sand and gravel was used on the work. All materials were delivered by scow. A cement scow with a capacity of 8,000 bags was always kept loaded, to take care of any delays in delivery of cement.

In operation the floating concrete plant was placed head on to the side of the pier, with a gravel barge on the one side and cement barge on the other. The gravel was delivered to the bin by the clam-shell bucket, and the cement through an opening in the roof to the mixing floor by the derricks on the cement barge. The mixer was run at 20 r.p.m., resulting in a capacity of sixty batches an hour, frequently attained for each of the 8 hr. of the working day.

All of the 2,200 brace or batter piles in the piers and bulkhead were driven with a McKiernan-Terry No. 9-B steam hammer, swung from the falls of a derrick boat, as indicated in one of the photographs. The hammer was swung on a suitable bridle so that it hung at the same angle as the brace pile and was fitted with a sleeve of 16-in. diameter pipe 4 ft. long, acting as a lead. From twenty to thirty piles would be loaded on the deck of the derrick boat and these set at the proper angle for driving. The hammer was then placed on the pile, which was guided by guy ropes from the derrick scow. From fifteen to twenty-five piles were driven in 8 hr. with this rig and a crew of seven men. The maximum driven in one day was eighty-eight, which had been previously placed for driving. When the derrick boat was not engaged in driving batter piles, it was available for other purposes. By the use of this method it was unnecessary to take a regular piledriver off the work on bearing piles, where they were used exclusively.

*Smith, Hauser & MacIsaac Contract.*—Heavy concreting and footing work was involved in the construction of piers 12 and 13 by Smith, Hauser & MacIsaac. These piers, the two largest of the Stapleton development, while presenting no unusual difficulties in construction, were delayed in their completion, as was the Terry & Tench contract, by the inability of the contractors to obtain materials, principally piling and timber, due to railroad embargoes and congestion. A general view of the early stages of the work on pier 12 is shown in an accompanying photograph.

As the delivery of materials by the railroad improved, more piledrivers and larger framing crews were put to work and at the peak close to 500 dockbuilders and piledriver men were employed. The piledriving at the inshore end and along the line of the bulkhead wall was quite hard, and piles of 45 to 50-ft. lengths were sufficient. As the work progressed, longer piles became necessary until at 600 ft. from the bulkhead line piles of 90-ft. length were used, and at 650 ft. even a 90-ft. plain pile would not drive according to specifications. Therefore, lagging was resorted to. The lagging of piles with as little handling as possible was successfully met



BATTER PILES DRIVEN BY STEAM HAMMER HAMMER GUIDED BY 16-IN. PIPE SLEEVE AND PILE HELD IN POSITION BY ROPE GUYS

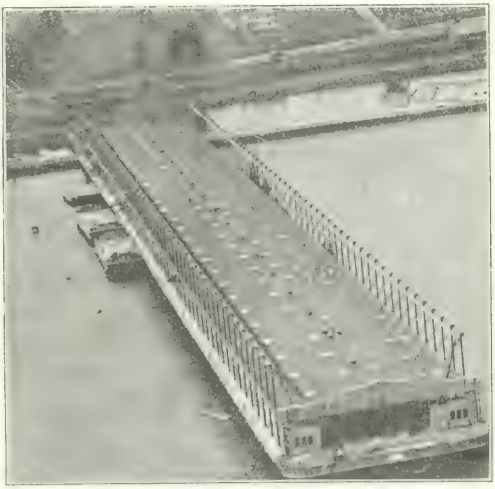
by building two lagging platforms across the caps of completed bents with the inshore end of pier 12. Along the track deck at the south side of the pier, a temporary track was laid, which supplied lagging lumber and bolts to the platforms. A floating derrick at each platform handled the piles from and to catamarans, which were then sent to the drivers. The

lagging consisted of two sticks of 5x6 timber 30 ft. long applied at the tip end of the half lagged piles and four sticks of the same length for a full lagged pile. Timber was fastened to the piles with 1-in. bolts. Before this type of lagging was adopted, several other types were tried and test piles driven proved conclusively the superiority of the type used, in the opinion of the contractors and the dock department.

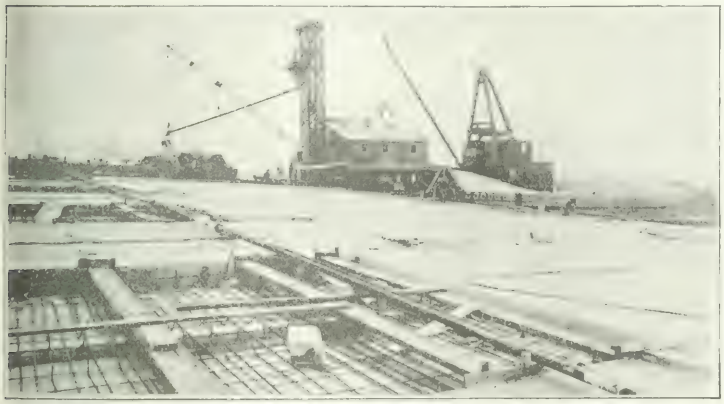
The timber work closely followed the piledriving and little trouble was experienced. Electric drills were used at first, but did not prove entirely satisfactory to the contractors since the light drills appeared to lack power and the more powerful types were too heavy for easy handling. Electric drills, however, were used with great satisfaction at the lagging platforms, and pneumatic drills on the construction.

The material was unloaded by locomotive crane, and piled in stock piles in the yard behind the piers. As materials were needed on the work, they were loaded on deck scows and distributed. Handling materials by hand was eliminated in so far as possible, resulting in a large saving to the contractor.

In October, 1920, concreting operations were started and carried on through the winter months to February, 1921, being resumed in March and carried to completion in June, 1921. All of the concrete was placed by a floating plant similar to that used on the Terry & Tench contract, with a 60-ft. steel tower and chutes, bins for storage of materials which were discharged directly into a 1-cu. yd. mixer. Premixed sand and gravel was loaded into the storage hoppers from scows by the derrick in the stern of the concrete scow and cement was unloaded from barges by common labor. The limited length of the tower and the short chute section used made it impossible to pour more than halfway across the pier, and the mixer then moved around to the other side to complete each section. The column footings were poured first, and were kept well in advance of the slab form work. The slab forms were supported on 3x3x¼ in. angles fastened to the caps with 4-in. lag screws 24 in. on center. The forms were built up in panels with 1x8-in. battens to hold them together. The beams were not fastened to the panels but were set on the angles on 20-in. centers for the main slab and 16-in. centers for the track slab. The slab panels were then laid on the beams and only fastened sufficiently to hold them in place. All work on the substructure of these piers was completed in July and turned over to the Department of Docks of the City of New York during August.



PHOTOGRAPH FROM HARBOR SIDE SHOWS SHED NEARING COMPLETION



FLOATING CONCRETE PLANT IN OPERATION, SAND AND GRAVEL SCOW ALONGSIDE FLOOR OF [illegible] AND POURING BY SLAB SECTIONS SHOWN IN FOREGROUND

Work is now in progress completing the building of the pier sheds. The Snare & Triest Co. have the contract for the sheds of piers 15 and 16 and the sheds for piers 17 and 18 and being built by the McHarg H. Barton Co.

The work was carried out under the direction of Murray Hulbert, commissioner of docks, New York City, and under the immediate direction of T. F. Keller, chief engineer of the Department of Docks.

## Motor Vehicles on Farms

The number of farms which had automobiles on Jan. 1, 1920, according to a recent announcement of the Bureau of the Census, Department of Commerce, was 1,979,504, or 30.7 per cent of all farms in the United States. These farms reported a total of 2,146,512 automobiles on the census date. The following states reported more than 100,000 automobiles on farms in 1920: Iowa, 177,558; Illinois, 139,090; Ohio, 128,384; Kansas, 111,055; Minnesota, 107,824; Texas, 105,292; Nebraska, 104,453; and Indiana, 102,122. Motor trucks were reported on 131,551 farms in 1920, or about 2 farms out of every 100 in the United States as a whole. The number of motor trucks on these farms was 139,105

# Sanitary Engineering Problems and Progress

Abstracts of Papers, Reports and Discussions at the A. P. H. A. Meeting and the Am. Soc. C. E. Sanitation Conference, New York City, Nov. 14 to 18

*Some forty papers and reports were presented and discussed during the fiftieth annual convention of the American Public Health Association, Nov.* 14 *to* 18, *and the conference on Sanitation Problems held by the American Society of Civil Engineers the same week, both as reported in our issue of Nov.* 24, *p.* 869. *Abstracts, necessarily brief, follow. The first paper, by George W. Fuller, was presented before one of the general sessions of the A. P. H. A. The papers grouped under "Stream Pollution and Sewage Disposal," "Odors and Their Travel Habits" and "Water Supply and Water Purification," were read at the Am. Soc. C. E. Conference. The other papers and reports dealing with water, sewage, sanitary control of bathing places, milk pasteurization, mosquito extermination and health aspects of zoning, were presented to the Sanitary Engineering Section of the American Public Health Association.*

## Fifty Years of Sanitary Engineering

By George W. Fuller
Consulting Engineer, New York City

Fifty Years Ago sanitary engineering in this country scarcely existed, even in name. The larger cities were provided with public water supplies and there was a general desire among sanitarians to supply water free from filth. Sewers in combination with storm-water drains had been built in the larger communities to a limited extent for several decades. The germ theory of disease had not been established. The laboratory man spoke of chemical tests in terms unappreciated by the engineer and of comparatively little aid to him. Bacteriology had not sprung into being. In brief, the history of the past 50 years tells practically all of the substantial accomplishments of the sanitary engineer in advancing the public health movement on this continent.

### Water Supply and Water Purification

In 1870 most American water supplies were muddy, colored, polluted and frequently objectionable as to tastes and odors. Typhoid fever death rates were high. The laboratory men were studying hardness, lead-poisoning and methods of measuring dead organic matter in water. The art of filtration was practically unknown in this country, except in so far as efforts to get clear water in European cities had been revealed by the classical publication of Kirkwood.

Today there are more than 800 filter plants in operation in this country and Canada, serving more than 20,000,000 of people, or more than one-third of the population resident in cities and towns. In scores of cases heavily polluted sources of supply have been abandoned in favor of new and comparatively unpolluted sources.

Typhoid fever annual death rates of representative cities on this continent ranged, 20 years ago, from about 15 to 50 per hundred thousand population. In a number of large and well known cities these figures reached 75 to 100 or more. Today the death rates have dropped in many of those same cities, largely as a result of preventing or removing the pollution of public water supplies, to nearly one-tenth of the rates prevailing 20 to 30 years ago.

About a dozen years ago the so-called sterilization or chlorination or disinfection of water supplies was proposed by Col. George A. Johnson, as a means of removing objectionable bacteria. Its use has become widespread, particularly as a factor of safety to be applied in connection with filtration processes. In many cases, however, its use has resulted in a falling off of the quality of filtered water, largely for the sake of economy during the war period, so that instead of being a factor of safety, chlorination has quite frequently become a substantial portion of the process for the elimination of objectionable bacteria. Undoubtedly, the pendulum swung too far and there is now a pronounced reaction whereby higher accomplishments are demanded of filter plants themselves. This affects the size of sand used in filter beds, the quantity of coagulant, the skill with which filter plants are operated, and other technical details which are receiving deserved attention.

### Drainage, Sewerage and Sewage Disposal

Drainage is an important element in relation to the public health, as shown by the fact that the drainage works installed some 20 years ago at New Orleans had a more beneficial effect upon the health of that community than did the installation in subsequent years of modern sewerage and modern water supply works. The engineer has had to deal with drainage to eliminate the mosquito and thus keep under control those diseases that require an insect as a vehicle for their transmission.

Most American cities are now provided with moderately complete arrangements as to sewerage, but after household wastes have been collected the problem of their disposal has been a perplexing one with which sanitary engineers have wrestled in association with other workers in the public health movement.

It is 34 years since the Lawrence experiment station was founded and fortunately we have a statement prepared for the Engineering Congress held in St. Louis in 1904, indicating the progress made up to that date in sewage disposal. Thus we have an opportunity of comparing roughly the progress made during the first 17 years with that of the second 17 year interval since 1887. In 1904 there were about 90 sewage-works in operation in cities and towns of 3,000 population or more, of which the total number in the United States in 1900 was 1,524. At that date about 1,100, or roughly about 75 per cent of the cities and towns, had more or less complete sewerage systems. The 1904 statement as to municipal plants does not include several hundred disposal plants in smaller towns, hotels, institutions and industrial establishments. In 1915 there were over 600 treatment plants for municipalities on this continent and about 300 institutional and private plants for hotels and industrial works. War activities interrupted municipal construction but several important plants have been completed since 1915.

Without getting into details of methods now in vogue, it may be noted that in the results accomplished at numerous plants for treating sewage, either in single- or two-story septic tanks or by stone beds, which financial considerations have necessitated as substitutes for sand beds, one is frequently surprised with the difficulty of getting efficient results uniformly in an inoffensive way. In part this is due to lax arrangements in the system of collecting sewers, in part it is due to inadequate or overtaxed disposal plants, and in part it is due to inadequate attention in the management of plant operations.

Activated sludge is the newest method of sewage treatment. It is a process which makes feasible a more complete purification of sewage than is readily secured by any other method than sand filters. It requires conscientious supervision but I am beginning to believe that since few if any sewage disposal plants are fool-proof, it is perhaps an advantage, rather than a disadvantage, to the process to call for frequent and efficient supervision. During the war, when very high prices prevailed for fertilizers, it was hoped that the drying of activated sludge would produce a commercial product that could be sold to the fertilizer trade

for a price which would [illegible] at least of handling the sludge itself. This is not certain under present circumstances but again we must recognize that this is necessarily not a fatal drawback and that if real accomplishments in treating sewage are to be effected in a sanitary way, the price must be paid in both money and intelligent direction.

Progress in sanitary engineering in the field of sewage disposal is more associated with availability of funds than perhaps is generally realized. It is more difficult to secure funds for disposing of these waste products than it is to get money for water supply improvements, or a new hospital, or new playgrounds, or new street pavements.

STREET CLEANING AND SOLID WASTES DISPOSAL

These subjects are properly included in the scope of sanitary engineering and in this country progress has been substantial. Accomplishments for the most part have followed European precedents but have not attained as satisfactory results, generally speaking, as found in the better known European cities.

The epidemic of infantile paralysis in 1916 and the outbreaks of influenza during the war stimulated street-cleaning in some cities to a substantial extent; but depleted funds and restrictions in capacity of water-works have caused some municipalities to fall back to a standard of accomplishment lower, rather than higher, than that prevailing just prior to the war.

The sanitary engineer is able to bring about in an effective way the sanitary disposal of solid wastes. Overtaxing of plants and difficulties from odors have been more pronounced than should have been or need be the case. Even in garbage reduction works the control of odors by passing the released gases through combustion chambers maintained at a very high temperature and their passage through curtains of water spray are things which the engineer knows about but which have not ordinarily been put in practice

* * *

## *Stream Pollution and Sewage Disposal*

*Tanks and Fine Screens for Treating Sewage: George T. Hammond, Consulting Engineer, Brooklyn, N. Y.*—The bad name lately attached to the Imhoff tank is largely due to faulty design and due even more to poor operation. This tank will remove considerably more suspended matter than will screens, but the freshness of sewage from screen treatment sometimes more than offsets the lesser degree of clarification that it effects as compared with the Imhoff tank. Separate sludge tanks are becoming prominent, but there is not yet much uniformity in their design.

*Pollution of Tidal Harbors by Sewage: Kenneth Allen, Sanitary Engineer, Board of Estimate and Apportionment, New York City*—The effect of back-and-forth tidal flow and the different specific gravities of sewage and of salt water have to be taken into account. At points in the East River in October of this year samples collected for analysis showed no dissolved oxygen.

*Storm-Water Treatment: John F. Skinner, Principal Assistant Engineer, Department of Engineering, Rochester, N. Y.*—In some cases heavy solids may be removed from storm water by sedimentation in grit chambers and light solids by screening. A combined grit chamber and screening installation may be used, the screens to be in the form of inclined baffle racks at intervals of about 25 ft. longitudinally in the grit chambers. Thus far little has yet been done in the way of storm-water treatment in this country but more may be expected in the future.

*Policies of Pennsylvania Department of Health: W. L. Stevenson, Assistant Chief Engineer, Pennsylvania Department of Health, Harrisburg, Pa.*—Polluted surface wash makes it out of the question to use surface waters for public water supplies without treatment. The greatest protection to the public can be secured with least expense by combining sewage and water treatment. In general, where no water supply is taken from the streams the cleansing of a river would proceed from upstream downward, whereas if a public water supply were involved the cleansing would begin at the sewage-works next above the water intake and be extended upwards.

*Steam Pollution and Its Control: Earle B. Phelps, Consulting Sanitary Engineer, New York City*—Three essentials must be considered: (1) capacity of stream both as to volume and biologically; (2) the pollution load, present and prospective; (3) remedial measures. The newer chemistry of stream pollution considers oxygen demand instead of nitrogen content. Engineers should design for the utilization of a stream as well as for its protection. Legislation for the protection of streams from pollution should give wide dicretionary powers of administrative control instead of containing specific restrictions.

*Sludge Disposal: T. Chalkley Hatton, Chief Engineer, Milwaukee Sewerage Commission*—In sewage-works practice more attention has thus far been given to the treatment of the liquid portion of the sewage than to the disposal of the sludge. Inspection of sludge dumps in England and elsewhere indicates that the sludge disposal problem is not yet half solved. In my recent trip to England I saw no improvement in sludge disposal over my preceding trip. I was informed by the Ministry of Health that as soon as British cities are in better financial condition they will be forced to make improvements in their sludge disposal methods. This side of the Atlantic, bad sludge conditions have been noted at Toronto and at Baltimore.

Except where lime is used in treatment, there is no reason why sewage sludge should not be utilized. In Germany I found that much attention was being given to sludge disposal. I observed but little sludge around sewage-works there and found that it was being used on farms. Recent experience in sludge disposal at Rochester indicates that other communities as well might get enough from their sewage sludge to pay for its dewatering.

At Milwaukee, after five years, of study, while we have not yet solved the sludge treatment problem to our satisfaction, we have been able to reduce the moisture content to 10 per cent by pressing and drying (activated sludge) and if the former prices of fertilizing material are restored we may expect to handle our Milwaukee sludge at a profit.

*The Dilution Factor: Langdon Pearse, Sanitary Engineer, Chicago Sanitary District*—From the viewpoint of nuisance prevention a sewage dilution of 4 to 7 sec.-ft. of stream flow per 1,000 population has been indicated with a lower limit of 2 and an upper of 10. The Sanitary District of Chicago has sought for a different standard and favors the biochemical oxygen demand test. Continued tests on sewage from a large sewer serving 300,000 people, with no marked industrial wastes, have given an equivalent of 0.22 lb. of oxygen per capita for complete oxidation, based on ten days' incubation in sealed bottles and taking no account of re-aeration. The latter should reduce the dilution factor. Of the oxygen requirement roughly about 20 to 30 per cent seems to be necessary in the first 24 hr. The required dilution will be much higher in warm than in cold weather as shown by the following figures for (1) dissolved oxygen, p.p.m.; (2) temperature corresponding to dissolved oxygen saturation, deg. Fahr.; (3) flow required in sec.-ft. per 1,000 population: 6-108-6.80; 8-81-5.09; 10-60-4.07; 12-46-3.40; 14-35-2.92. Observations on the main channel at Chicago appear now to indicate that a higher dilution is required than the minimum of 3.33 sec.-ft. per 1,000 population to dilute the raw sewage of domestic origin in the summer, a figure between 4 and 5 sec-ft. now seeming more likely. With an industrial load at times over 50 per cent of the human load, the need is apparent of much higher dilution for both domestic and industrial sewage combined. The exact figures will depend on re-aeration factors and seasonal conditions, such as temperature and extent of ice sheet, as well as the standard of dissolved oxygen to be maintained at critical points.

From the standpoint of fish life, considerable oxygen is required. Fish specialists suggest today not alone the study of the oxygen content, but also the $CO_2$ and the H-ion concentration.

An extended investigation of the self-purification of the sewage of the Sanitary District of Chicago from Lake Michigan to the Mississippi River is now being made jointly by the United States Public Health Service and the Sanitary District of Chicago. Re-aeration, temperature, the ice sheet,

the time or length of travel, and also sludge travel are to be studied and existing data will be summarized. With the work already done by the Public Health Service on the Potomac and Ohio rivers, this third investigation should provide very useful data.

The dilution required to prevent an undue load upon water purification plants appears to have been first cast in definite form by the International Joint Commission which suggested an average load such that the raw water would not contain as a yearly average more than 500 B. Coli per 100 c.c., or, as translated by Prof. Phelps, a dilution of 5 sec-ft. per capita or greater.

*Misuse of Sewers: W. H. Dittoe, Engineer, Ohio State Board of Health, Columbus*—Abuse of both sewers and sewage-works exists through the failure of city authorities to control connections. Sanitary engineers who have left this matter to city officials should take the lead in laying down proper rules for making connections. There should also be a protection of sanitary sewers against the reception of storm water and of storm sewers against receiving sewage. All these things require proper municipal ordinances, enforced, together with permits for making sewer connections, records, and the like.

*General Discussion*—J. Frederick Jackson, engineer, Connecticut State Board of Health, said that the Connecticut Industrial Wastes Commission had been discontinued by the legislature largely because the commission could not see its way clear to support a very drastic measure against stream pollution. Glenn D. Holmes, engineer, Intercepting Sewer Board, Syracuse, N. Y., in commenting upon indications there in favor of plain sedimentation, said that the detention period rather than the velocity was the thing to be considered. F. A. Dallyn, engineer, Ontario Provincial Board of Health, remarked on it being fortunate that biologists were included in the current discussion. This led W. F. Wells, sanitary biologist of the New York State Conservation Commission, Albany, to state that as a biologist he felt encouraged to go on with his work. There is need, he said, of some way of bringing recognized principles for the protection of fish to public attention. Rudolph Hering, New York City, stated that the dilution recommendation originally made for the Chicago sewage was 4 sec.-ft. per 1,000 population instead of the 3½ ft. finally adopted. Had this and other of the original recommendations, including the dredging of sludge from the Chicago River, been followed better results in the drainage canal would have been secured. Alexander Potter, consulting engineer, New York City, endorsed Mr. Dittoe's remarks as to the misuse of sewers. C. M. Baker, engineer, Wisconsin State Board of Health, Madison, said that the State of Wisconsin inspects plumbing and that the work is fairly controlled. Paul Norcross, consulting engineer, Atlanta, Ga., expressed agreement with Mr. Hatton's remarks as to the present status of sludge disposal and said further that he thought existing sludge disposal conditions was one of the reasons for the condemnation of sewage-works by laymen; also that at one of the three Atlanta sewage-works sludge disposal conditions had caused litigation.

## Odors and Their Travel Habits

*Synopsis of Paper by L. L. Tribus, Consulting Engineer, New York City*—(The full paper was printed in the October Proceedings of the American Society of Civil Engineers.) This paper is more a rambling collection of notes about "smells," with some incidents illustrating their intensity, prevalence, persistence and movements, than a logical engineering presentation of a definite subject, with conclusions, as a suggested guide to follow. In fact, definiteness as to smells is impossible, even as to any standard of describing them, and the paper makes a point of that fact.

The tolerance of odors given off by essential industries, if due care is taken to reduce offence to the minimum, is considered, the effect of odors upon persons of different susceptibilities is discussed, and the fact that certain races accept as pleasing those odors which produce even disgust in others is noted. Some notes are given in regard to difference of behavior during daylight and night, particularly the curing effect of direct sunlight.

Observed distances of travel of odors are given in numerous instances, and various cases from litigation are reviewed, giving opinions of unnamed experts as to their views upon distances to which odors travel, and the atmospheric conditions under which they become specifically obnoxious.

In general, the types of odors reviewed are those from garbage treatment and sewage disposal works, with some comments upon the production of offensive gases in the preparation of food products, ore and oil refining, etc.

The writer's conclusions are that many engineers ought to give items from their own experiences, so as to provide a reservoir of information that might be helpful in settling various disagreements and even litigation; that chemists might devote more attention to counteractive work; and that some consideration might be given to amendments to public health laws to make possible the stopping of prospective nuisances without having to wait for their actual development before effective action can be taken.

*Physiology and Government Control of Odors: George C. Whipple, Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.*—The direct effect of odors upon health is small, but there may be considerable indirect effect by their causing loss of sleep and extended worry. The fact that human beings insist that health and comfort be not separated is recognized by the courts. In the last analysis, decision as to whether a thing is a nuisance depends upon the conclusions of twelve good men are true. As time goes on the police powers in this direction will be extended. In granting building permits for chemical or other industrial plants, the authorities should take into account the likelihood of nuisance. City zoning helps in controlling nuisances of the kind, but does not go far enough because while the buildings may be confined to a given zone, the odors are not. Before granting permits for possible nuisance-producing plants it might be well to secure and publish a written opinion on the subject from the State Board of Health. While laymen may judge of the existence of a nuisance as well as experts, the probabilities can better be told by experts. The control of odors, dust, and noise affords a possible career for young engineers.

*Observations of Odors in Rhode Island: Stephen DeM. Gage, Chemist and Sanitary Engineer, State Board of Health, Providence*—The law does not recognize the anticipation of odors and might well be revised in this respect. The oil industries at Providence are giving out odors that affect considerable populations. Oil-burning furnaces cause complaint. The crude Mexican oil now chiefly used contains 4 per cent of sulphur before gasoline, etc., is distilled off and subsequently 6 per cent or more, oftentimes. In a community where 1,000,000 bbl. of crude oil are burned, 30,000 lb. of sulphur or 60,000 lb. of sulphur dioxide are given off. The author is not prepared to say that this is dangerous to health, but that possibility must be taken into consideration.

*Some Interstate Odors: Olin H. Landreth, Consulting Engineer, New York City*—Fumes from copper smelting at Ducktown, Tenn., destroyed vegetation in Georgia and led to litigation. Stipulations were entered into under which the amount of green ore treated during the growing season was restricted and damages were paid to farmers. New York State has amended its corporation laws within the last few years so as to gain some control of odors across the state line by provision for annulling charters of domestic corporations and taking away licenses of foreign corporations permitted to do business within the state.

*Garbage Disposal Odors: I. S. Osborn, Consulting Engineer, Cleveland, Ohio.*—The whole subject of odors has received very little study. If the amount of money spent in litigation over odors had been devoted to research much more would have been accomplished.

The nature of the business and the sort of men engaged in garbage disposal have not been such as to develop study. The chief garbage disposal odors come from the digestors, and the dryers; other garbage disposal odors can be controlled with comparative ease. Considerable of practical value may be learned from the studies of odor control at the Barren Island garbage disposal plant, New York City, made in 1915. Since then chlorine gas as a method of

controlling garbage disposal odors has been tried elsewhere, but with less success than was expected. So long as short-time contracts for garbage disposal are let, necessitating getting back the money before the contracts expire, complaints from odors may be expected. Attempt to control the production of odors by anticipation would hold back progress. The subject needs more engineering study.

*General Observations: Rudolph Hering, Consulting Engineer, New York City*—The subject was reviewed by me in a paper written some seven years ago. Prejudice is often the cause of complaint of odors. For instance, seeing smoke arise from an incinerator which is from a coal fire only and thus could not give any garbage disposal smell.

*Studies of Odors: R. S. Weston, Consulting Engineer, Boston*—Studies of odors from decomposing sugar house wastes, lactic acid manufacturing plants, and oil refineries have afforded me an opportunity for attempting to systematize the odor investigations. With the help of Wallace & Tiernan, better methods for the determination of hydrogen sulphide in air have been devised than mere smelling. We almost need a new kind of engineer—one who would take into account physiology, meteorology and chemistry, in conjunction with structural engineering—for the study of odors.

*General Discussion*—Alexander Potter, New York City, said that a study of odors from a trunk sewer indicated that they had their origin in lateral sewers from which they had traveled downward. Apparently the friction of the flowing sewage upon the sewer air carried the latter with it. Velocities of the sewage and air flows were measured.

## *Water Supply and Water Purification*

*History of Water Purification: George C. Whipple, Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.*—Fifty years ago the quality of American water supplies was low, but progress since then has been marked by the Europeap trip and water purification report of J. B. Kirkwood, 1866 and 1869; the Poughkeepsie filtration plant built after Kirkwood's design in 1872; the studies of European water treatment practice by Prof. William Ripley Nichols and his report to the Massachusetts State Board of Health in 1878, followed five years later by his pioneer book on water supply; the Lawrence experiments dating from 1887; the Lawrence water filtration plant, 1893. Also, taking up mechanical filtration, the Hyatt patents of 1884 and the first municipal mechanical filtration and coagulating plant at Somerville, N. J., in the same year—Prof. Albert R. Leeds being the real inventor; the Providence experiments of Edmund B. Weston, 1893; the Louisville experiments under the direction of Charles Hermany and George W. Fuller, 1897, followed by various later experiments at different cities; and the Little Falls filtration plant of the East Jersey Water Co., built in 1902.

Methods of testing filter performance have changed very much in the past twenty-five years. There is now more interest in what the filter actually does than in what it can do. An innovation is the determination of acidity in terms of hydrogen-ion. The B. Coli test is generally used but has its limitations. Spore formers are being considered. Typhoid fever is now so low, generally speaking, that it no longer serves as a measure of the purity of water, as M. N. Baker has pointed out.

*Active and Quiet Water: Allen Hazen, Consulting Engineer, New York City*—Recently a Dutch writer divided all waters into two classes, active and quiet. Active waters attack iron; quiet waters do not. The water from the Great Lakes is generally quiet, both before and after filtration; also the hard waters of the Alleghenies are generally quiet. Near the Atlantic coast the waters are soft, carry matter of vegetable origin, and are active. We need to find out how to treat these active waters without using chemicals.

*Interference with Water Filtration Plant Operation by Wastes from By-Product Coke Ovens and Gas Works; C. A. Emerson, Jr., Chief Engineer, Pennsylvania Department of Health, Harrisburg*—Liquid wastes from by-product coke ovens and gas plants are giving trouble in connection with many water supplies. These ovens are increasing in number. They give tastes that may travel for miles downstream and last for days. Chlorination of the waters thus affected increases the taste and odor trouble. The remedy lies within the coke oven plants. In some instances these liquid wastes have been used for coke quenching, for which purpose they are not sufficient to meet the demands. This method has silenced complaints from cities 70 miles downstream. The remedy for troubles from gas plant wastes is the use of settling and skimming basins to remove tarry matters and light floating substances. The circulation of the effluent from such basins or tanks for use in scrubbers cut down both the final volume of waste and the trouble that this sort of waste causes.

*Reduction in Typhoid Death Rate (1) For the Whole Country and (2) For New York State Caused by Water Purification and Improved Supplies: Prof. C. E. A. Winslow, Professor of Public Health, Yale University, New Haven, and C. A. Holmquist, Director, Division of Sanitation, New York Department of Health, Albany* — [Prof. Winslow reviewed typhoid statistics for the registration states up to 1919. Mr. Holmquist showed the great decline in typhoid since the organization of the Sanitary Engineering division of the State Department of Health in 1906 (1) for the state as a whole and (2) for a number of cities which formerly had very high typhoid but have subsequently introduced filtration. The New York State typhoid rate for 1920 was 3.5. Present indications are that the rate for 1921 will be 3.4 and possibly still lower.]

*Purification of Soft, Colored Waters: Robert S. Weston, Consulting Engineer, Boston*—Engineers are pretty well agreed that satisfactory water should have a color of say 10 and not to exceed 15 on the platinum scale. In the East it is generally only ground water that will comply with this standard. Slow sand filtration plants as a rule will remove say a third of the color. To do more requires chemical treatment. The latter is likely to give trouble in the case of New England waters. The subject demands more study. There is also need of consideration of the problem of after-precipitation when alum is used. Hydrogen-ion determinations are useful in this connection and not difficult.

*The Operation of Reservoirs for Water Supply: Samuel A. Greeley, Hydraulic and Sanitary Engineer, Chicago*—Storage of water in the upper Mississippi Valley is generally costly. The water in this section is generally so turbid as to require filtration and this gives rise to greater toleration for possible pollution. The relative scarcity of natural reservoirs and lakes in a considerable portion of the Middle West creates a great demand for the use of such bodies of water for recreation purposes. The use of such reservoirs for bathing is the most serious of the various uses. The provision of special bathing pools affords relief from this danger.

## *Sanitary Engineering Section*

*Proper Size of Sand for Rapid Sand Filters: W. H. Dittoe, Chief Engineer, Ohio State Department of Health, Columbus*—During the past five years studies have been made of fifty rapid sand filter plants in Ohio. The larger of the plants are in charge of trained men, fifteen of whom may be classed as experts. General conclusions reached by the State Department of Health are: (1) Final product from filters should be free from gas formation in 10 c.c. after 24 hr. incubation at 37 deg. Fahr. in lactose broth. (2) Filtration plants should be so designed and constructed as to give no serious operating difficulties. (3) Purification works should be operated so each part will do its proper work without any overloading and so that disinfection should be used as a factor of safety only.

The study of these Ohio plants indicates that those having filter sand of an effective size of 0.6 m.m. or more are not producing satisfactory effluents, while an effective size of 0.45 give a high degree of purity, with no need for disinfection except as a factor of safety.

The conclusion has been reached that hereafter all new filters should be provided with fine sand and that all old ones having coarse sand should have the sand replaced with fine as soon as may be, this sand to have an effective size

of from 0.35 to 0.42 m.m. and a uniformity coefficient of 1.8. The preference is for an effective size of 0.37 m.m. and a uniformity coefficient of 1.6, with all sand particles less than 1 m.m. in size. For the past two years all new plants have conformed to these specifications as well as all substitutions of sand in old plants. A layer of "torpedo" sand is placed between the main sand bed and the gravel.

*General Discussion*—F. A. Dallyn, Toronto, Ont., favored finer sand, but said that in Canada this greatly increased the cost of filters because fine sand had to be imported from America; consequently, coarser local sand is now permitted. At Toronto, $35,000 a year can be saved by using less alum and allowing some turbidity. Why should not this be done if it has no effect upon increase of typhoid?—[as Mr. Dallyn evidently believes.] Robert Spurr Weston, Boston, voiced agreement with the principle of fine sand, and said he would like even smaller sand than Mr. Dittoe had specified, but remarked that fine sand consolidates in sections. Allen Hazen, New York City, said that fine sand works to one side and coarse sand to the other side of the filters. C. M. Baker, Lansing, Mich., spoke of fine sand rising to the top of the filters. C. A. Emerson, Jr., Harrisburg, Pa., questioned whether state boards of health should not confine their action more to judicial functions than they do and expressed the belief that they had gone too far in performing the function of consulting engineers.

*Industrial Wastes in Relation to Water Supplies; Wellington Donaldson, Sanitary Engineer, New York City*—In general any burden of industrial wastes on water filters effects health in some way, as where these wastes cause taste from chlorine, leading consumers to resort to well waters or bottled waters that may not be safe. Of more importance are wastes that interfere with filter operation, as oil, which coats the sand, or wastes that affect coagulation, or others which lessen the action of chlorination.

*Centrifuges for Sludge Dewatering*: *T. Chalkley Hatton*—Reserved for separate presentation.

*The Chemical and Biological Reaction of the Dorr-Peck Activated-Sludge Tank*: *A. M. Buswell, Chief, Illinois Water Survey, Urbana*—[Chiefly a description, with an account of the results, of the Champaign experimental plant.] at Champaign, Ill.

*General Discussion*—John F. Skinner, Rochester, N. Y., told of the low cost of operating the sludge drying beds that take Imhoff tank sludge at Rochester, N. Y. He seemed to think it would be difficult to meet these figures with centrifuges, taking both capital charges and operating expense into account. R. H. Eagles, New York City, spoke of the use of sulphuric acid on the one hand, and on the other of sulphur dioxide and live steam for sludge treatment. Kenneth Allen, New York City, said that a centrifuge he saw some years ago worked well and that there had been an improvement since—referring to the earlier and the later and modified Ter Meer centrifuge. He thought there was a field for the use of centrifuges on plain sludge, but the chances are not so good for successful use on activated sludge, besides while Imhoff sludge can be readily dried on beds.

Dr. Edward Andern, consulting engineer, Manchester Sewage-Works, England, opened some brief remarks by saying that he was visiting this country on a voyage of discovery—with special reference to activated-sludge plants. He did not think that circular tanks were as well adapted as rectangular to the activated-sludge process because with circular tanks it was almost impossible to avoid short circuiting. He saw very little advantage in the Dorr-Peck activated-sludge tank over tanks of plain construction. In England, Dr. Ardern said, both air and mechanical agitation are being used for activation purposes. He thought that within twelve months there should be some knowledge of which of the two is best. Dr. Ardern agreed in general with Mr. Hatton's remarks on the sludge problem, but not with Mr. Hatton's sweeping conclusion that sludge disposal in England is inefficient, and apparently not wholly as to the likelihood of getting fertilizing value from sewage sludge in general. Dr. Ardern stated that in England the agricultural chemists, years ago, had satisfied themselves that ordinary sewage sludge had low fertilizing value, besides which the grease in the sludge gives trouble when the sludge is applied to land. The sludge from the activated-sludge process is more promising. The Board of Agriculture of England has engaged Dr. Russell, a leading agricultural chemist, to investigate activated-sludge possibilities.

F. A. Dallyn, Toronto, expressed himself as being very hopeful as to the prospect of getting fertilizing value from activated sludge.

Mr. Hatton said he wished to take issue with Dr. Ardern as to ordinary sludge not yielding sufficient fertilizer value to make it practicable. In support of this he cited experiences at Baltimore. Mr. Hatton also said that as far as activated sludge is concerned he had proposals on his desk from four companies to take all the sludge produced at Milwaukee. F. W. Mohlman, of the Chicago Sanitary District, said that parallel tests of a Dorr-Peck tank at Chicago and an ordinary activated-sludge tank followed by sedimentation in a tank with the Dorr thickener, showed about the same detention period and air demand for each type.

*Connecticut Stream Pollution Studies*: *J. Frederick Jackson, Engineer, State Department of Health, Hartford*—[Under the title "Correlation of Stream Pollution Criteria from Studies of Naugatuck and Hockanum Rivers" the author pointed out, among other things, that the dilution ratio in terms of stream flow to population as ordinarily considered does not govern on these streams, partly on account of industrial wastes.]

*Sanitation of Public Bathing Waters*: *Committee Report and Papers*—For the Committee on Bathing Places, George W. Simons, Jr., chairman, Jacksonville, Fla., reported the results of a canvass of physicians and health officers to ascertain (1) their opinions and (2) their observations on the transmission of specific diseases by the use of swimming pools and other public bathing places. A long list of infections was covered. Many of the replies were in the affirmative as to possibilities and also as to observed cases, the latter being fewer than the former. Under typhoid and paratyphoid, 155 replied that in their opinion bathing places are means of spreading these diseases while 18 reported actual cases believed to have been contracted in public bathing places. S. DeM. Gage and A. E. Griffen, Providence, R. I., presented a score card for rating the sanitary quality of bath-houses and public bathing places. W. F. Walker, Detroit, recounted favorable observations on ultra-violet rays for the disinfection of swimming pool water.

*Garbage and Refuse Disposal*—M. N. Baker, New York City, chairman of the committee on this subject, reviewed the generally unstable conditions prevailing in this field; commented on the relatively few engineers engaged in garbage disposal engineering, and suggested that it be taken up by more; and raised a question as to the desirability of having plans for garbage and refuse disposal plants submitted to state departments of health for approval. E. A. Fisher, Rochester, N. Y., described the new Cobwell garbage reduction plant in that city. Dr. J. D. Robertson, commissioner of health of Chicago, said he thought it was now generally considered by health authorities that garbage disposal is not much of a health question. C. M. Baker, Lansing, Mich., and F. A. Dallyn, Toronto, Ont., stated that their respective state and provincial boards of health pass upon plans for garbage disposal.

*Milk Pasteurization*—H. A. Whittaker, Minneapolis, chairman of the Committee on Milk Supply, reported that pasteurization in relation to the cream line had been the subject of study for the year. Dr. H. D. Pease, New York City, read a paper summarizing the results of studies by himself, S. M. Heulings and E. C. Towne on the physical effects of pasteurization on milk.

*Mosquito Extermination*—A review of this subject was presented by W. D. Becker, supervisor of sanitation, Philadelphia Department of Health.

*Health Value of Zoning*—Charles B. Ball, chief sanitary inspector of the Chicago Department of Health, made a strong plea, illustrated by well chosen lantern slides, for the beneficial effects of zoning upon health. He stated that the *National Real Estate Journal* for Nov. 7, 1921, contained a list of 44 cities that have already passed zoning ordinances and 76 more that are now working on the problem.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## In Support of Corps of Engineers

Sir—The editorial "Overemphasizing the Corps of Engineers" in your issue of Oct. 6, and subsequent letters are of much interest to former engineer officers. Just as the reputation of any school is made by its graduates so, it seems to me, should the ability of the Corps of Engineers to perform its duties in war be the measure of the soundness of the present method of training the Corps. By giving it, in times of peace the handling of much property, machinery and men, with adequate responsibility and authority and with the constant inculcation of the traditional spirit of the Corps, it was enabled to fully meet its test in the late war.

Great engineering achievements that have not a permanent physical monument such as the Panama Canal are apt to be quickly forgotten; but surely the engineering profession should not forget but should take pride in the expansion of the handful of engineer officers and the few battalions of engineer troops which existed before the war into an aggressive working force of 175,000 officers and men in France alone. They were equal to any task assigned them, including combat work and all construction for all branches of the service. This force was organized and directed by regular officers of the Corps of Engineers and while I hold no brief for them, I am willing to certify to their ability and to the soundness of their training.

I saw service in France as engineer officer in charge of construction and later for many months I served in Tours under the Director of Construction and Forestry, Brig.-Gen. Edgar Jadwin, who with his deputy, Col. J. A. Woodruff, were both regular army officers. Those two officers, with their civilian officer assistants, managed the personnel, generally directed the policies and work and obtained materials for over 150,000 men with an efficiency that produced results and contributed powerfully to the winning of the war. This I submit is an achievement that has not been paralleled within our time. It was done by a system of decentralization that gave engineer officers in charge of projects an opportunity to produce results limited only by their individual abilities.

All of us would do well to emulate many of the qualities of the Corps of Engineers, particularly the industry, high-mindedness and devotion to duty of its officers. It is a branch of service in which all Americans should take pride and anything which would curtail its training or lower its morale would be deplorable and not for the good of the country. The wisdom of continuing its present functions is evident and should need no defense.

Houston, Tex. JOHN LANSDALE,
Nov. 16. Valuation Engineer, Southern Pacific Lines; formerly major, Engineers, A. E. F.

## Against Rod Soundings

Sir—I notice in your issue of Sept. 29, p. 539, a brief article by George E. Horr entitled "Determining Character of Subsoil with Sounding Rods." I am surprised to read his criticism of the wash boring. If Mr. Horr knows of one instance when the geological conditions were reported incorrectly, how many does he know that proved otherwise?

I disagree also with his recommendation as to the efficiency of rod soundings, even as a preliminary. This method of procedure, in my opinion, is a waste of time and money in ascertaining with any degree of certainty the depths required for a pile of rock foundations. By this method it is impossible to estimate the skin friction or the sustaining loads of a pile in the various strata encountered, for a small stone or boulder driven ahead of the rod gives a false resistance. Having no samples or water levels the contractor after figuring safely on the indefinite information furnished is liable to add 10 to 25% of his estimate for contingencies, thereby increasing the cost to the owner ten to twenty-five times the cost of making proper foundation test borings. A few hundred dollars spent in making borings, either wash, auger or core borings if necessary, ensures positive information and saves thousands of dollars in contingencies and extras.

Because of the lack of information as to the intervening strata between surface and a suitable hard bottom or information regarding water levels, the information from rod soundings is so unreliable that building department permits should not be issued upon such soundings.

SAMUEL WORTHINGTON,
Phillips & Worthington
New York City, (Foundation Test Borings, Wells
Oct. 3, 1921 and General Prospecting)

## Water Meters Help Give Maximum Service

Sir—In addition to your commendable answer in *Engineering News-Record* of Oct. 27, p. 702, to the contributor from Fresno who has attempted to justify flat water rates permit me to add the following: Is not the water meter like an insurance policy and the Liberty Bonds we all possess, in that they compel people to save? Do we neglect our personal appearance and the painting of our homes, etc., because we must economize for those investments?

The layman and the public in general are inclined to draw the conclusion that the introduction of meters is prompted by the desire of the water company to increase its earnings. The policy of the water company is to give the maximum amount of service for a minimum of charge and it can do this only if its facilities are used economically. If it must lay larger mains and build more pumping stations to supply water to be wasted that the company must receive a greater return in earnings than would otherwise be necessary. This must be fundamentally true and applies not only to privately owned utilities but also to those operated by municipalities.

San Francisco, Cal., Nov. 14. GEORGE H. BRAGG,
Pacific Gas & Electric Co.

## Would Tax Trucks on Mileage Basis

Sir—In riding around Massachusetts, on its beautiful state highways, I am impressed with two things: (1) That trucks should pay a fee for inter-town trips. (2) That trucks should be definitely limited as to width of body.

With reference to a definite system of fees, I believe that a charge of $0.10 per mile for a single trip for a loaded truck is not unreasonable. For a 5-ton truck, loaded on a 50-mile trip, the customer pays $1 per mile, or $50. A fee of $5 extra would certainly not be objectionable to him. In this way, definite compensation would be paid for the serious damage which most trucks inflict on the roads. Also, trucks would thereby pay a larger percentage of the highway construction costs than now. At present the pleasure car pays for almost the whole cost, and has the road destroyed to a great extent by the trucks, and blocked and made almost impassable at times.

Of course, our Massachusetts State Highway Department is more than self-supporting, but I feel that trucks are not paying for their share of the benefits received.

Boston, Oct. 24. L. F. BUFF,
Buff & Buff Manufacturing Co.

## Tatoosh Peak Named For Lane

The U. S. Geographic Board at a recent meeting named one of the loftiest peaks in the Tatoosh Range within Mount Rainier National Park in memory of the late Franklin K. Lane, former Secretary of the Department of the Interior. The peak has an altitude of 6,000 ft. and is located near Cliff Lake, Pierce Co., Wash.

# HINTS FOR THE CONTRACTOR

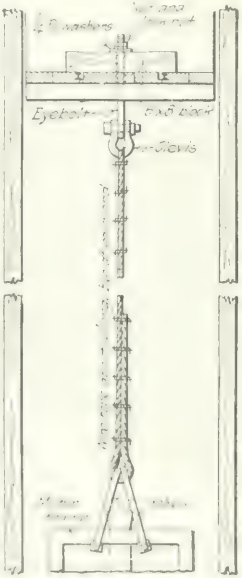
## Breaking Up 30-Year-Old Brick Tunnel Found Difficult Task

AFTER 30-years' service a portion of the Van Buren St. brick tunnel of the Chicago Surface Lines under the Chicago River has recently been lowered so as to pass under the tracks of the new Union Station. The brick and hydraulic cement were found in such an excellent state of preservation that a steam shovel could not pick holes in the 2½ ft. tunnel roof of seven rows of brick. A 1½-ton iron ball, used to break up scrap iron, made little headway until an opening had been made by blasting. To bring the work down to an even grade points and sledge hammers were used, taking out a brick at a time. Samuel G. Artingstall was engineer in charge of the original work which was carried out by Joseph Downey, contractor.

## Mine Locomotive Lowered Through Shaft By Novel Method

BY B. G. BEST
Civil and Mining Engineer, Ironwood, Mich.

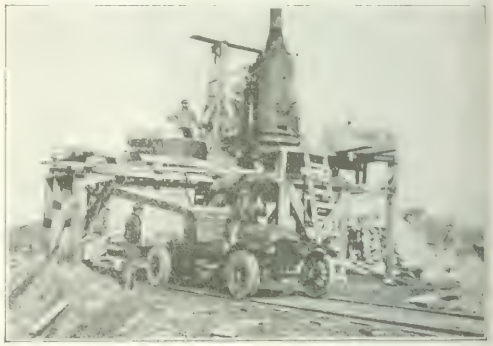
WHERE small locomotives have to be lowered through shafts for tunneling or other underground operations the method used in northern Michigan iron mines and described here is useful. The motor is placed on surface tracks a short distance from the shaft and all removable parts are taken off and lowered on the cage. A rope is then fastened to the rear coupler and snubbed around a post or deadman. A 1½-in. eye-bolt is now passed through a hole in the center of the floors of the cage, through a 6 x 8 in. block laid across the rails and secured by nuts and washers as shown. A piece of hoisting rope, about 12 ft. long and with and eye in each end is attached to the eye-bolt by a clevis made of 2-in. steel. The cage is hoisted a few feet above the collar of the shaft and two yokes of 1½-in. rods are passed through the lower eye of the hoisting rope. The yokes are then placed around the front end of the frame of the motor and the bolts inserted. The cage is slowly hoisted and the motor swung into the shaft, being held back by the rope attached to the rear coupler and the clevis being turned until the motor hangs square in the shaft. The tail rope is pulled taut and made fast to the upper end of the eye-bolt. The cage is lowered until the motor has reached the level where it is be used. The tail rope is then loosened and pulled out on the level. If the track underground is on the same side of the shaft as that on surface it is necessary to turn the motor around, so that when landed it will be right side up. This is done by turning the clevis. The lower end of the motor is pulled out on the level, either by hand, with block and tackle, or by a second motor, the cage being lowered at the same time.



ATTACHMENT TO SHAFT CAGE FOR LOWERING LOCOMOTIVE

## Ford Trucks With Flanged Tires Haul Concrete Cars

ON SEWER work at Syracuse, N. Y., this season, wet batches were hauled from a central mixing plant by Ford trucks equipped with flanged tires to travel on railway track. The sewer, 7½ x 7 ft., of reinforced concrete, is 4,500 ft. long. The central


FORD TRUCKS HAUL CARS ON STANDARD-GAGE TRACK

mixing plant was erected about 300 ft. from one end and consists of a one-bag mixer, on a framework 12 ft. high, charged by an elevating skip on extension leads, and discharging into a 2-cu.yd. bottom gate hopper. A single car with a 2-cu.yd. side-door body, hauled by two Ford trucks on standard-gage track, handled the wet batches. It was found that two trucks, facing in opposite directions with the car between them, were more satisfactory than one on account of the low reverse gear of the Ford truck. One truck hauls the car out and the other brings it in. The flanged wheels designed by the contractor are single castings, which bolt to the truck wheel. John Young, Syracuse, N. Y., is the contractor.

### Standard Gage for Australian Railways

For a unification of gage on Australian railways the standard gage of 4 ft. 8½ inches has been recommended by a commission appointed by the Federal government of Australia. In view of the great cost of complete unification, said to be estimated at nearly $350,000,000, it is proposed to limit the work at first to the main lines at an estimated cost of $75,000,000.

# NEWS OF THE WEEK

New York, December 1, 1921

## Hoover Endorses Trade Association Idea

**Needed in Our Economic System, He Says, Although A Few of Them Merit Censure**

*(Washington Correspondence)*

Despite the criticisms that have been heaped upon the trade associations and the disinclination on the part of the Department of Justice to attempt to clarify the situation prior to the decision of the Supreme Court in the hardwood lumber case, the U. S. Department of Commerce is actively championing the trade association idea. Secretary Hoover and members of his staff are taking pains in their utterances to show that the questionable conduct of a few trade associations, or aggregations calling themselves trade associations, has resulted in uncharitable criticism of all trade organizations. Mr. Hoover has expressed himself so definitely on the subject that there can be no doubt that he believes trade associations are necessary to the maximum progress of industry. The rapid multiplication of trade associations until they number nearly 3,000 is interpreted by Mr. Hoover to indicate "a great and vital movement and something permanent in our economic system." Other quotations from Mr. Hoover on the subject follow:

CO-OPERATION IN BUSINESS NEEDED

"The coming together of manufacturers and producers in the different trades for the purpose of the advancement of their industries as a whole is a profound step toward co-operation in the whole business world. Out of it will be gained tremendous benefits for the business public. The various trade associations present a point of contact with the government such as did not exist ten years ago.

"I know of no way in which we can undertake the solution of collective questions except by the cooperative organization of the men in the industry. We cannot go on maintaining our standard of living in the face of the foreign competition that we have in front of us, unless we can make some progress in the collective sense. The only way that we can hope for it is through the organization of associations that will take up the problems common to all, that gain inch by inch the efficiency and stability that make for national efficiency."

F. M. Feiker, assistant to the Secretary of Commerce said recently:

"The trade association is the natural organization functioning in the establishment of contacts between the government and industry. They are indispensable in such matters as the collection of statistics, the detailed promotion of foreign trade and in the elimination of excess variety. It is the only avenue that the Department of Commerce sees by which the government can establish contact with a trade to the mutual advancement of fundamental interests."

## Am. Soc. C. E. to File Professional Records of Its Members

In accordance with a decision by the Board of Direction on Oct. 11, the American Society of Civil Engineers is sending to its members blank forms on which space is provided for a biographical and professional record. These blanks, when filled in, are to be kept at society headquarters in New York and will be available to all inquiries. Each member has the privilege of keeping his record up to date.

## Survey Ordered for Market St. Subway in San Francisco

**At the Nov. 21 meeting of the San Francisco Board of Supervisors the city engineer was ordered to study and make plans for a 4-track subway under Market St. from the Ferry to Valencia St., a distance of about 2¼ miles.**

**This was proposed as a means of relieving the increasing congestion of this important thoroughfare and making its entire width through the business district available for vehicular and pedestrian traffic. The proponent of the measure said he did not anticipate immediate construction, but thought that a start should be made on such a project.**

## Power Commission To Consider St. Paul High Dam

The Federal Power Commission probably will consider at its next meeting the "high dam" project between St. Paul and Minneapolis. It is apparent that the Northern States Power Co. could utilize this power to greatest advantage, but the matter is complicated by a determined protest from Senator Nelson of Minnesota who wants to see this development handled by a municipal corporation formed ten years ago under a special act of the Minnesota Legislature. This corporation is composed of the City of St. Paul, the City of Minneapolis and the University of Minnesota. In addition, the City of St. Paul is endeavoring to secure sole control of the water power.

Senator Nelson's main objection seems to be based on the allegation that the Northern States Power Co. is a monopoly and that to give it jurisdiction over this additional power would add to the monopoly, although there seems to be little question that the public utility company is the only applicant in a position to get maximum utilization of the power available.

The municipal corporation has been in existence since 1911 and has done nothing toward developing the project. The application of St. Paul is regarded in some quarters as in fact an application of Henry Ford, as it is understood that he is to have first call on the power if the city should be given the permission to develop it.

## Big Demand for Exhibit Space at Road Show

**Plan to Lease Armory and Other Buildings in Addition to Chicago Coliseum**

All records for the amount of space sought by exhibitors of highway construction equipment and materials at the forthcoming Good Roads Show, to be held in the Coliseum, Chicago, Jan. 17-20, in connection with the convention of the American Road Builders Association will be broken this year. On Nov. 23, 86 exhibiters had contracted for all the space originally provided in the Coliseum, and Annex, and plans are now being considered for the leasing of a nearby armory and other buildings to accommodate manufacturers who wish to display their products at the show.

The first plans of those in charge of the exhibit provided for about 40,000 sq.ft. of space, but according to present estimates the amount will have to be increased to at least 60,000 sq.ft. This year exhibitors are demanding a larger area for the display of their products than was the case at last year's show. The recent passage of the Federal-Aid Highway Act, it is believed, has made certain a record-breaking highway construction program for 1922 and manufacturers apparently anticipate that the engineers and contractors attending the annual convention of the American Road Builders' Association will display keen interest in their products.

The subject of highway transport is to be featured at the convention and it is noteworthy that at this year's show more motor truck exhibitors will be represented than ever before. The U. S. Bureau of Public Roads will have an elaborate exhibit occupying about 2,000 sq.ft. of space. At the present writing there is a waiting list of 50 prospective exhibitors not yet provided for.

## Commerce Department Collects Construction Data

Among the recently inaugurated activities of the Division of Building and Housing of the U. S. Department of Commerce are the collection from contractors and secretaries of building exchanges of building material prices actually paid by contractors. Information has been obtained for several months and has been distributed among those who have supplied the information.

The division, which is under the direction of John M. Gries as chief, is also obtaining from the contractors data on the percentage of different materials and the amount of labor that go into a typical six-room frame and a six-room brick residence. This survey will enable some estimate to be made of the importance of price fluctuations in labor and in different classes of materials entering into these types of dwellings.

## Ohio River Bridge To Be Double-Tracked

**Illinois Central R.R. Authorized to Replace Single-Track Structure at Cairo, Ill.**

Authority for replacement of the single-track bridge of the Illinois Central R.R. over the Ohio River at Cairo, Ill., by a double-track bridge on the present stone piers to cost about $8,500,000 was granted Nov. 2 to the railroad by the Secretary of War. The permit provides for beginning work in one year and completing it within three years. The present bridge, built in 1887-88, consists of two through-truss spans of 523½ ft., seven of 405 ft., and three deck-truss spans of 250 ft. The new bridge is to have the same headroom under the channel spans at high water as the present.

On the Illinois side the former structural approach has been filled, leaving only a 50-ft. deck-girder span, but the Kentucky approach has 21 deck-truss spans of 150 ft. and one 106-ft. deck-girder span, all on steel cylinder piers filled with concrete. It is proposed to increase the dimensions of the river piers from 43 ft. to 52 ft. length and from 14 ft. to 17.75 ft. width at the top by rebuilding the upper portion, the work to begin at the starling or middle belt course and the increased size to be obtained by a reduction in the batter.

### Similar Proposal Rejected

A similar proposition was made by the railroad company a few years ago, but was rejected by the War Department on the ground that navigation interests claimed that a channel span of 800 to 1,000 ft. was needed for the safe passage of large tows of coal barges. As the company was not willing to undertake such expensive reconstruction the matter was dropped. During 1914-1915, however, the superstructure was strengthened sufficiently to enable it to carry heavier loading, as described in *Engineering News-Record* of March 9, 1916, p. 448.

Since the railroad traffic is approaching the capacity limit of the single-track structure the project for double-tracking was revived. The character of the river traffic has greatly changed. The large tows or fleets of coal barges are no longer operated and the river conditions do not now justify the claims for such long spans as were demanded when the former request was made. On the basis of 1919-20 prices the cost was estimated at $8,482,000, as against $10,752,000 for a new bridge with a 700-ft. channel span.

## Wenatchee Reclamation Project To Cost $5,000,000

One of the largest reclamation projects ever undertaken in the State of Washington is being planned for the Wenatchee and Columbia River valleys, in which more than 46,000 acres of fruit and farm lands will be reclaimed. The Greater Wenatchee Irrigation Association, of which F. W. Schultz, banker of Wenatchee, is president, will have charge of the work. The total cost of completing the project has been estimated at $4,500,000 to $5,000,000.

## Ontario Hydro-Electric Current May Light Detroit

At the recent November election the voters of Detroit, Mich., adopted a charter amendment which permits the Public Lighting Commission, subject to the approval of the city council, to make a ten-year contract with the Ontario Hydro-Electric Commission for current from Niagara Falls. Such current is already being used directly across the border in Windsor, Ont. If the plan is adopted it will obviate the necessity of the $5,000,000 power house proposed by the Detroit Public Lighting Commission.

## Big N. Y. Subway Contract Awarded

**The New York Transit Commission last week awarded to the Powers-Kennedy Contracting Corp., 149 Broadway, New York City, the low bidder, the contract for the extension of the Queensboro route of the duel subway system from Grand Central Station under 42nd St. and Bryant Park to 8th Ave. The amount of the bid was $3,867,138.**

## Hudson Vehicle Tunnel's Status Still Unchanged

The situation with regard to the Hudson River vehicular tunnel, which has been deadlocked for months due to disagreements between the New York and the New Jersey commissions, may be summed up as follows:

Both commissions have approved an agreement with the Erie R.R. involving the site of the ventilating shafts on the Jersey side, but at this writing the railway's representatives have not signed the document. This matter constituted one of the big differences between the two commissions due to the insistence, by the Jersey members, of perpetual rights for a railroad siding along the tunnel plaza. In the agreement, as now approved, no reference to the siding is made.

All bids for the construction of the Jersey shafts, received recently, have been rejected and the plan now is to include the Jersey shafts in the main tunnel contract.

Clifford M. Holland, chief engineer, has been authorized to have printed the contract and specifications for the under-river tunnel, the main portion of the project. If no hitch occurs, it is expected that a call for bids on the big subaqueous tunnel contract will be made during the latter part of December.

The board of consulting engineers, which was summarily "dismissed" last summer by the New Jersey commission, without the concurrence of the New York commission, has served a writ of mandamus on the New Jersey commission demanding their pay for the period May 14 to date. Each consulting engineer had been retained at a yearly rate of $10,000 and payment has been held up by the New Jersey body, which subsequently appointed two "technical advisers" in place of the consulting board. It is understood that the Supreme Court of New Jersey has set Dec. 28 for a hearing on the case of the "dismissed" consulting engineers.

## Cities on East Side San Francisco Bay Reject Consolidation

By a vote of 29,480 to 20,070, the ten municipalities of Alameda County, Cal., on Nov. 15 rejected the proposal for a consolidation of city and county governments. The Oakland vote was 16,000 for and 12,000 against, while all the other municipalities also voted against the measure. The Oakland balloting was light, only 29,000 out of 88,000 registered voters going to the polls. The vote from other parts of the county was the largest ever cast.

The proposed consolidation would have been under a new charter that provided for a city and county manager to be paid $12,000 a year with seven councilmen receiving $3,000 per year each.

## Object to Kendrick's Dismissal

Members of local engineering organizations, including the American Association of Engineers, the Alabama Technical Association, and the American Society of Mechanical Engineers, are objecting to the recent dismissal of Julian W. Kendrick as city engineer of Birmingham, Ala. Mr. Kendrick was replaced by the new city admistration, which took office Nov. 7 and appointed A. F. Hawkins as Mr. Kendrick's successor. Mr. Kendrick had served as city engineer for 30 years.

The board of commissioners of Birmingham has received a resolution from the three engineering societies above named protesting against their action in dispensing with the services of the former city engineer and demanding public announcement of the reasons for the commission's action.

## To Consider Rules for Tunnel and Compressed Air Work

The Industrial Board of the New York State Department of Labor has scheduled hearings on proposed rules relating to tunnel construction and work in compressed air, to be held at Buffalo (Iroquois Building) Dec. 12; at Rochester (Melbach Building) Dec. 14; at Syracuse (Onondaga County Court House) Dec. 16; and in New York City (Department of Labor headquarters)

TABLE I—PROPOSED WORKING PERIODS IN COMPRESSED AIR IN NEW YORK

| Pressure in Lbs. per Sq. In. | Total Length of Working Period, Hours | Number of Periods in Compressed Air | Length of Each Period, Hours | Rest Interval Between Periods, Hours |
|---|---|---|---|---|
| 0–21 | 8 | 2 | | |
| 21–30 | 6 | 2 | 3 | 1 |
| 30–35 | 4 | 2 | 2 | 2 |
| 35–40 | 3 | 2 | 1½ | 3 |
| 40–45 | 2 | 2 | 1 | 4 |
| 45–50 | 1 | 2 | ½ | 5 |

Dec. 20. Copies of the proposed rules may be secured from the Division of Industrial Codes, 124 East 28th St., New York City.

The proposed hours of labor in compressed air are indicated in Table 1. Other features of the rules relate to permissible periods of decompression, wash and rest rooms, sanitation and ventilation, medical attendance, and other subjects. Rules covering the transportation, storage and use of explosives are set forth in considerable detail.

## Kentucky Highway Department To Decentralize Activities

The State Highway Department of Kentucky, according to information received from Commissioner Joe S. Boggs, will reduce the number of its division engineers on Jan. 1 from 9 to 6, thereby increasing the size of the districts. An assistant division engineer and the necessary clerical help will be furnished to each division and many matters of detail that are now handled by the central office will be disposed of at division headquarters.

The work of the department, Commissioner Boggs points out, has so grown in the past two years that it is now necessary for the central office be made purely an administrative office and for most all detail work to be handled in the divisions. Under the new plan it is believed that the department will function much better than at present.

## Water and Other Bond Issues Beaten at Kansas City, Mo.

An $11,000,000 bond issue for waterworks improvements at Kansas City, Mo., and 17 other bond items were defeated in an election at Kansas City, Mo., Nov. 22, but while there were actual majorities against each of the miscellaneous items (bridges, sewers, paving, etc.) the water bond vote was 19,028 for to 12,350 against, the defeat being due to a two-thirds majority requirement. Charter amendments for creating a bi-partisan water commission and for the sale of the water bonds (if voted) were carried by large actual majorities. Another vote on the water bonds is predicted, perhaps on January 31, when it is hoped that they will be authorized, particularly now that provision has been made for a bi-partisan water commission.

## To Speed Public Works Program

Mayor Benjamin Bosse of Evansville, Ind., at a recent meeting with a committee he appointed to devise ways and means of providing work for unemployed men in that city, said he would speed up his public improvement program for the next four years in order to give work to the idle men. His idea was to have the work that he had mapped out for the next four years done in two years.

## Contractor Pours Seat Concrete in Ohio Stadium

Foundation work for the big stadium of the Ohio State University at Columbus has been practically completed by the E. H. Latham Co., the contractor, and in the western leg of the structure the reinforced-concrete seat-bank construction of the inner section is being poured. The stadium is in the form of a horseshoe. It will seat 63,000 spectators. Its main portion consists of steel frame and reinforced-concrete seating slab, but the inner portion is wholly of concrete. The broad lower tier, 148 ft. wide, will have fifty-four rows of seats. Above will be a narrower second tier.

Although the original working schedule of the contractor, drawn up at the time work began, last July, did not contemplate pouring any seat-slab concrete until next spring, such progress has been made that a large part of the inner section will be in place by winter. Steel erection and form construction will go on during the winter and all the concrete work will be completed next summer. It is expected that the first football game in the new stadium will be played during the 1922 season. The structure will require 4,300 tons of steel and about 4,500 cu.yd. of concrete. Its total cost will be $1,341,000 as fixed maximum, with profit sharing for reduction of cost below this amount.

CONSTRUCTING OHIO STATE UNIVERSITY STADIUM TO SEAT 63,000

## Engineer to Help Revise Charter of New York City

Among the members of the New York City Charter Revision Commission announced Nov. 28 by Gov. Miller are William Barclay Parsons, formerly chief engineer of the Rapid Transit Commission of New York City; Edward M. Bassett, a member of the recent Public Service Commission, First District, and chairman of the recent heights of Buildings and Zoning Commission; Francis M. Scott, a former corporation counsel of New York City and once a member of the Aqueduct Commission, who is named as chairman; Howard Lee McBain, professor of administrative law at Columbia University; and Herman A. Metz, formerly city controller. Under the legislative act creating the commission, the mayor, city controller, a borough president and the president of the board of aldermen are also members of the commission.

## Advance Planning of Public Works Is Proposed

### Senate Bill Aims to Provide Relief For Unemployment in Times of Depression

In order to carry out the policy recommended by the President's Conference on Unemployment at Washington, D. C., and to prepare against future periods of business depression and unemployment, a bill involving the long-range planning of public works was introduced last week into the Senate. The bill contemplates the allocation of public works construction over a period of years which shall provide employment in times of depression. It has in view that the prosecution of public works be utilized as a stabilizing force during a period of over-expansion as well as during a period of depression.

As a means of granting authority necessary to carry out such a policy, the bill provides that the head of each executive department be authorized to prepare and to revise periodically the necessary plans for public works and projects within his jurisdiction. From such information and from information furnished by the Department of Commerce as to the trend of business conditions, it is believed possible to forecast in a general way business conditions so that the allocation of public works in times of depression may serve to relieve unemployment stress.

The total value of all public works in the United States by all governmental agencies, without considering those public works paid for by current taxation, is estimated at $825,000,000 annually. If a national policy were adopted of expanding public works in years of depression and contracting public works during the other years, it is believed that there would be executed three times the average in a year of unemployment, inasmuch as such a period of stress is not likely to occur very often. Under such conditions it is estimated that approximately $2,500,000,000 would be available for public works construction in a bad year.

## Funds Available to Hetch Hetchy Mountain Division

The date of expiration on an option covering $8,520,000 of San Francisco's Hetch Hetchy Water Supply bonds, held by the Construction company of North America, has been extended from November 1 to February 15. The construction company, which holds the contract for the tunnel work on this project has already purchased more than $13,000,000 worth of these bonds.

Funds are now available for completing the mountain division of this project which includes the Hetch Hetchy dam, 18 miles of tunnel, and the forebay, penstock and equipment for the development of 66,000 hp. at Moccasin Creek. The $8,520,000 block of bonds under action is expected to supply funds with part of which can be built that portion of the aqueduct between Niles and Crystal Springs. This is the part of the Hetch Hetchy system which it is proposed that the city and the Spring Valley Water Co. use jointly according to a plan recently outlined by the California Railroad Commission (*Engineering News-Record*, Sept. 15, 1921, p. 463).

## Prof. Geffcott Is New Secretary of British Civil Engineers

Prof. Henry H. Geffcott, the recently appointed successor to Dr. J. H. T. Tudsbery as secretary of the Institution of Civil Engineers, London, has sent the following reply to congratulatory letter received from Elbert M. Chandler, acting secretary of the American Society of Civil Engineers:

"I thank you most warmly for your kind letter of congratulations and good wishes to me on my appointment to the secretaryship of the Institution of Civil Engineers.

"I look forward with much pleasure to my new work. I need hardly say I heartily reciprocate your wishes for cordial co-operation between our institutions and I trust that our work may be mutually helpful in the interests of our common profession."

## Pouring 1,000 Cu.Yd. Per Shift in Hetch Hetchy Dam

The first concrete in the Hetch Hetchy dam which is being built as a part of the new water-supply system for San Francisco, was poured late in August and on Nov. 18 a total of 53,000 cu.yd. had been placed. The maximum pour in 8 hr. was 1,239 cu.yd. and during the first 18 days of November six 8-hour shifts placed more than 1,000 cu.yd. each. Only one 8-hour shift is being worked per day at present.

The present contract is for carrying the dam up to a height of 342 ft. above the lowest foundation. This will involve a total of 365,000 cu.yd. of concrete and is to be completed before Feb. 1, 1923, which will be in time to store the 1923 summer runoff. A general description of the foundation work and preparation for construction of the dam appeared in *Engineering News-Record*, Aug. 11, p. 222.

## Sell $8,520,000 Block of Hetch Hetchy Water Bonds

The last of all the bonds that have been issued to date by San Francisco for the construction of the Hetch Hetchy water supply project were sold Nov. 15 in an $8,520,000 block which was unexpectedly taken up by the same syndicate of bankers which two months ago purchased a $13,500,000 issue of these securities. This syndicate is acting in conjunction with the Construction Company of North America which has the contract on the 18-mile tunnel. The total amount of Hetch Hetchy bonds issued to date is $45,000,000.

The $8,520,000 block just sold bears interest at 5½ per cent and was bought at par. The proceeds of the sale are to be reinvested in short-term and negotiable securities where the money will draw practically the same rate of interest as the Hetch Hetchy bonds.

This money will not be needed at present for work in the Mountain Division and is expected to be used, in part, on the Niles-San Francisco aqueduct which will ultimately be a part of the Hetch Hetchy system. In the meantime this aqueduct will add 22,000,000 gal. per day to the San Francisco supply by tying in with the Spring Valley system in accordance with a plan recently suggested by the California Railroad Commission.

## Memorial Hall for Detroit Voted

A proposed $5,500,000 bond issue for a Memorial Hall in the city of Detroit was authorized by the voters at the November election. The hall would be located near the established art center of the city and by serving as a convention hall it is expected that it would be self-supporting.

## To Junk or Not To Junk Moffat R.R.

The Bankers Trust Co. of New York has asked the courts to request the receiver of the Denver & Salt Lake (Moffat) Railroad to discontinue operations. Opposed to this action are state and city governments, Denver civic organizations and private commercial interests developed along the railroad. The petition of intervention by the Denver Civic and Commercial Association is on the ground that while 1920 showed a loss, the 1921 business has so far shown a substantial profit above all costs of maintenance and operation, despite unusual business and financial depression and the large sums spent on repairs and betterments.

It is further maintained that a substantial surplus has been accumulated in the hands of the receiver, large business enterprises established on the road will be ruined by a discontinuance of service, suspension of business will greatly diminish the value of the road if it is to be sold, and maintenance of the property as abandoned property will be greatly in excess of any possible deficit because of continued operation. The association prays that the court order a strict inquiry as to feasible methods of increasing revenues and decreasing operating costs and expenses.

## Ohio Water Purification Plant Operators Organize

As a result of a call issued by the Ohio State Department of Health, 46 representatives of the water filtration plants of Ohio met in Columbus, Nov. 21 and 22, and organized the Ohio Conference of Water Purification Plant Superintendents. The three main topics discussed were (1) systemization of plant and laboratory methods; (2) research work along lines suggested by the American Water Works Association; (3) monthly reports to the American Water Works Association; (3) monthly reports to the State Department of Health. There was also a question box.

Officers were elected as follows: chairman, J. W. Ellms, Cleveland; vice-chairman, J. S. Gettrust, Akron; secretary, Clarence Bahlman, Cincinnati. These three and R. W. Furman, Toledo, and F. J. Hull, Ashtabula, will constitute the Board of Directors.

## Award Contract for Big Dam

The Wichita Falls (Texas) Irrigation District, Nov. 16, awarded a contract to W. E. Callahan Construction Co. for (1) an earth storage dam across the Big Wichita River 50 miles above Wichita Falls, to cost $1,259,254; (2) diversion dam of the gravity concrete spillway type with a movable crest, $726,150; (3) the South Side canal leading to Wichita Falls from the diversion dam, which is located 30 miles below the storage dam, to Lake Wichita the source of the city's water supply, $566,234; and (4) the North Side main canal, $802,573. For the four items Smith-Healey Cons. Co. bid $1,354,310, $744,700, $586,241 and $804,363, respectively. Winston Bros. bid $2,055,950 and $824,548 respectively for items 1 and 3. Womack Construction Co. bid $949,979 and $1,279,008 for items 3 and 4. Scarborough-Smith-McEnroe bid $679,932 for item 3. R. A. Thompson is chief engineer in charge of the project for the district.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS: Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City: Annual Meeting, New York City, Dec. 5-9.

AMERICAN ROAD BUILDERS ASSOCIATION, New York: Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City: Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.: Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

**The Associated Technical Societies of Detroit**, at a joint meeting, Nov. 18, sponsored by the Detroit Engineering Society, was addressed by William Ord, manager of the paving department of the Lakewood Engineering Co., on "Modern Concrete Road Construction."

**The Taylor Society**, New York, announces that Henry R. Towne, chairman of the board, Yale & Towne Manufacturing Co., has been elected honorary president of the society.

**The Seattle Engineer's Club**, at its meeting Nov. 10, was addressed by E. R. Adams, manager, Alexander & Baldwin, Ltd., owners of extensive plantations, shipping and other industries in the Hawaiian Islands, on "Industrial Conditions in the Islands."

**The Seattle Section, Am. Soc. C. E.**, at its Nov. 10 meeting, was addressed by A. F. Wiking on "Pontoon Bridges in Sweden and the Proposed Lake Washington Bridge."

**The Western Society of Engineers'** program for December has scheduled the following papers on some engineering subjects: Dec. 5, "Economic Features of the St. Lawrence-Great Lakes Water Ways Project," by Francis Shenehon, consulting engineer, Minneapolis; Dec. 15, "Economic Considerations of Line Revisions on the Delaware, Lackawanna & Western R. R., by George J. Ray, chief engineer, Hoboken, N. J.; Dec. 19, "Operation of Sewage Disposal Plants," by H. H. Wagenhals, associate sanitary engineer, U. S. Public Health Service, Cincinnati. The Young Men's Forum Dec. 3 will hear S. H. Sheel, manager, investment bureau, Commonwealth Edison Co.,

Chicago, speak on "Selling the Utilities to the User." The public affairs committee, which now numbers 48 members, holds weekly lunches and recently was addressed by John Nolen, Cambridge, Mass., on the "Duty and Responsibility of the Engineer to His Fellow Citizens in City Plan Development."

## Personal Notes

IVAN HOUK, who has been engineer and district forecaster of the Miami Conservancy District, Dayton, Ohio, has been appointed city engineer of Dayton.

ALFRED A. TAYLOR, who has been an employee of the New York City Street Cleaning Department for more than 20 years and for several years general superintendent of the department, has been appointed commissioner to succeed John P. Leo, resigned.

M. G. FELDRAPPE, formerly structural engineer and chief estimator for the H. K. Ferguson Co., is now with the A. A. Lane Construction Co. in a similar capacity.

LEIGH HUNT and GEORGE MARKS have associated for the practice of engineering and architecture, in Milwaukee, Wis.

MACKLIN MACK, who has been a draftsman in the Indianapolis engineering department for four years and recently senior aid in the department, has been appointed engineer for the cith planning commission.

EDWIN A. PLITT, assistant civil engineer of the Baltimore Paving Commission, has resigned to enter the U. S. Consular Service.

C. D. BUCK, formerly assistant to the chief engineer, Delaware State Highway Department, has been promoted to the position of chief engineer. During 1922 the department proposes to carry on a construction program of $2,250,000.

HENRY J. SAUNDERS, formerly with the Bureau of Valuation, Interstate Commerce Commission, San Francisco, Cal., as supervising engineer in charge of the roadway office cost and report work, has been transferred to the Washington office of the commission as assistant supervising engineer in the new consolidated organization of the Bureau of Valuation, which takes over all the valuation work formerly handled by the offices at San Francisco, Kansas City, Chicago, Chattanooga and Washington.

WILLIAM GERIG, assistant chief engineer of the Alaskan Engineering Commission, since August, 1919, has resigned owing to the near approach of completion of the Alaska R.R. Mr. Gerig was a division engineer on the Panama Canal and later consulting engineer for the U. S. Reclamation Service and the New York State Barge Canal. In 1917, he was appointed consulting engineer for harbor and pier construction for the Alaskan Engineering Commission.

LAWRENCE V. SHERIDAN, an engineer of Dallas, Texas, and formerly employed in the park department of Indianapolis, has been appointed executive secretary of the Indianapolis planning commission at a salary of $5,000 a year. He will not take up his new duties until Dec. 19. He was engineer for the Indianapolis Board of Park Commissioners, 1911 to 1914, devoting a great deal of his time to locating boulevards and inspection of construction projects. He was connected with the Bureau of Municipal Research of New York City from 1914 to 1916. In 1917 he was in charge of planning Camp Pike, Ark., the National Army cantonment. Mr. Sheridan was commissioned a second lieutenant in the third officers' training camp and served in France in 1918. Since 1919 he has been engaged in business in Dallas, where he gave considerable attention to city planning, reclamation projects and municipal development.

## Obituary

PROF. CHARLES R. CROSS, member emeritus of the faculty of the Massachusetts Institute of Technology died Nov. 16 in Brookline, Mass. He was born in Troy, N. Y. in 1848 and received the degree of B.S. from the Massachusetts Institute of Technology in 1870. He was professor of physics at the institute from 1877 to 1917 when he was made emeritus professor. He was director of the Rogers Laboratory at the Institute from 1885 to 1917.

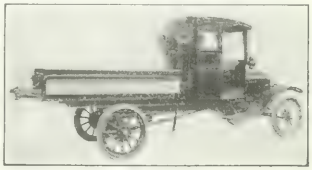
JOHN C. QUINTUS, assistant division engineer of the Great Lakes Division, U. S. Engineer's Office at Buffalo, N. Y., died in Buffalo, Nov. 27. He was born in Sheboygan, Wis., in 1856. After graduating from the University of Michigan in 1879, he joined Engineer Department of the Army and was assistant engineer on river and harbor improvement. In 1912 he became assistant division engineer to Col. James G. Warren, at Buffalo, and assistent in the design and construction of the harbor at Erie, Pa., the construction of the break-water in Buffalo harbor and the building of the Black Rock ship lock.

SIR DOUGLAS FOX, consulting engineer, of London, England, an international figure in the railway construction field, past-president of the Institution of Civil Engineers and honorary member of the American Society of Civil Engineers died in London Nov. 12, after only a few hours' illness. During recent years he had devoted much time to the designs and estimates for the proposed tunnel under the English Channel. He was born in 1840 at Bellefield, near Birmingham and began his engineering work on the Whitney Railway later being taken into partnership by his father Sir Charles Fox, a prominent consulting engineer. His principal work in this connection related first to the railways in the South of England and afterward included such projects as the Mersey River tunnel, opened to traffic in 1886, the Liverpool Overhead Railway, the London tubes, the Great Zambesi River bridge in South Africa, and the Cape Government Railways. In South America he constructed railways in the Argentine, Colombia, and Brazil. Sir Douglas was one of the founders of the British Engineering Standards Committee.

## Equipment and Materials

### End-Dump Hoist and Body for Ford Motor Truck

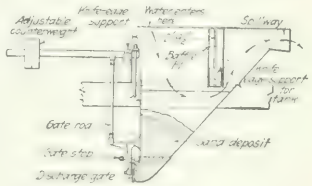
A steel body, with a hand hoist for end dump, is being built for Ford trucks by the Archer Iron Works, Chicago. With this hoist the body can



be lifted to dumping position in 30 sec. and dropped back by gravity in 5 sec. The body is steel, 44 x 14 in. x 7 ft. with a double-acting tail-gate and movable place boards.

### Balanced Sand Settling Tank

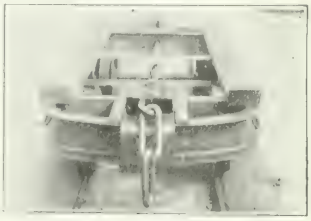
A balanced settling tank for sand and gravel washing plants has been designed by the Smith Engineering Works, Milwaukee, Wis. This tank, triangular in form and with a hopper bottom, is swung on supports and has a discharge valve opened by a lever with adjustable




counterweight. Knife edge bearings for both the tank and counterweight make the device sensitive and subject to close adjustment. In discharging, there is a double movement; the tank tips with the weight of sand, so that the bottom moves to the right. At the same time the lever opens the gate by a movement to the left, so that with ¼-in. travel of the gate there is a ½-in. gate opening.

### Improved Batch Box Car

A new batch-box car intended for the 1922 market by the Koeppel Industrial Car & Equipment Co., Koppel, Pa., has oval end frames of 6-in. ship channel.



Cast steel couplers with heavy springs are used. The 14-in. wheels, on 2½ in. heat-treated steel axles, have brass or roller bearings in boxes of the double spring suspension type.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## November Contracts Total $96,635,585 in Value

**Miscellaneous Buildings Form 45 per Cent of Total—Street and Road Work for Month is $20,750,75**

The value of contracts let during November, 1921, as reported in *Engineering News-Record*, totaled $96,635,585, as against $75,665,457 for the corresponding month of 1920. This represents an increase of 27.7 per cent in the actual amount of money involved. Were consideration taken of the decrease of construction costs within the year—about 35 per cent—the value of total contracts for the past month would become about $130,000,000, or a value about 73 per cent greater than for November, 1920. In the tabulations reproduced herewith no account is taken of residential building or of housing, except that for industrial uses.

Miscellaneous building construction—which includes bank and office, business, educational, and public buildings and churches, theaters, hotels, apartments, etc.—is valued at $42,859,857, which is more than double the value of contracts for similar construction during November, 1920. Street and road work is also high the total for this class of building being $20,750,756, as against $12,443,345 for the correspond-

VALUE OF CONTRACTS LET IN NOVEMBER

| | | |
|---|---|---|
| Sewers | 4,571,862 | 2,733,230 |
| Streets, roads | 12,443,345 | 20,750,756 |
| Excavation | 772,228 | 726,328 |
| Buildings | 19,502,015 | 42,859,857 |

ing month of 1920. Though 1921 has been a banner year in highway work, so far as the actual amount of money involved in contracts let is concerned, the indications are that 1922 will see even greater activity particularly if the high figure obtained in November for winter letting of road contracts continues.

Appropriations made for waterworks and sewer construction are about equal for the two years, the total being in either case around $7,000,000, the advantage in favor of November of 1921.

The amount of industrial construction being undertaken still fails to measure up to the corresponding month of 1920, the November figures being: 1920, $20,586,456; 1921, $11,402,944.

One of the interesting features of the comparative figures is the fact that a recent statement issuing from the War Department that the Corps of Engineers' work probably would be curtailed somewhat through lack of the appropriation of sufficient funds is apparently borne out in the value of contracts let by the Federal Government. These during November, 1921, amounted only to $693,751, as against $2,399,033 in November, 1920.

### Engineering News-Record Construction Cost Index Number

| | |
|---|---|
| December 1921 | 167.82 |
| November 1921 | 166.32 |
| December 1920 | 251.62 |
| Peak, June, 1920 | 273.80 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Cost Index Number is 1.5 points higher than last month owing to a stronger lumber market; pine in New York is $2.50 higher than a month ago. Structural shapes in large quantities can still be bought for $1.50 per 100 lb. The average labor rate for the country this month is 45c., the same as last. Thus, general construction cost is 33 per cent cheaper than one year ago and 39 per cent under the peak; it is 68 per cent above the 1913 level.**

### Engineering News-Record Construction Volume Index Number

| | |
|---|---|
| Monthly | |
| November 1921 | 101.00 |
| October 1921 | 109.00 |
| November 1920 | 51.00 |
| 1913 | 100.00 |
| Yearly | |
| 1921 (11 months) | 85.00 |
| 1920 (11 months) | 94.00 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Volume Index Number is 101 for the month of November, and 85 for the whole of 1921 to date, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let this year) is 15 per cent under the volume in the first 11 months of 1913. Our monthly volume number, 101 for November, 1921, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.**

## Canadian Railway Rates Cut

The Canadian Board of Railway Commissioners on Nov. 24 issued an order providing for a reduction in freight rates to become effective December 1. The order fixes freight rates on a basis of 25 per cent in the East and 20 per cent in the West above the rates effective prior to the increase made in September 1920 of 40 per cent in the East and 35 per cent in the West. Rates on coal are not altered.

Sleeping and parlor car fares are reduced to the basis of 25 per cent over the fares in effect prior to the increase in September 1920.

## Cement Down in the East

On Nov. 22 the mill price of cemen was dropped 15 cents per barrel in th eastern portion of the United State from Maine to central Pennsylvani and south to Texas. The price in th Lehigh Valley district is $1.60 net, t dealers. The price at the Hudson Rive mills was lowered 5 cents and th lighterage charge was reduced 5 cent making the reduction in New York an Long Island 10 cents.

## Federal Court Decision Favors Trade Associations

Much of the uncertainty regardin the legality of collecting and distribu ing trade information has been r moved by the recent decision rendere by Federal Judge Carpenter in Ch cago. The government's petition f an injunction against the America Linseed Co. was denied for want proof that a conspiracy existed in r straint of trade. The question involv was whether or not an association h the right to collect and furnish to i members current market quotation statistics as to stocks on hand, ge eral business conditions, or other i formation of interest to the trade.

The decision indicated that pric fixed by sales on an exchange estal lish the market at that moment, bu not for some future date and that industries where there are no ex changes the market is determined b the prices which the producers an dealers put upon their goods.

*Next Week—Production and Stocks of Materials in the Country*

## Bids Wanted on Big Jobs

Among the jobs on which bids are asked in Construction News, pp. 239-248, are the following: A $3,500,000 railway extension of the Temiskaming & Northern Ontario Ry., from Cochrane to Newport, Ont.; a $3,000,000 library for Philadelphia, Pa.; a $1,400,000 hospital enlargement for Milwaukee, Wis.; a $1,500,000 office building for Seattle, Wash.; a $1,000,000 school for Brooklyn, N. Y.; a $750,000 temple at New Britain, Conn.; apartment hotels at Pittsburgh, Pa., and Far Rockaway, N. Y., $1,000,000 and $800,000, respectively.

## California Road Contract Sought By Twenty-Two Firms

Sharp competition characterized the bidding for the first 7½-mile section of the Ocean Boulevard, which, when completed throughout, will connect the coast highway between Oxnard and San Juan Captistrano, and give Southern California 250 miles of uninterrupted coast-line highway. Twenty-two contracting firms subletted bids to the California Highway Commission for this work, which included grading a 40-ft. section and paving with cement concrete 20 ft. wide 6 in. thick, reinforced with steel rods. The bids ranged from $445,864 to $260,739. The engineer's net estimate on this section was $286,227.

### Trend of Business

**Stock Market**—Week's average 2 points higher than previous week. Sales to Nov. 26 exceed 151,000,000 shares, against 199,000,000 in the 1920 period.

**Bonds** — Strong tone continues. The feature was the 104.31 bid for $11,200,000 issue State of Pennsylvania fifteen to thirty year 4¾ per cent highway bonds. "Representative Public Bond Sales for October and November" will be published in this section next week.

**Money**—Funds plentiful, and no tightening expected for the remainder of the year.

**Foreign Exchange**—Sterling held at $3.99@$4, high. No features.

**Textiles**—Problem: raw materials (cotton, raw silk, wool, flax) advancing, with consuming public particularly averse to price increases on finished materials at this time.

**Steel**—Producing at about 50 per cent. October rate was 44 per cent. For price situation see "Ups and Downs of the Market," this issue.

## Milwaukee Body Recommends Aids to Unemployment Relief

Indicative of what is being done in all sections of the country to relieve unemployment are the recommendations made by the emergency employment committee of Milwaukee, Wis., which recommendation include a calling of a special session of the legislature to determine upon a 1923 road-building program, and the carrying on of extensive public work. Other recommendations are:

(1) That full use for registration and placing of men be made of the state employment bureau; (2) that the county board and city council be urged to get together immediately on the civic center plans; (3) that the zoning and city planning ordinances be promptly defined, but that no advantage be taken of the present emergency to weaken these undertakings; (4) that is considered prices will be no lower private building be begun now as it in the spring; (5) that manufacturers take advantage of the present conditions to put their plants in a high state of efficiency; (6) that owners of houses and other buildings be urged to start at once all repairs, improvements, etc.; (7) that the city council grant water and fire protection to buildings outside the city.

# Labor Rates and Conditions Throughout the Country

The wage scales as applied to the construction industry seem to have become generally stabilized for the winter. The only wage change reported is non-union or common labor in San Francisco, now 45@50c., as against 50 @55c. last month.

Atlanta reports that building fell off considerably in November, but that September and October showed heavy building permits, mostly for small residences.

Lathers are on strike in Cincinnati, having refused to accept the decision of the local wage board. No further adjustments will be made in labor rates in Philadelphia until after Jan. 1, 1922.

Construction work in Detroit shows a slight decrease from operations in effect this time last month. Denver reports 90 per cent of its bricklayers and carpenters at work; about 75 per cent of the hod carriers and common laborers are employed; but only 25 per cent of the structural iron-workers can find employment.

A survey of 83 representative industries in Baltimore shows a total increase of nine per cent in the number of employees for the month ending Nov. 15.

A comparison of labor rates prevailing in Montreal in 1914 with the current wage scale, shows bricklayers receiving 55c. then as against 80c. per hr. now; carpenters received 45c. at that time as compared with the present rate of 60c. per hr. and common labor was paid 30c., whereas the rate paid today is 25@30c. per hr. Building trades wages, generally speaking, are about 75 per cent higher than they were in 1914.

Labor plentiful, all classes.—Higher rates indicated by +, decreases by—

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | $0.90 | $0.70 | $1.00 | $0.30 | | $1.00 | $0.20 |
| Baltimore | 1.25 | .80 | .87½ | .54 | $0.74 | 1.00 | .30 |
| Birmingham | 1.00 | .75 | ..... | .25 | | 1.00 | .15@.25 |
| Boston | .90 | .75 | .90 | .60 | .90 | .90 | .40 |
| Cincinnati | 1.12½ | .87½ | .87½ | .72½ | .77½ | .77½ | .37½ |
| Chicago | 1.10 | 1.00 | 1.10 | | | 1.05 | .35@.40 |
| Cleveland | 1.01 | 1.04 | 1.04 | .60 | .91 | 1.04 | .57½ |
| Dallas | 1.00 | 1.00 | 1.00 | .60 | 1.00 | 1.00 | .35@.45 |
| Denver | 1.37½ | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.00 | .35@.40 |
| Detroit | 1.00 | .80 | .80@.90 | .50@.60 | 1.00 | .60@.80 | .50 |
| Kansas City | 1.07½ | 1.00 | 1.00 | .80 | 1.07½ | 1.07½ | .70 |
| Los Angeles | 1.25 | 1.00 | 1.00 | 1.12½ | .87½ | 1.00 | 50 |
| Minneapolis | 1.00 | .80 | .80 | .65 | | .80 | .50 |
| Montreal | .80 | .60 | .50 | .30@.35 | .50 | .55 | .25@.30 |
| New Orleans | 1.00 | .88 | .90 | .40 | .80 | 1.00 | .30 |
| New York | 1.25 | 1.12½ | 1.25 | .87½ | 1.00 | 1.12½ | .75 |
| Pittsburgh | 1.12½ | 1.00 | 1.00 | .80 | ..... | 1.00 | Open |
| St. Louis | 1.25 | 1.25 | 1.37½ | .87½ | 1.25 | 1.25 | .62½ |
| San Francisco | 1.10 | 1.03 | 1.03 | .92½ | 1.03 | 1.16 | —.45@.55 |
| Seattle | 1.00 | .80 | .90 | .70 | 1.00 | .80@.90 | .50 |
| Philadelphia | 1.00 | .90 | .90 | .75@.90 | 1.00 | .90 | .50@.60 |

## British Government's Decision on Unemployment Relief

(*London Correspondence*)

The British Government, in considering the various schemes for works to relieve unemployment, has come to the following decisions:

(1) In the case of non-revenue-producing works the grants will be made to the extent of 65 per cent of the interest and sinking fund charges on loans for approved expenditure.

(2) Subject to satisfactory arrangements being made for the supply of particulars of the men recruited to the employment exchange and subject to the preference to ex-service men, it will be within the discretion of local authorities to apply to boards of guardians for labor for their schemes.

(3) It is required that where a local authority undertakes the work by direct labor, the rate of wages for unskilled labor should, for a probationary period of six months, be appreciably lower than the full district rate prevailing in the area. The Cabinet Committee on Unemployment understands that local authorities will be assisted by a closer definition of the proportion of the full rate of wages which should be paid on these works, and they have decided that the rate of wages in such cases must not exceed 75 per cent of the local authority's rate for unskilled labor. This requirement of a lower rate of wages than the prevailing local rate does not, of course, apply in the case of schemes carried out by ordinary contract.

*If you don't see it in the Business Side of Construction, why not ask us to put it there?*

## Colorado Society of Engineers Reports Better Conditions

Engineering in Colorado, as reflected by the employment bureau of the Colorado Society of Engineers, is in a less critical condition than in other parts of the country. The number of positions filled by the free bureau is running 50 per cent lower than last year. Nevertheless, less than 5 per cent of the society members are without work. According to the society the city of Denver has found it necessary to investigate the exorbitant fees charged by some of the employment agencies and to start an agency of its own.

### *How's Your Business?*

**Myers-Whaley Co., Knoxville, Tenn.**, makers of shovel loaders for tunnel work—"Sales and shipments to Sept. 1 were 78 per cent of those for the same period of 1920. Prospects for new business depend on general condition of mining, etc. Prospects for fall and winter business uncertain."

**Barber-Greene Company, Aurora, Ill.**, material-handling machines—"Business so far this year has been 46⅔ per cent of that for the same period of 1920. Indications are that business will be much more than 46⅔ per cent of last year by the end of the year. We do not look for any great revival this fall or winter but look for good business in 1922, beginning in the spring. We cannot see that business conditions are greatly improved but at the same time we can detect a better spirit and much more confidence in the future."

## Census of Manufactures Practically Complete

The general schedule for the census of manufactures in the United States for the year 1921 has been practically completed. This two-year census will make available to industry a great deal of useful information which has heretofore been more or less fragmentary. Among the salient facts included in the census are amount of wages and salaries paid, the number of days factories were in operation during the calendar year, the number of hours normally worked by wage earners per shift and per week, the quantity produced of the principal products in manufacturing industries, the total value of all products, and the cost of all materials used in the manufacture of those products.

## Employment Rose One Per Cent During October

A general improvement in industrial conditions during October and an estimated decrease of unemployment by 1.01 per cent between September 30 and October 31 is indicated in a recent statement issued by the U. S. Labor Bureau. The estimate as to unemployment is based on reports received from 1,428 firms engaged in all kinds of industries.

A census of unemployment in New York City made by the committee on unemployment statistics appointed by the commissioner of public welfare shows that 343,000 persons were unemployed during the week of Oct. 17. This does not include a large number who are working on part time. Those out of work represent a total of about 13⅓ per cent of the city's 2,531,747 residents employed in gainful occupations as shown by the 1920 census. To this figure are added the idle from out of town estimated at from 20,000 to 50,000

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Railway Supplies**—Reduction of $5 on standard bessemer rails and $7 per ton on openhearth rails, Pittsburgh mills. Standard spikes quoted at $2.25 as against $2.30@$2.40; track bolts, $3.25@$3.50 as compared with $3.25@$3.55 per 100 lb., last month.

**Pipe**—Additional discounts of 3% quoted on all sizes, black and galvanized wrought steel pipe in New York warehouses. Drop of $2 quoted on 4-in. cast iron pipe in New York; $2 on 4-in. and $1 per ton on 6-in. Birmingham. San Francisco quotes advance of $1 per ton on 4-in. cast iron pipe.

**Road and Paving Materials**—Atlanta quotes asphalt at $27.50 as against $30 per ton in package. Decrease of 75c. per sq.yd. on wood blocks in St. Louis.

**Sand, Gravel and Crushed Stone**—New York quotes sand at $1 as against $1.25, and gravel at $1.75 as compared with $2 per cu.yd. one month ago. Gravel, ready mixed, current price $2 per cu.yd. Atlanta quotes decrease of 10c. in sand and 15c. per ton in gravel. Crushed stone in Atlanta $2 per ton as against $2.25.

**Lime**—New York quotes common lump lime at $3.39@$3.69 as against $3.69 per 280 lb. barrel (net). Reduction of 10c. per bbl. reported on lump finishing lime in Minneapolis, and on common lump in Atlanta. Seattle quotes reduction of 50c. per ton on hydrated finishing lime and Sheboygan lime is quoted in Minneapolis at $1.55 as against $1.60 per 180-lb. barrel.

**Cement**—Mills supplying New York quote $1.90 alongside dock, as against $2.10 per bbl. net; dealers hold to the $2.40 delivered price. St. Louis quotes $1.97, as against $2.25; Jersey City, $2.13 as compared with $2.28 a month ago. Decreases ranging from 15c. to 25c. per bbl. reported at certain of the principal cement mills.

**Structural Material**—Shapes, plates and bars $1.50, Pittsburgh, in large tonnages; small tonnages $1.60 per 100 lb. New York warehouses quote reduction of 10c. per 100 lb. on structurals, and advances ranging from 95c. to $1 per 100 yd. on expanded metal lath. Structural rivets $2.25@$2.40, Pittsburgh, as against $2.40, and ¾-in. cone-head boiler rivets $2.35@$2.50 as compared with $2.50 per 100 lb., formerly. Pittsburgh mills quote drop of 40c. on cut nails. San Francisco warehouses quote a decrease of 25c. on cut nails and an advance of 10c. per keg on wire nails.

**Lumber**—Advance of $2.50 per M. ft., b.m., wholesale, on long-leaf yellow pine, base sizes, quoted in New York. Pine lumber advanced $1 in Minneapolis, and increases ranging from $1 to $2.50 per M. ft. reported in Atlanta. Douglas fir up 50c. in Seattle, $3 in Los Angeles, and from 50c. to $2 in Minneapolis. Denver quotes decreases of 50c. to $3 in Douglas fir, base sizes. Hemlock up $2 in Minneapolis and down $1 per M. ft. in Los Angeles.

**Manila Rope**—Advanced 1c. per lb. in New York and Atlanta.

**Explosives**—Sixty per cent gelatin dynamite down 2c. per lb. in Los Angeles. Prices stable elsewhere.

**Linseed Oil**—Chicago quotes 76c. as against 72c. per gal. New York quotations same as in effect one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

**PIG IRON**—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

| | Current | One Year Ago |
|---|---|---|
| **CINCINNATI** | | |
| No. 2 Southern (silicon 2.25 @ 2.75) | $ [illegible] † | $46.50 |
| Northern Basic | [illegible] † | 40.00 |
| Southern Ohio No. 2 (silicon 1.75 @ 2.25) | 28.52† | 47.00 |
| **NEW YORK, tidewater delivery** | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | [illegible] † | 52.10 |
| **BIRMINGHAM** | | |
| No. 2 Foundry (silicon 2.25 @ 2.75) | *18.00*† | 42.00 |
| **PHILADELPHIA** | | |
| Eastern Pa., No. 2X, (2.25@2.75 sil.) | **23.26**† | 46.00* |
| Virginia No. 2 (silicon 2.25 @ 2.75) | **25.74**† | 46.25† |
| Basic | **25.74**† | 44.00* |
| Grey Forge | **22.50**† | 45.50 |
| **CHICAGO** | | |
| No. 2 Foundry Local (silicon 1.75 @ 2.25) | [illegible] † | 43@45 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | *24.66*† | 46@48 |
| **PITTSBURGH, including freight charge from the Valley** | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | [illegible] † | 44.00 |
| Basic | [illegible] † | 38.00 |
| Bessemer | 21.96† | 42.00 |

*F.o.b. furnace. † Delivered.

## RAILWAY SUPPLIES

**STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

| | Pittsburgh Current | Pittsburgh One Year Ago | Birmingham | Chicago |
|---|---|---|---|---|
| Standard bessemer rails | $40.00 | $45@55 | | **$40.00** |
| Standard openhearth rails | *50.00* | 47@57 | $40.00 | 40.00 |
| Light rails, 8 to 10 lb | 31.00@33.00 | 2.80@4.00* | 1.60* | 1.65@1.80* |
| Light rails, 12 to 14 lb | 31.00@33.00 | 2.84@3.84* | 1.60* | 1.65@1.80* |
| Light rails, 25 to 45 lb. | 31.00@33.00 | 2.75@3.75* | 1.60* | 1.65@1.80* |

*Per 100 lb.

**RAILWAY TIES**—For fair-sized orders, the following prices per tie hold:

| | 6 In. x 8 In. by 8 Ft. | 7 In. x 9 In by 8 Ft. 6 In |
|---|---|---|
| Chicago, White Oak | $1.35 | $1.50 |
| Chicago, Hardwood and Red Oa | 1.20 | 1.30 |
| Chicago, Empty Cell Creosoting (add'l) | .45 | .50 |
| San Francisco, Green Douglas Fir | .75 | .97 |
| San Francisco, Empty Cell Creosoted, Douglas Fir | 1.70 | 2.20 |

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

| | White Oak | Red Oak | Pine and Cap Cypress |
|---|---|---|---|
| Grade 3 | $1.15 | $1.05 | $0.95 |
| Grade 2 | 1.05 | .95 | .85 |
| Grade 1 | .95 | .85 | .75 |

**TRACK SUPPLIES**—The following prices are per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh Current | Pittsburgh One Year Ago | Chicago | St. Louis | New York |
|---|---|---|---|---|---|
| Standard spikes, ⅜-in. and larger | $ [illegible] | $4.00@4.25 | $5.00 | $4.50 | $4.00 |
| Track bolts | 6.00 | 6.00 | 5.00 | 4.50 | 4.50 |
| Standard section angle bars | 2.75 | 3.00@4.00 | 3.00 | 4.00 | 4.00 |

## PIPE

**WROUGHT PIPE**—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

| Inches | Steel Black | Galv | Iron Black | Galv |
|---|---|---|---|---|
| 1 to 3 | 68½ | 56 | 44½ | 29½ |

LAP WELD

| | | | | |
|---|---|---|---|---|
| 2 | 61½ | 49 | 39 | 25½ |
| 2½ to 6 | 65½ | 53 | 42 | 29½ |
| 7 and 8 | 62 | 49 | 40 | 27 |
| 9 to 12 | 61½ | 48 | | |

BUTT WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 1 to 1½ | 66½ | 55 | 1 to 1½ | 44½ | 30½ |
| 2 to 3 | 68½ | 56 | | | |

LAP WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 2 | 59 | 48 | 2 | 40½ | 27½ |
| 2½ to 4 | 63½ | 52 | 2½ to 4 | 43½ | 31½ |
| 4½ to 6 | 62 | 51 | 4½ to 6 | 42½ | 30½ |
| 7 to 8 | 58½ | 45 | 7 to 8 | 35½ | 23¼ |
| 9 to 12 | 52 | 39 | 9 to 12 | 30¼ | 18¾ |

**STEEL**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black New York | Black Chicago | Black St. Louis |
|---|---|---|---|
| 1 to 3 in. butt welded | 63% | **60%** | **56½%** |
| 3½ to 6 in. lap welded | 54% | **57%** | **53½%** |

| | Galvanized New York | Galvanized Chicago | Galvanized St. Louis |
|---|---|---|---|
| 1 to 3 in. butt welded | 50% | 46% | **42½%** |
| 3½ to 6 in. lap welded | 50% | 43% | **39½%** |

Malleable fittings, Class B and C, from New York stock sell at list less 5% Cast iron, standard sizes, 32% off.

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York Current | New York One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
|---|---|---|---|---|---|---|
| 4 in. | $50.50 | $87.22 | $38.00@$50.00 | 48.50 | $46.20 | **$54.00** |
| 6 in. and over | 47.50@48.50 | 77.22 | 36.00@42.00 | 44.50 | 43.20 | 50.00 |

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin.ft.:

| Size, In. | New York Current | New York One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 3 | $40.00 | $62.00 | $35.00 | $50.00 | | **$55.00** |
| 4 | 50.00 | 77.00 | 45.00 | 60.00 | $90.00 | 65.00 |
| 5 | 80.00 | 110.00 | 140.00 | 80.00 | 115.00 | 84.00 |
| 6 | 105.00 | 140.00 | 140.00 | 100.00 | 150.00 | 110.00 |
| 8 | 175.00 | 228.00 | 200.00 | 150.00 | 250.00 | 181.00 |

**SEWER PIPE**—The following prices are in cents per foot for carload lots:

| Size, In | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | $0.14 | $0.087 | | $0.1175 | 0.12 | $0.12 | |
| 4 | 14 | 087 | $0.09 | 1575 | 12 | 15 | $0.18 |
| 5 | 21 | 1305 | | 1645 | 18 | 18 | 165 |
| 6 | 21 | 1305 | 135 | 225 | 18 | 21 | 25 |
| 8 | 35 | 203 | 225 | 315 | 28 | 30 | 35 |
| 10 | 52 | 3045 | | 329 | 42 | 42 | |
| 12 | 67 | .3915 | 3825 | 441 | 54 | 54 | 80 |
| 15 | 1.15 | .522 | 5625 | 73 | 72 | 90 | |
| 18 | 1.55 | 725 | 765 | 1.029 | 1.00 | 1.32 | |
| 20 | 1.98 | .87 | 1.125 | 1.372 | 1.20 | | |
| 22 | 2.64 | 1.16 | | | 1.60 | | |
| 24 | 2.97 | 1.305 | 1.4625 | 1.95 | 1.80 | 2.16 | 2.40 |
| 27 | 4.50 | 1.885 | | 2.75 | 3.75 | 3.00 | |
| 30 | 5.00 | 2.088 | 3.20 | 3.40 | 4.75 | 3.60 | |
| 33 | 6.55 | 2.61 | | 4.05 | 5.50 | | |
| 36 | 7.50 | 2.9725 | | 4.70 | 6.00 | | |
| | | 3 | 5 | 8 | 12 | 24 | 36 |
| Boston | | $0.108 | $0.162 | $0.252 | $0.486 | $1.62 | $4.92 |
| Minneapolis | | | | 40 | 77 | 2.55 | 5.66 |
| Denver | | | 15 | 30 | 50 | 1.95 | |
| Seattle | | 145 | | 36 | 72 | 2.59 | |
| Los Angeles | | 117 | 165* | 275 | 495 | 1.65 | |
| New Orleans | | | 108 | 27 | 459 | 1.755 | |
| Cincinnati | | 10 | 15 | 233 | 45 | 1.50 | 4.305 |
| Atlanta | | 098* | 147 | 245 | 4165 | 1.5925 | |
| Montreal, delivered | | 30* | 45 | 85* | 1.35 | 4.50 | 6.50 |
| Detroit | | 105 | 157½ | 245 | 4725 | 2.115 | 5.4325 |
| Baltimore (f.o.b.) | | 1225 | 2275 | 35 | 6885 | 2.28 | 5.2 |
| Kansas City, Mo. | | 15 | 21 | 33 | 60 | 2.41 | 4.74 |
| Philadelphia | | 095 | 143 | 225 | 45 | 1.44 | 4.60 |

*4-in., 6-in., 9-in., respectively.

## ROAD AND PAVING MATERIALS

**ROAD OILS**—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

| | Current | One Year Ago |
|---|---|---|
| New York, 45% asphalt (at terminal) | $0.05½ | $0.12 |
| New York, 65% asphalt (at terminal) | 05 | .12 |
| New York, binder (at terminal) | 08 | 12 |
| New York, tar (at terminal) | .06½ | 11 |
| New York, liquid asphalt (at terminal) | .06½ | 11 |
| St. Louis, 40-50% asphalt | .015* | .12 |
| Chicago, 40-50% asphalt | 05 | 08½ |
| Chicago, 60-70% asphalt | 05½ | 08½ |
| Dallas, 40-50% asphalt | 10 | 10 |
| Dallas, 60-70% asphalt | 13 | 13 |
| Dallas, 75-90% asphalt | 15 | 15 |
| San Francisco, binder, per ton | 15.00† | 15.00 |

*Contract $21.75 per ton in Western field.
†F.o.b. Oleum, Cal. Freight to rail points 80 per cent.

**ASPHALT**—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots:

| | Package | Bulk |
|---|---|---|
| New York (Bayonne, N. J.) | $26.00 | $17.00 |
| Boston | No quotations | |
| Chicago | 25.85 | 19.50 |
| San Francisco, Oleum, Cal. | 21.50* | 15.00* |
| Dallas | 35.00 | 27.00 |
| Seattle | 27.50 | 21.50 |
| Denver | 45.00 | 65.00 |
| Minneapolis | ..... | 20.50 |
| St. Louis | 28.00 | 22.00 |
| Baltimore | 28.85 | ..... |
| Los Angeles, *at factory* | 22.50 | 15.00 |
| Montreal | 28.00 | 21.00 |
| Atlanta | 27.50 | ..... |
| Detroit (petroleum asphalt) | 24.50 | 20.00 |
| Cincinnati | 26.10 | 21.80 |
| Maine: N. J. base bbl. | 27@38 | ..... |
| Maine: N. J. asphalt cement | 29@36 | 25@31 |
| Philadelphia | 22.00 | 16.50 |

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

**PAVING STONE—**

| | | |
|---|---|---|
| New York | 5-in. granite, 28@29 blocks per sq.yd. | $130.00 per M |
| Chicago | About 4x8x4 dressed | 3.35 sq.yd. |
| | About 4x8x4 common | 3.00 sq.yd. |
| San Francisco | Basalt block 4x7x8 | 65.00 per M |
| Boston | 5-in. granite | 125.00 per M |
| Atlanta | Granite | 2.00 sq.yd. |
| Detroit | Granite, 26½ blocks per sq.yd. | 107.00 per M |
| Baltimore | Granite | 2.15 sq.yd. |
| Montreal | Granite | 125.00 per M |
| New Orleans | Granite, 4 x 8 x 4 | 3.25 sq.yd. |
| Cincinnati | Granite | 4.30 sq.yd. |
| St. Louis | 4x8x4 dressed | 3.25 sq.yd. |
| | 4x8x4 common | 3.00 sq.yd. |
| Kansas City | No. 1 Granite | 3.95 sq.yd. |
| Philadelphia | Granite | 2.10 sq.yd. |

**FLAGGING—**

| | | | |
|---|---|---|---|
| New York | Bronx | $0.25 | sq.ft. |
| | Manhattan, 4 ft. | .26 | sq.ft. |
| | Queens, 5 ft. | .26 | sq.ft. |
| | 6x20-in. cross-walk | 1.00 | lin.ft. |
| Chicago | 18 in. wide | .99 | lin.ft. |

**CURBING**—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

**WOOD BLOCK PAVING—**

| | Size of Block | Treatment | Per Sq.Yd. |
|---|---|---|---|
| New York | 3 | 16 | $2.09 |
| New York | 3½ | 16 | 2.17 |
| New York | 4 | 16 | 2.37 |
| Boston | 3 | 16 | 2.17 |
| Chicago | 4 | 16 | 3.00@3.25 |
| Chicago | 3½ | 16 | 2.50@2.75 |
| St. Louis | 3½ | 16 | 2.50 |
| St. Louis | 4 | 16 | 3.00 |
| Seattle | 4 | 16 | Off market |
| Minneapolis | 3½ | 16 | 2.15 |
| Atlanta | 3½ | 16 | 2.30 |
| New Orleans | 3 | 16 | 2.00 |
| New Orleans | 3½ | 16 | 2.25 |
| New Orleans | 4 | 16 | 2.50 |
| Dallas | 4 | 18 | 3.90 |
| Baltimore | 3½ | 16 | 3.60 |
| Montreal, delivered | 4 | 16 | 4.50 |
| Detroit | 3 | 16 | 2.84 |
| Detroit | 4 | 16 | 3.00 |
| Cincinnati | 4 | 16 | 2.60 |
| Kansas City | 4 | 16 | 2.15 |
| Philadelphia | 3½ | 16 | 3.50 |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots is as follows, per cu.yd.:

| | Gravel 1½ In. Current | Gravel 1½ In. One Year Ago | Gravel ¾ In. Current | Gravel ¾ In. One Year Ago | Sand Current | Sand One Year Ago |
|---|---|---|---|---|---|---|
| New York | $1.80@1.90 | $3.00 | $1.80@2.00 | $3.00 | $1.60@1.90 | $1.50 |
| Denver | 2.50 | 2.00 | 2.50 | 1.80 | 1.10 | 1.60 |
| Chicago | 2.00 | 2.75 | 2.00 | 2.75 | 2.00 | 2.75 |
| St. Louis, *per ton* | 1.30 | 1.05 | 1.25 | 1.70 | 1.20* | 1.70 |
| Seattle | 1.50 | 1.25 | 1.50 | 1.25 | 1.50* | 1.25 |
| Dallas, *delivered* | 2.25 | 2.50 | 2.25 | 2.50 | 2.25 | 2.00 |
| Minneapolis, *at pit* | 1.50 | 2.00 | 1.50 | | .50 | 1.25 |
| Cincinnati | 1.87 | 2.00 | 2.03 | 2.00 | 1.60 | 2.00 |
| San Francisco | 2.25 | 2.00 | 2.25 | 2.50 | 1.50 | 1.65 |
| Boston, *per ton* | 2.65 | 2.00 | 2.65 | 2.60 | 2.00 | 1.60 |
| New Orleans | 2.00 | .90 | | | 1.35 | 1.85 |
| Los Angeles, per ton | 1.35† | 1.25 | 1.35† | 1.25 | 1.20† | 1.15 |
| Memphis, per ton | 3.50 | 3.12 | 3.50 | | 1.75 | 1.62 |
| Detroit | 2.00 | 1.85* | 2.00 | 1.85 | 2.00 | 3.50 |
| Baltimore, per ton | 1.40 | 1.40‡ | 1.40 | 1.60‡ | 2.40 | .70 |
| Montreal, per ton | 1.25 | 1.50‡ | 1.50 | | 1.25 | 1.25‡ |
| Cleveland, per ton | Limited supply of gravel | | | | 1.28 | 1.25‡ |
| Philadelphia | 1.90 | | 1.55 | | 1.90 | |

*Price with sand. †Freight from quarries to Los Angeles. ‡Freight from quarries to Detroit. §Ottawa $4.50. ‖Freight from quarries to Montreal. ¶Average 70c. per ton; sand is included in above price.

‡Per cu.yd.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. Current | 1½ In. One Year Ago | ¾ In. Current | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1.80@1.90 | $1.90@2.00 | $1.80@1.90 | $2.15 |
| Chicago | 1.60 | 2.75 | 1.60 | 2.75 |
| St. Louis, *delivered* | 1.55* | 2.00 | 1.55* | 2.00 |
| Dallas, *delivered* | 3.20 | 2.50 | 3.20 | 2.50 |
| San Francisco | 2.25 | 2.50 | 2.25 | 2.25 |
| Boston, *delivered* | 3.00* | 3.00* (del.) | 3.00* | 3.00* (del.) |
| Minneapolis, *at plant* | 2.00 | 2.00 | 2.25 | 2.50 |
| Kansas City | 2.75 | 2.35 | 2.75 | 2.35 |
| Denver | 3.50 | | 3.50 | |
| Seattle, *delivered* | 3.00 | 3.50 (del.) | 3.00 | 3.50 (del.) |
| Atlanta | 2.00* | 3.25 | 2.00* | 3.50 |
| Cincinnati *delivered* | 2.37½ | | 2.08 | 2.15 |
| Los Angeles | 1.60‡ | 1.60* | 1.70* | 1.70* |
| Detroit | 1.90* | 2.00 | 1.90* | 2.00* |
| Baltimore | 1.75* | 1.75* | 1.65* | 1.75* |
| Montreal | 2.00* | 2.30* | 2.10* | 2.55* |
| Birmingham *delivered* | 3.20 | | 3.10 | |
| Philadelphia | 1.70* | | 1.60* | |

*Per ton.

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants:

| | 1½-In. | ¾-In. | Roofing | Sand |
|---|---|---|---|---|
| Lebanon or Bethlehem, Pa. | $1.00 | $1.00 | $2.50 | $0.60 |
| Easton or Catasauqua, Pa. | 1.00 | 1.00 | 2.00 | |
| Buffalo, N. Y. and Erie, Pa. | 1.25 | 1.25 | 2.25 | 1.00 |
| Emporium, Pa. | 1.25 | 1.25 | | 1.00 |
| East Canaan, Conn. | 1.25 | 1.35 | 4.00 | 1.00 |
| Birmingham, Ala. | .75 | .95 | 2.05 | |
| Toledo, Ohio | 1.50 | 1.50 | 2.35 | |
| Atlanta, Ga. | | 2.10 | | |
| Eastern Pennsylvania and New Jersey | 1.20 | 1.20 | 2.50 | |
| Western Pennsylvania and New Jersey | 1.25 | 1.25 | 2.50 | 1.00 |
| Birmingham, f.o.b. sidings | $1.12 (or $1.45 per cu. yd. on site) | | | |

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per 180-Lb. Barrel Finishing | Lump, per 180-Lb. Barrel Common |
|---|---|---|---|---|
| New York | $16.99 | | | $3.39@3.45 |
| Chicago | 18.00 | | | 1.40 |
| St. Louis | 0.58 | $0.50 | $2.25 | 0.75 |
| Boston | 23.00 | 20.00 | 3.35 | 3.15 |
| Dallas | 25.00 | | | 2.75 |
| Cincinnati | 0.49 | 0.45 | | |
| San Francisco | 22.00 | 18.00 | | 1.90 |
| Minneapolis | 29.00 | 22.00 (white) | 1.70 | 1.40 |
| Denver | 30.00 | | 3.95† | 2.90 |
| Detroit | 15.25 | 13.25 | 11.50‡ | 10.50 |
| Seattle | 27.00 | | 3.25 | 2.75 |
| Los Angeles | 30.00 | 30.00 | 3.00* | 3.00 |
| Baltimore | 15.00 | 13.00 | | 12.00 |
| Montreal | 21.00 | 21.00 | 15.00‡ | 15.00 |
| Atlanta | 19.00 | 16.00 | 2.00 | 1.75 |
| New Orleans | | 17.25 | | 1.17 |
| Philadelphia | 14.50 | 12.50 | | 11.00 |

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.

Minneapolis quotes brown lime; Kelly Is, white is $1.70. Sheboygan $1.5
Cincinnati and St. Louis quotes hydrated lime per 50-lb. sack.
Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24 per ton.

NOTE—Refund of 10c per barrel.

**NATURAL CEMENT**—Price to dealers per bbl. for 500 bbl. or over, f.o.b. cars, exclusive of bags:

| | Current | One Year |
|---|---|---|
| Minneapolis (Rosendale) | $2.80 | $1.85 |
| Kansas City (Ft. Scott) | 1.60 | 1.60 |
| New Orleans | 3.16 | 3.36 |
| Atlanta (Magnolia) | 11.00 ton | 1.90 |
| Cincinnati (Utica) | 1.77 | 2.85 |
| Boston (Rosendale) | 85@.95 | 2.35 |

**PORTLAND CEMENT**—Current prices are for barrels in carload lots, with bags, to contractors:

| | Current | One Month Ago | One Year Ago |
|---|---|---|---|
| | Without Bags | | Without Bags |
| New York (delivered) | $2.40 | $2.40 | $4.10 |
| New York, alongside dock to dealers | 1.90 | 2.10 | |
| Jersey City | 2.13 | 2.28 | 3.55 |
| Boston | 2.61 | 2.61 | 3.63 |
| Chicago | 1.97 | 1.97 | 2.35 |
| Pittsburgh | 2.02 | 2.02 | 2.42 |
| Cleveland | 2.28 | 2.28 | 2.73 |
| Detroit | 2.31 | 2.31 | 2.78 |
| Indianapolis | 2.23 | 2.23 | 2.61 |
| Toledo | 2.31 | 2.31 | 2.71 |
| Milwaukee | 2.19 | 2.19 | 2.59 |
| Duluth | 1.95 | 1.95 | 2.35 |
| Peoria | 2.14 | 2.14 | 2.63 |
| Cedar Rapids | 2.28 | 2.28 | 2.71 |
| Davenport | 2.22 | 2.22 | 2.67 |
| St. Louis | 1.97 | 2.25 | 3.45 |
| San Francisco | 2.84 | 2.84 | 3.09 |
| New Orleans | 2.88 | 2.88 | 4.60 |
| Minneapolis (on cars) | 2.26 | 2.26 | 3.50 |
| Denver | 3.10 | 3.10 | 3.25 |
| Seattle | 3.10 | 3.10 | 3.12 |
| Dallas (f.o.b.) | 2.55 | 2.55 | 3.85 |
| Atlanta | 2.69 | 2.60 | 3.75 |
| Cincinnati | 2.37 | 2.37 | 3.32 |
| Los Angeles | 3.31 | 3.31 | 3.10 |
| Baltimore (del.) | 2.88 | 2.88 (del.) | 4.08 (del.) |
| Birmingham | 2.27 | 2.27 | |
| Kansas City | 2.45 | 2.45 | 2.76 |
| Montreal (delivered) | 3.12 | 3.21 (del.) | 2.95 (in bags) |
| Philadelphia | 2.50 (del.) | | |

NOTE—Bag, 10c. each, 40c. per bbl.; 80c. per bbl. in Montreal.

Current mill-prices per barrel in carload lots, without bags; to contractors:

| | |
|---|---|
| Buffington, Ind. | $1.85 |
| Pittsburgh, Pa. | 1.85 |
| Steelton, Minn. | 1.85 |
| Northampton, N. Y. | 1.85 |
| Hudson, N. Y. | 1.85 |
| Valentine, N. J. | 1.85 |
| Lehigh Valley District | 1.85 |

**TRIANGLE MESH**—Price per [illegible] lbs.:

PLAIN 4-INCH & 4-INCH MESH

| Style Number | Weight in Pounds | Pittsburgh, Mill | New York (at dock) | Chicago | Dallas | San Francisco |
|---|---|---|---|---|---|---|
| 032 | 0.22 | $0 74 | $1 13 | $0 82 | $1 15 | $1 24 |
| 049 | 0.28 | 94 | 1 40 | 1 05 | 1 46 | 1 56 |
| 068 | 0 35 | 1 14 | 1 62 | 1 27 | 1 80 | 1 92 |
| 093 | 0.45 | 1 46 | 2 11 | 1 63 | 2 30 | 2 46 |
| 126 | 0.57 | 1 80 | 2 58 | 2 02 | 2 86 | 3 07 |
| 153 | 0.68 | 2 14 | 3 05 | 2 40 | 3 40 | |
| 180 | 0.78 | 2 46 | 3 48 | 2 76 | 3 93 | |
| 245 | 1.03 | 3 24 | 4 55 | 3 63 | 5 15 | |
| 287 | 1.19 | 3 75 | 5 30 | 4 20 | 5 96 | 6 41 |
| 336 | 1 38 | 4 35 | 6 07 | 4 87 | 7 32 | .... |
| 395 | 1.60 | 5 04 | 7 01 | 5 65 | 8 00 | .... |

PAVING

| | | | | | | |
|---|---|---|---|---|---|---|
| 036P | 0.17 | $0 56 | $0 88 | $0 62 | $0 88 | .... |
| 053P | 0.24 | 79 | 1 20 | 0 88 | 1 24 | .... |
| 072P | 0.31 | 99 | 1 48 | 1 11 | 1 57 | .... |
| 097P | 0.40 | 1 28 | 1 87 | 1 43 | 2 02 | .... |
| 049R | 0.24 | 79 | 1 20 | .... | 1 24 | .... |
| 067R | 0.31 | 99 | 1 48 | .... | 1 57 | .... |
| 084R | 0.40 | 1 28 | 1 87 | .... | 2 02 | .... |

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in roll-150-, 200- and 300-ft. lengths. Galvanized [illegible] about 15% higher.

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27 | 233 | **$24 20** | $23 39 | $23 39 | $27 62 | $25 50 |
| 26 | 250 | **25 65** | 24 93 | | 29 21 | 27 56 |
| 25 | 300 | **28 30** | 27 45 | 27 45 | | 30 71 |
| 24 | 340 | **30 10** | 29 33 | 29 33 | 35 73 | 33 16 |
| 22 | 433 | **34 75** | 34 06 | .... | .... | 35 10 |

* Price to contractors at warehouse [illegible] in Manhattan, Bronx or Brooklyn.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.:

ROLLED FROM BILLETS

| | Warehouse, Uncut | | | | | |
|---|---|---|---|---|---|---|
| Inches | *Pittsburgh, Mill | Birmingham Mill | New York | Chicago | St. Louis | Dallas | San Francisco |
| ½ and larger | $1 75 | $1 75 | $[illegible] | $1 90 | $2 87 | $3 50 | $3 00 |
| ⅝ and larger | 1 55 | 1 90 | [illegible] | 1 95 | 2 92½ | 3 55 | 3 05 |
| ¾ and larger | 1 60 | 1 90 | [illegible] | 2 00 | 2 97½ | 3 60 | 3 10 |
| ⅞ and larger | 1 75 | 1 90 | [illegible] | 2 15 | 3 12½ | 3 75 | 3 25 |
| 1 and larger | 1 00 | 1 90 | [illegible] | 2 40 | 3 37½ | 4 00 | 3.50 |

* Pittsburgh mill prices on large tonnages only.

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| ½ and larger | $1 75 | $1 90 | $3 25 | ½ | $2 00 | $2 15 | $3 50 |
| ⅝ in. | 1 80 | 1 95 | 3 30 | ¼ | 2 25 | 2 40 | 3 75 |
| 1 | 1 85 | 2 00 | 3 35 | | | | |

**BRICK**—Contractors price per 1,000 [illegible] carload lots, as follows:

| | Current | One Month Ago | One Year Ago | Paving Block, 3-inch* | Paving Block, 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $18 40 | $18.40 | $22 70 | $47 00 | $42 50 |
| New York (at dock) | 15 00 | 15 00 | .... | .... | .... |
| Chicago | 11 00 | 11 00 | 15 00 | 34 00 | 40 00 |
| St. Louis, salmon | 17 00 | 17 00 | 17 00 | .... | .... |
| Denver, salmon | 14 00 | 14 00 | 15 00 | .... | .... |
| Dallas | 12 72 | 12 72 | 25 00 | 44 00 | .... |
| San Francisco | 18 00 | 18 00 | 18 00 | .... | 44 38 |
| Los Angeles | 15 50 | 15 50 | 13 50 | [illegible] not used | .... |
| Portland (del.) | 17 00 | 17 00 | 30 00 | 46 00 | 56 25 |
| Minneapolis (del.) | 17 00 | 17 00 | 24@26 | .... | 43 00 |
| Kansas City | 14 50 | 14 50 | 22 00 | .... | .... |
| Seattle | 14 00 | 14 00 | 19 00 | 48 00 | 53 50 |
| Cincinnati | 18 00 | 18 00 | 22@23 | 41 00 | .... |
| Montreal (del.) | 16 00 | 16 00 | 20 00 | 100 00 | 120 00 |
| Indianapolis | 15 00 | 17 00 | 20 00 | 41 30 | 44 00 |
| Baltimore (del.) | 20 00 | 20 00 | 20@25 | 38 00 | .... |
| Atlanta | 25 00 | 25 00 | 26 00 | 40 00 | .... |
| New Orleans | 14 00 | 14 00 | 25 50 | .... | .... |
| Pittsburgh | 11 50 | 11 50 | .... | .... | .... |
| Philadelphia | 16 00@19 00 | | | | 42 00 |

* For paving blocks [illegible] ‡ Vitrified 1-lb plant, Baltimore.

**HOLLOW TILE**—Price per block in carload lots to contractor for hollow building tile.

| | New York | | | | | Pittsburgh, Lyons | Amboy N. J., Factory |
|---|---|---|---|---|---|---|---|
| | Current | One Year Ago | Chicago | Philadelphia | St. Louis | | |
| 4x12x12 | $0 [illegible] | $0 2444 | $[illegible] | $0 195 | $0 145 | $0 145 | |
| 6x12x12 | 15160 | 3259 | .0450 | 195 | 195 | 20 | |
| 8x12x12 | 20210 | .4345 | [illegible] | 245 | 145 | 315 | $0 17810 |
| 10x12x12 | | | .1584 | 320 | 200 | | 22260 |
| 12x12x12 | | | .1811 | 395 | 230 | | 26720 |
| Hollow partition block | | | | | | | |
| 4x12x12 | | | | | | | 12x12x12 |
| [illegible] | | | $6 [illegible] | | | $0,182 | $0 251 |
| [illegible] | | | | | | | |
| Metropolis (delivered) | | | | | | | |
| Cincinnati | | | .0682 | | 128 | | 179 |
| Kansas City | | | 025 | | 187 | | 274 |
| Denver | | | 09 | | 16 | | 24 |
| Seattle | | | 19 | | 175 | | 30 |
| Los Angeles factory | | | 103 | | 195 | | 22 |
| Minneapolis | | | 14 | | 25 | | 42 |
| Portland (delivered) | | | 070 | | 135 | | 225 |
| Cleveland | | | 15 | | 30 | | 35 |
| Baltimore | | | 16 | | 26 | | 42 |
| Atlanta | | | .... | | 1.0 | | |
| Birmingham | | | 124 | | | | |
| San Francisco and New York | | | 095 | | 1785 | | |

**STRUCTURAL MATERIAL**—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with [illegible] per 100 lb from warehouses at places named:

| | *Pittsburgh, Mill | Birmingham, Mill | New York (del.) | Dallas | St. Louis | Chicago (del.) | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in | 1.50 | $1 90 | $2 28 | $4 00 | $2 97½ | $2 88 | $3 70 |
| Channel, 3 to 15 in. | 1.50 | 1 90 | 2 28 | 4 00 | 2 97½ | 2 88 | 3 70 |
| Angles, 3 to 6 in., ¼ in. thick | 1.50 | 1 90 | 2 28 | 4 00 | 2 97 | 2 88 | 3 70 |
| Tees, 3 in. and larger | 1.50 | 1 90 | 2 28 | 4 00 | 2 97 | 2 88 | 3 70 |
| Plates | 1.50 | 1 90 | 2 28 | 4 00 | 2 97 | 2 88 | 3 70 |

* Pittsburgh mill price on large tonnages; small tonnages $1.60 per 100 lb.

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Warehouse | | | | | |
|---|---|---|---|---|---|---|
| | Pittsburgh, Mill | New York — Current | New York — One Yr Ago | Chicago | St. Louis | San Francisco | Dallas |
| ½ in. and larger | $2.25@2.40 | $3 70 | $6 11 | $3 42 | $3 77½ | $5.50 | $5 50 |

CONE HEAD BOILER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | 2.35@2.50 | 3 80 | 7 10 | 3.52 | 3 87½ | 5 60 | 5 65 |
| ⅝ and ¾ | 2.50@2.65 | 3 95 | 7 25 | 3.68 | 3 87½ | 5 75 | 5 80 |
| ⅞ and 1 | 2.75@2.90 | 4 20 | 7 50 | 4.18 | 3 87½ | 6 00 | 6 05 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2 90 | $3 60 | $4 90 | $5 00 | $3 48 | $4 95 |
| Cut | 3 00 | 6 10 | 6 00 | 7 75 | 4 08 | 5 00 |

**PREPARED ROOFINGS**—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

| | New York, 1-Ply l.c.l. | New York, 2-Ply l.c.l. | New York, 3-Ply l.c.l. | Philadelphia, 1-Ply l.c.l. | Philadelphia, 2-Ply l.c.l. | Philadelphia, 3-Ply l.c.l. |
|---|---|---|---|---|---|---|
| No. 1 grade | $2 12 | $2 48 | $2 90 | $2.02 | $2 38 | $2 80 |
| No. 2 grade | 1.87 | 2 18 | 2.55 | 1.77 | 2.08 | 2 25 |

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.15 per roll in carload lots and $2.40 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $6.15 per square in carloads; $6.40 in smaller quantities, in Philadelphia.

**ROOFING MATERIALS**—Prices f.o.b. New York:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft | $2.35 |
| Tar pitch (in 400-lb. bbl.), per 100 lb | 1 85 |
| Asphalt roofing (in barrels), per ton | 47 50 |
| Asphalt felt (light), per ton | 77 00 |
| Asphalt felt (heavy), per ton | 78 50 |

**SHEETS**—Quotations are per 100 lb. in carload lots from warehouse also the base quotations from mill:

| Blue Annealed | Pittsburgh, Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $2.25@2.50 | $2 87½ | $3 38 | $[illegible] | $3 53 |
| No. 12 | 2.30@2.55 | 2 92½ | 3 43 | [illegible] | 3 58 |
| No. 14 | 2.35@2.60 | 3 97½ | 3 48 | [illegible] | 3 63 |
| No. 16 | 2.80 | 3 07½ | 3 58 | [illegible] | 3 73 |
| Black | | | | | |
| *Nos. 18 and 20 | 2.60@2.85 | 3 95 | 3 95 | [illegible] | 3 80 |
| *Nos. 22 and 24 | 2.65@2.90 | 4 00 | 4 00 | [illegible] | [illegible] |
| *No. 26 | 2.70@2.95 | 4 05 | 4 05 | [illegible] | 3 90 |
| *No. 28 | 2.75@3.00 | 4 15 | 4 15 | [illegible] | 4 00 |
| Galvanized | | | | | |
| No. 10 | 2.75@3.00 | 4 15 | 4 15 | [illegible] | 4 00 |
| No. 12 | 2.85@3.10 | 4 25 | 4 25 | 5 95 | 4 10 |
| No. 14 | 3 10 | 4 25 | 4 25 | 5 95 | 4 10 |
| Nos. 17 to 21 | 3 40 | 4 55 | 4 55 | 6 25 | 4 40 |
| Nos. 22 and 24 | 3 55 | 4 70 | 4 70 | 6 40 | 4.55 |
| Nos. 25 and 26 | 3 70 | 4 85 | 4 85 | 6 55 | 4 70 |
| *No. 28 | 3.75@4 00 | 5 15 | 5 15 | 6 85 | 4 90 |

[illegible] per 1,000 lb. for 5 to 28 gage. [illegible] galvanized corrugated sheets add 15c., all gages.

**LINSEED OIL**—These prices are per gallon:

| | New York, Current | New York, One Year Ago | Chicago, Current | Chicago, One Year Ago |
|---|---|---|---|---|
| Raw, 5-barrel lots | $0 72 | $0 95 | $0 76 | $1 25 |

**WHITE AND RED LEAD**—Base price in cents per pound.

| | Red — Current | | Red — 1 Year Ago | | White — Current | White — Yr Ago |
|---|---|---|---|---|---|---|
| | Dry | In Oil | Dry | In Oil | In Oil | In Oil |
| 100-lb. keg | 12 25 | 13 75 | 14 25 | 15 75 | 12 25 | 14 25 |
| 25 and 50-lb. kegs | 12 50 | 14 00 | 14 50 | 16 00 | 12 50 | 14 50 |
| 12½-lb. keg | 12 75 | 14 25 | 14 75 | 16 25 | 12 75 | 14 75 |
| 5 lb. cans | 15 25 | 16 75 | 17 25 | 18 75 | 15 25 | 17 25 |
| 1-lb. cans | 17 25 | 18 75 | 19 25 | 20 75 | 17 25 | 19 25 |

# LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

**San Francisco**—Prices of rough Douglas fir No. 1 common, in more than carload lots:

Lumber Prices to Contractors in Yards at San Francisco

| | 6–8 and 12 Ft. | 10–16–18 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft. |
|---|---|---|---|---|
| 3x3 and 4 | $25 00 | $28 00 | $31 00 | $33 00 |
| 3x6 and 8 | 25 00 | 28 00 | 29 00 | 31 00 |
| 4x4-6 and 8 | 27 00 | 30 00 | 31 00 | 33 00 |
| 3x10 and 12 | 27 00 | **30 00** | 31 00 | 33 00 |
| 3x14 | 28 00 | 30 00 | 32 00 | 34 00 |
| 4x10 and 12 | 29 00 | 31 00 | 33 00 | 35 00 |
| 4x14 | 30 00 | 32 00 | 34 00 | 36 00 |

| | 24 Ft. and Under | 25 to 32 Ft. | 33 to 40 Ft. |
|---|---|---|---|
| 6x10 | $30 00 | $32 00 | $34 00 |
| 6x14 | 32 00 | 34 00 | 36 00 |
| 8x10 | 30 00 | 32 00 | 34 00 |
| 8x14 | 32 00 | 34 00 | 36 00 |

**New York, Chicago, St. Louis and Detroit**—Wholesale prices to dealers of long leaf yellow pine.

| | New York* — 20 Ft. and Under | New York* — 20–24 Ft. | Chicago — 20 Ft. and Under | Chicago — 22–24 Ft. |
|---|---|---|---|---|
| 3x 4 to 8x8 | **$38 00** | **$39 00** | *$40 00* | *$42 00* |
| 3x10 to 10x10 | **41 00** | **41 00** | *42 00* | 44 00 |
| 3x12 to 12x12 | **42 50** | **43 50** | *44 00* | *47 00* |
| 3x14 to 14x14 | **47 50** | **48 50** | *48 00* | 50 00 |
| 3x16 to 16x16 | **52 50** | **53 50** | *53 00* | *55 00* |
| 3x18 to 18x18 | **57 50** | **58 50** | *59 00* | *61 00* |
| 4x20 to 20x20 | **67 50** | **68 50** | 66 00 | **68 00** |

*Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

**St. Louis**—Yellow pine, 22@24 ft. long, 3 x 4 to 4 x 4, $34 50. 3 x 6 to 8 x 8, $33. 3 x 12 to 5 x 12, $40. 3 x 14 to 4 x 14, $45. 3 x 16 to 4 x 16, $51. 3 x 18 to 5 x 18, $58.

Detroit—Norway pine 2 in. x 4 in., 10 ft. x 16 ft. long, $35, 2 in. x 12 in., 10 ft. x 16 ft. long, $37; short leaf yellow pine 2 in. x 4 in., 9 ft. x 12 ft. long, $27.50 2 in. x 8 in., 18 ft. x 20 ft. long, $31; yellow pine flooring No. 1 common 1 in. x 3 in., $39.75, 1 in. x 4 in., 6 ft. x 12 ft. long, $37.25; yellow pine shiplap $37.00.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

**Other Cities**

| | 8 x 8-In. x 20 Ft. and Under — P. | Fir | Hemlock | Spruce | 12 x 12-In. 20 Ft. and Under — P. | Fir |
|---|---|---|---|---|---|---|
| Boston | $47 00 | $52 00 | $55.00 | $48 00 | $57 00 | $52 00 |
| Seattle | | 22 00 | | | | 24 00 |
| New Orleans | 28 00 | 23 50 | | | 33 09 | 27 00 |
| Baltimore | 30 00 | | | | 32 50 | |
| Cincinnati | 42 00 | 50 00 | | | 46 00 | 64 00 |
| Montreal | 78.00 | 85 00 | 68 00 | 78.00 | 120 00 | 100 00 |
| Los Angeles | | 41 00 | 40 00 | | | **44 00** |
| Denver | | **33 75** | | | 50 00 | |
| Minneapolis | 40 00 | **37 00** | **35 00** | | 47.00 | **36 00** |
| Atlanta | **30 00** | | | | *38 00* | |
| Dallas | 33 00 | | | | 37 00 | |
| Kansas City | 33 00 | 29 50 | 47 00 | | 38 00 | 33 00 |
| Birmingham | 16 00 | | | | 22@25 | |
| Philadelphia | 45 00 | 51.00 | 54.00 | 47.50 | 55.00 | 51.00 |

| | 1-In. Rough, 10 In. x 16 Ft. and Under — P. | Fir | Hemlock | 2-In. T and Gr. 10 In. x 16 Ft. — P. | Fir |
|---|---|---|---|---|---|
| Boston | $47 00 | $48 00 | $37 00 | $45 00 | $48 00 |
| Seattle | | **15 50** | | | *17 00* |
| New Orleans, at mill | 52 00 | 25 00 | | 32 00 | |
| Baltimore | 34 00 | | | 32 50 | |
| Cincinnati | 62 50 | 80 00 | | 33 50 | |
| Montreal | 120 00 | 60 00 | 60 00 | 80 00 | 80 00 |
| Los Angeles | | *37 00* | *36 00* | | 63 00 |
| Denver | | *30 25* | | | |
| Minneapolis | **38 50** | 31 25 | **31 25** | 36 00 | **29 75** |
| Atlanta | **19 00** | | | **22 00** | |
| Dallas | 32 00 | 30 00 | | 36 00 | |
| Kansas City | 36 00 | 33 00 | | 32 50 | 31 00 |
| Birmingham | 15 00 | | | 15 00 | |
| Philadelphia | 34.00 | 36.00 | 35.00 | 32.50 | |

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. for delivery.

Cincinnati—Prices for contractors on carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

# FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant bars, bar iron, sheets, piling and galvanized wire nails, tacks, poles, bale ties, steel cut nails, etc., the following freight rates are effective in cent per 100 lb. in carloads of 36,000 lb.:

| | | | |
|---|---|---|---|
| Baltimore | $0 33 | Detroit | $0 32½ |
| Birmingham | 76 | Kansas City | 81½ |
| Boston | 41 | New Orleans | 51½ |
| Buffalo | 29½ | New York | 38 |
| Chicago | 38 | Pacific Coast (all rail) | 1 66½ |
| Cincinnati | .325 | Philadelphia | 35 |
| Cleveland | 24 | St. Louis | 47½ |
| Denver | 1 35 | St. Paul | 66½ |

Note—Add 3% transportation tax. * Minimum carload, 40000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

# CONTRACTORS' SUPPLIES

**STEEL SHEETPILING**—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

| Current | One Month Ago | One Year Ago |
|---|---|---|
| $1 80 1 90 | $1 80 1 90 | $4 00@$4 50 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | Eastern Territory New York and East of Missouri River |
|---|---|
| Hercules red strand, all construction | 25% |
| Patent flattened strand, special grd cast steel | 25% |
| Patent flattened strand, iron rope | 10% |
| Plow steel round strand rope | 40% |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| Round strand iron and iron tiller | 10% |
| Galvanized steel rigging and guy rope | 12½ % |
| Galvanized iron rigging and guy rope | +7½% |

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

**MANILA ROPE**—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ¾-in., 6; ⅞-in., 4½, 1-in., 3½, 1⅛-in., 2 ft. 10 in., 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0 19 | New Orleans | $0 16 |
| New York | **18½** | Los Angeles | 15½ |
| Chicago | 18 | Seattle | .16 |
| Minneapolis | 18½ | St. Louis | 18½ |
| San Francisco | 16 | Montreal | 30 |
| Atlanta | **21** | Detroit | .175 |
| Denver | 18 | Baltimore | .22 |
| Cincinnati | 19 | Kansas City | 17½ |
| Dallas | 29 | Birmingham | 20½ |
| Philadelphia | 19 | | |

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | $0 3075 | $0.3425 |
| Boston | 24 | .275 |
| Kansas City | 26 | .295 |
| Seattle | 1875 | .2125 |
| Chicago | 2275 | 2525 |
| Minneapolis | 2274 | .2530 |
| St. Louis | 26 | .29 |
| Denver | 2350 | .2700 |
| Dallas | 29 | .375 |
| Los Angeles | 25 | .33 |
| Atlanta | 2675 | .3025 |
| Baltimore | 2550 | .27 |
| Cincinnati | 2275 | .2725 |
| Montreal | 32 | .37 |
| Birmingham, *delivered* | 165 | .205 |
| New Orleans | .2725 | .3075 |
| San Francisco | 195 | .23 |
| Philadelphia | 2525 | .2875 |

**PILES**—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

| Diameters | Points | Length | Barge | Rail |
|---|---|---|---|---|
| 12 in. at butt | 6 in. | 30 to 50 ft. | $0 14 | $0 19 |
| 12 in.—2 ft. from butt | 6 in. | 50 to 59 ft. | 0 18½ | 0 25 |
| 12 in.—2 ft. from butt | 6 in. | 60 to 69 ft. | 0 21 | 0.27½ |
| 14 in.—2 ft. from butt | 6 in. | 50 to 69 ft. | 0. 24 | 0.32½ |
| 14 in.—2 ft. from butt | 6 in. | 70 to 79 ft. | 0.26 | 0.34½ |
| 14 in.—2 ft. from butt | 5 in. | 80 to 89 ft. | 0.33 | 0.42 |

**SCRAP**—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 railroad wrought | $10 50 | $11 50 | $13 50 |
| Stove plate | 10 50 | 12 00 | 13 50 |
| No. 1 machinery cast | 16 50 | 13 50 | 16 00 |
| Machine shop turnings | 3 00 | 4 00 | 6 50 |
| Cast turning | 3 75 | 5 50 | 8 50 |
| Railroad malleable cast | 9 50 | 12 50 | 11 00 |
| Re-rolling rail | 11 50 | 13 00 | 12 00 |
| Relaying rails | 30 00 | 30 00 | 27 00 |

**SHIP SPIKES**—Current prices per 100 lb.:

| In. | San Francisco — Galv. | San Francisco — Black | Seattle Black |
|---|---|---|---|
| | $9 10 | $8 40 | $8 55 |
| | 8 65 | 6 65 | 8 25 |
| | 8 50 | 6 50 | 8 30 |

Pittsburgh base, $3 25@$3 40 per 100 lb.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, DECEMBER 8, 1921 — Number 23

## Bond Market Improved

IN ABSORBING power and in price, the market for city, state, and utility bonds now shows a marked improvement. Gilt edged municipal bonds for some time past have commanded a yielding or net return interest rate of 5 to 6 per cent, and utility bonds have been 1 to 2 per cent higher. Last week Pennsylvania state highway bonds, offered at 4¾ per cent, brought such a premium as to reduce them to a 4.2 per cent basis. There is also a substantial improvement in city bonds and the utility bond outlook is better than before. Some of this upward trend in prices is due to year-end conditions, so that as these pass and as new bond issues are rushed forward to take advantage of the favorable market, some reaction may be expected, but there is reason to hope that this will not be enough to offset the upward trend. The reduction in interest charges will encourage city, county and state governments, and utility companies as well, to start long delayed and much needed improvements. This, in turn, will help all industry. The outlook for 1922 is brightened correspondingly.

## Sanity in Working Agreements

LAST WEEK'S decision of the Railroad Labor Board with reference to the working rules of the shop-craft unions marks a return in railroad circles to some measure of sanity in reference to the jurisdiction of the crafts. The vicious rules obtaining under the national working agreements, whereby journeymen were obliged to do many things that could as well be done by common labor and helpers, and under which even minor repairs could be performed only by the journeymen of the appropriate craft, are swept aside. Now a boiler-maker will be permitted to handle work of another craft incidental to his duties, whereas before, he had to stand idle until a journeyman of the other craft was secured to do even ten minutes of incidental work. Likewise laborers and helpers may be employed for tasks that they can perform but which heretofore had to be done by journeymen. It is to be hoped that the start made in the elimination of these rules in the railroad shops and the equally conspicuous beginning made by Judge Landis in abrogating equally vicious rules in the building trades at Chicago will spread throughout the country and to all classes of work. The unions cannot expect to regain public sympathy if they persist in gouging the public by such dishonest working rules. They must get the conception that only by contributing to the economic strength of the country can they permanently prosper.

## Practical Research

OF THE five types of concrete flumes described and compared in detail in the article in this issue everyone, says the author, Mr. Ward, will give service "sufficiently satisfactory to justify their creation." However, the first type built was not "sufficiently satisfactory" to the engineers and they pushed on from one type to another, keeping the costs approximately the same until they had developed two types, the semi-precast and the jointless monolithic flume, which they believe have slight advantages over the other types. Further, the original bell-and-spigot type they class as obsolete. This is research of the most desirable sort. The comparisons are particularly valuable inasmuch as the conditions to be met are alike as to inaccessibility and construction difficulties but sufficiently varied in character of foundation and location on the sloping canyon side to make them generally applicable in the irrigated regions. The necessity of finding a way to expedite construction during the short available working period between irrigation seasons is almost wholly responsible for the development of the semi-precast type which in the end proved as good as the best. As a short working season is generally common to reconstruction work on irrigation projects, this type will probably receive much attention in the future. While the Reclamation Service engineers are decidedly against calling the King Hill flumes an experiment, nevertheless the work they have done on them and the progressive design and construction methods aided by operating observations show how a large organization can add to engineering knowledge and at the same time serve its own structural needs.

## Engineers or Builders?

SEVEN men were crushed to death last week by the collapse of a half-erected theater building in Brooklyn. The design of the structure contained no obvious faults, but the collapse appears to be chargeable essentially to that sordid cause, shoddy workmanship. In the erection of buildings this evil is more common than in other construction, and it has made a rather bad record, though not all of it marked by fatalities. Throughout the history of building it has been shown again and again that trying to "get by" with bad work leads to failures. Repeatedly our columns have emphasized the danger of shoddy building work, and advocated reliance on the professional warranty of architect's or engineer's supervision as a safeguard. We would again urge this remedy on the occasion of the present accident, which occurred under the system of supervision by the owner, acting as his own contractor. That the plan of professional supervision has not found acceptance hitherto may indicate that the public is unwilling to place so much responsibility upon one class, or perhaps that it considers the plan ineffective. At any rate, as yet no community, no city or state has made professional supervision of building a legal requirement. A radically different method of control has been advocated by some building officials, and we believe also by a number of architects, and is again brought forward on the occasion of the present accident: that builders be licensed—presumably on proof of competence—and that no building operations be permitted except under direction of a

licensed builder. There is undoubted promise in such a system, though no practical trial has been made. But is it more than merely promising? Its workability and effectiveness are open to doubt, to say the least, and pending a more convincing showing in this respect than has yet been offered we shall continue to believe that compulsory supervision of building work by the engineer or the architect is the true way out of the present condition. As a help toward clearing up the existing uncertainty on the subject, the advocates of the builders' license system would do a service to the community if they would present a thoroughly argued plea for their proposal, explaining at the same time why professional supervision would fail to accomplish the results sought.

### Steel Versus Masonry

ONE salient point in the description of the Brooklyn theater wreck printed on p. 954 invites thought. The steel roof trusses of the structure rested on pilasters of the brick walls, not on steel columns, and two or three of these pilasters were found crushed or sheared at the top. Failure of a single one would have sufficed to bring down the roof structure substantially as it lies. Without forestalling the findings of the criminal authorities engaged in investigating the accident, we may assume that such failure was the initial cause. It was, at any rate, a *possible* cause, and one that would have been eliminated had steel columns been provided to carry the trusses. Is it not time, in the development of building practice, to demand that building laws should require steel supports for heavy steel carrying members such as trusses or girders? There has been a growing tendency, these many years, to avoid placing heavy concentrated loads on the brickwork of buildings, and to restrict the load-carrying functions of the masonry to minor service, a limitation justified by the inevitable uncertainties of load distribution where steel main members are supported on brickwork. This development has taken place in the face of the fact that every one recognizes the strength and dependability of well laid masonry whether stone or brick. One difficulty is that the excellence of workmanship and the perfection of bearing and bracing to secure the load distribution aimed at, and to avoid disintegrating actions on brickwork, are far less easily obtained than ample design and thorough workmanship in a shop-fabricated steel column. Building regulation, we believe, aims to establish the safer practice of two alternatives; the principle involved herein well warrants the requirement of steel column supports.

### A Subject for Further Study

THERE will be those who see in the article on the Nashville concrete bridge deterioration only destructive criticism, who will say that because no definite explanation is given of the serious condition of many of the slender supporting members of these bridges, such publicity will only cause unfair discrimination against concrete and unnecessary uneasiness regarding other concrete structures. The answer to this is that the conditions described actually exist and that that existence is a matter of vital moment to all engineers. If cognizance of them were to be withheld until all the reasons why they occurred were made available they might remain known only to those engineers who might happen to be in Nashville. It will be quite easy to say that if the concrete had been made of proper materials and in proper fashion the structure would be in as good condition as are dozens of similar contemporary structures, but that is a negative way of looking at such cases, all too common in the study of concrete failures, partial or complete. An exhaustive study of the Nashville bridges should be made. The engineers who report on it in this issue have given it all the study their resources command but they would be the first to advocate a thorough investigation of the structures, both into the history of the concrete, the methods and materials used in making it, and into the physical properties of the concrete as it exists today. This is plainly a case of steel corrosion and corroded reinforcement means a porous concrete and the presence of water. What we want to know is the cause and extent of the porosity in the Nashville concrete. Any peculiarities of exposure are quite secondary. The city of Nashville will save its engineers some worry and possibly itself some damage suits if it considers its duty to lie beyond a mere superficial repair of the weakened members.

### Well Preserved Cables

IN THE demonstration made last week of the well preserved condition of the Williamsburg bridge cables a valuable piece of evidence has been made available as to the permanence of our large bridge structures. As reported on p. 939, this demonstration, together with the fuller inspection data which it is hoped may be published in the near future, gives fair assurance that the main parts of the great New York suspension bridges have an indefinite length of life (we are tempted to say, unlimited life). Such bridges, in other words, are not subject to perceptible decay, and so far as corrosion is concerned they may remain free from measurable deterioration if intelligent inspection and maintenance are applied. As we look at the ancient stone bridges of Europe we reflect with wonder and admiration on their endurance through the ages; yet it is not beyond the bounds of possibility that our great steel bridges may survive as long. Quite generally the world has been content to look upon iron and steel bridges as short-lived, built today and rusted out tomorrow. But with the proof from experience that carefully maintained structures are by no means perishable but continue in service with no noticeable deterioration, these views need to be recast, and bridges come to be looked upon as enduring works, whose planning merits the same scrupulous consideration of long-time needs as does that of harbors or power developments. These facts have been becoming evident for a good while past, with doubt, however remaining as to the internal preservation or deterioration of large suspension bridge cables. The information on the latter point which Mr. Byrne is now bringing out tends to establish this conclusion much more firmly by guaranteeing the enduring qualities of the type of structure upon which some of our most vital highway communications depend, namely, the wire cable suspension bridge.

### Disarmament Conference and Business

IT WAS to be expected that after the first interchange of generalities the disarmament conference would settle down to laborious discussion of detail in which there would be a conflict of opinion. Not only that, but playing for advantage was to be expected. In turning into these channels the conference is merely "running

true to form." Nevertheless, the healthy impression made on the business tone by the conference keeps up. It is right that it should be so. It seems inconceivable that the conference will adjourn without very substantial advantage; even a small one will have a favorable effect upon the business sentiment. A feeling of greater security, a relief from the burden of financing armaments, the release of men for productive enterprise—all of these must have a favorable influence on the business situation. They are right, therefore, who hold an optimistic attitude, who see in the disarmament conference another augury of continued and increasing revival of business.

## Contracting Not Developing Its Technique

UNIFORMITY develops slowly in methods of construction. Sewer tunnel construction in Detroit, Mich., one method of which is described in this issue, is an illustration. Here, with a uniform soil and the experience of a score of contractors on similar operations, there is as great a variety of equipment and as many processes now as there were when the first contracts were let over two years ago.

In road building, where, again, conditions favor standardization of methods and equipment, there has been almost no progress toward uniform practice in the last three years of intensive paved road construction. There are fewer methods now than formerly because a whole group has been eliminated by the recent requirement of highway engineers that materials cannot be stock-piled on the subgrade. Standardization is in no degree responsible.

Two facts appear to account for this slow progress toward uniform construction methods. One is that fewer opportunities exist in construction than in industrial processes. For this condition there is no remedy.

The other fact is that where standardization may be practicable, contractors do not possess the information required for determining equipment or procedure. Not only is the information lacking, but contractors are making no appreciable effort to provide it. This condition can be changed by proper effort.

Who will make the effort? The individual contractor will not; he will seldom make known the information on which he bases his own choice of plant and procedure. If he did so generally, there would still be necessary some agency to co-ordinate the information and formulate preferred practices.

Obviously this agency should be organized contracting; it has the most to gain. When all is said that can be said of the importance to the contractor of the business of contracting—the organizing, financing, purchasing and the hiring of labor—the engineer and the owner regard this as the contractor's personal concern and judge him, as a contractor, by his skill and efficiency in constructing. In its justifiable efforts to improve its business relations and practices, contracting cannot, therefore, afford to neglect technical proficiency nor any means by which can be increased the confidence of the engineer and owner that contractors have this qualification.

There is real need of increased confidence in the contractor's technical efficiency. In road building, which is now engaging more contractors than any other kind of engineering construction, contractors are criticised more for their lack of definitive practice, their haphazard choice of equipment and methods, than for any other fault. It indicates, it is charged, that contracting is not developing its road building technique. State highway departments have undertaken force account construction in many instances so that they might compare methods and processes, which contractors are not doing, and obtain the essential facts, which contractors are not getting, for determining the preferable methods and plant under different ordinary conditions.

Contractors should be doing their own technical research and should be establishing economic construction practices for themselves. They are organized, through the Associated General Contractors, to perform the task. The association has done much to bring uniformity into estimates for road work and in analyzing forms of contracts. The same activity in establishing preferred practices in construction for various kinds of work where the conditions are reasonably uniform, as in road construction, is badly needed. Preferred practices and technical proficiency should be emphasized in the plans for 1922 to be formulated by the association at its annual convention next month in Cleveland.

## An Academy of Labor

LAST MAY there was undertaken at Frankfurt-on-Main, a new experiment in trying to give the workers, and employees generally, a thorough grounding in the principles on which our economic and political structures are built. There was initiated at the University of Frankfurt an Academy of Labor with a teaching staff detailed by the Prussian Ministry of Education and with more than 100 students selected by their respective labor and employees bodies. The classes for the first school year are still in progress and will not terminate until next February. In order that well qualified persons might form the student body, the labor organizations are undertaking to pay all the living expenses of their representatives, so that, care free, they can pursue their studies.

The particular object in instituting the academy at the present time is to bring to the restoration of Germany whatever of value can be developed by contact between experience and theory. The principle on which the classes are organized is to examine the experience of the workers in the light of theory, the expectation being that there will be a modification of the views of the teachers, and possibly of the students as well.

Those directly concerned with the experiment are not ready yet to reach conclusions regarding its success, but the hope is entertained that it will be of assistance to solid thinking and a helpful factor in Germany's reconstruction.

The idea, generally, fits in with that which has been frequently urged in these columns, that the American Federation of Labor needed to form its program on the basis of fundamental instead of on fighting issues whose strength lies merely in their appeal to the unthinking. At times in the last two years there has been a hopeful note in pronouncements of the federation, but within the last six months, since unemployment and resistance to union domination began to make such inroads upon its influence, the federation has lapsed back into its old fighting spirit. In that direction there is no hope for a solid improvement—at least as far as the influence of the federation is concerned—in the relations between employer and employee.

# Concrete and Gunite Flumes on the King Hill Project—I

## Five Types Compared as to Cost, Maintenance, Construction and Serviceability—Semi-Precast and Monolithic Flumes Have Slight Advantages

By Walter Ward
Project Manager, King Hill Project, U. S. Reclamation Service, King Hill, Idaho

*Probably every reasonable type and combination of types of concrete and gunite flumes are included in the list of structures built on the King Hill Project by the U. S. Reclamation Service under Mr. Ward's direction. All of the flumes have now seen service through at least two seasons. In the summer of 1919 a representative of "Engineering News-Record" happened in on Mr. Ward and made arrangements for the present article after a day's trip over the work which had then reached the stage of preparations for the final type of flume tried—the semi-precast. So valuable was the data then available to the irrigation engineer, who because of the widespread drouth was that year as never before confronted with the necessity of waste prevention, that Mr. Ward consented to the preparation of a brief preliminary article (see "Engineering News-Record," April 1, 1920, p. 661). His consent was only obtained, however, under the promise of an opportunity to "clean up" the subject at a subsequent date when a full report backed by the experience of at least a full year's operation could be presented. Since Mr. Ward prepared the article another irrigation season has closed but he writes that no changes are necessary.*—Editor.

FIVE different types of reinforced-concrete flume on the U. S. Reclamation Service King Hill Project, Idaho, have been tried out and comparative experience is now available. The types are semi-precast and monolithic (called hereafter concrete), gunite, combination gunite-and-concrete, and concrete with bell-and-spigot joints. The first two are the least expensive to build but the others have proved sufficiently satisfactory to justify their erection.

Some types have marked advantages under certain conditions. All are safe on rock foundations, the choice then being left entirely to first cost, maintenance and estimated useful life. Flumes without joints, either concrete or gunite, will have a lower maintenance charge than the flumes with joints. Where the foundation is clay, or loam which might become saturated with water and freeze in winter or which might settle under the flume during operation, flumes with joints are not safe. On such foundations with continuous flumes either concrete or gunite, there is considerably less chance of heaving and little if any chance of erosion.

Bell-and-spigot flume should probably be considered an obsolete type as it has the highest cost, probably the shortest useful life, and the following disadvantages which do not obtain in the other types: Unless located on rock the leakage causes erosion with ultimate settlement and failure. Freezing throws the sections out of grade further increasing the leakage and decreasing the capacity. Provided it has a suitable foundation the semi-precast has a marked advantage when the building season is short.

A gunite flume would not prove economical unless a considerable volume of work is undertaken, as it requires a larger amount of special equipment than a concrete flume, and skilled operators. Until the useful life period is known no choice can be made between the concrete flume without joints and the combination gunite-and-concrete type. Local conditions and first cost must then govern. On this work the former is slightly cheaper. In the gunite flumes the cross-ties present a barrier against which weeds and floating débris lodge.

The King Hill project is a long narrow project with a main canal 52 miles long taking its supply from the Malad River, a spring-fed stream tributary to the Snake River. It furnishes an unfailing supply of 300 sec.-ft. A large part of the canal system is located in the Snake River canyon in south central Idaho and crosses numerous gulches, creeks and is four times siphoned across Snake River. Wherever the topography and soil formation permit, the canal is an ordinary earth channel, but the long stretches of the canal located in the Snake River canyon are on side hill slopes so steep that the only type of structure feasible is a flume built on a bench excavated in the hillside. The Snake River and the deeper gulches and creeks are crossed by means of inverted siphons. There are seventeen of these siphons on the main canal ranging from 48 in. to 100 in. in diameter. The main canal consists of 37½ miles of open earth channel, 5 miles of pipe line and 9½ miles of flume.

In *Engineering News-Record*, April 1, 1920, p. 661, was a brief account of the reconstruction program together with a description of the early history of the project from its opening in 1908 leading up to the contract in 1917 between the State of Idaho and the King Hill Irrigation District, and the Reclamation Service whereby the latter agreed to reconstruct the project to prevent its reversion to desert. At the end of nine years many of the wooden flumes and siphons had nearly reached the end of their useful life.

After an examination by the engineers of the Reclamation Service of the wooden structures that were then in place, they decided that a more permanent type of construction was absolutely necessary for the success of the project. Several types of flume were studied, the principal ones being semi-circular wood-stave flume, metal flume, gunite flume and concrete flume. The factors influencing the type of structure to be built were the first cost, the useful life, the ultimate cost and the service that each type could be expected to give. Estimates made in 1917 based upon the cost of both labor and material prevailing at that time indicated that a semi-circular wood-stave flume with an estimated useful life of 20 years would cost $9.20 per lin.ft. A 14-gage galvanized-metal flume with timber sub-structure resting on concrete sills would cost $12.40 per lin.ft. and would have a useful life of 20 years. A

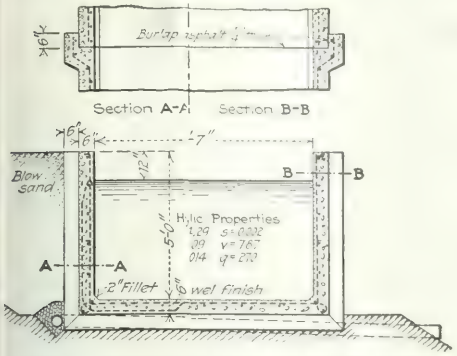



FIG. 1. DETAILS OF BELL-AND-SPIGOT FLUME
Longitudinal rods = ⅜" d, 12 in. c. to c.
Transverse rods = ⅜" d, 9 to 11½ in. c. to c.

gunite flume and a crete flume, each with an estimated useful life of years, would cost $12.50 per in.ft. For purposes comparison all estimates were based on a carrying city of 300 sec.-ft.

It was decided thate ultimate cost of the gunite and concrete flumes ld be considerably less than either the wood-stave metal flume, due to the fact that they would havo many years greater useful life. Also these flumwere more watertight, which fact alone would tend eliminate either of the other types, because much of foundation is of such a character that it will eroded settle rapidly under a flume which has any considde leakage.

### Concrete Flume with Bell-and-Spigot Joints

A concrete flume with bell-and-spigot contraction joints, one of the first built, was adopted because a flume with contraction joints at frequent intervals requires such a small amount of temperature steel that it was assumed that the cost would be materially reduced. Further, the fact that flumes built heretofore without contraction joints and with only a nominal amount of temperature steel had not been entirely satisfactory where there was a range of temperature similar to that of southern Idaho. The 6-in. side walls of this flume are reinforced as cantilevers so that no cross-ties are necessary. Although the flume will carry the required capacity with a freeboard of 1 ft., the side walls are designed to withstand the load with the flume running full. Additional reinforcing steel was placed in the bank wall wherever it was expected that sand would collect behind the flume subject this wall to external pressure. The comparatively small amount, 0.181 per cent, of longitudinal steel used as reinforcement against temperature changes has proved ample, as some sections of this type of flume have been in service for three years and no temperature cracks have developed.

Contraction joints with elastic filler were spaced on tangents at intervals of 22 ft. 9 in. for bell sections and at intervals of 23 ft. 3 in. for spigot sections. Both sections are 6 in. thicker on curves to permit of the economical use of the same length steel as used in the tangent sections. Extra length of the longitudinal bars on the inside of the curve was cut off and used to lengthen, with a 24-in. lap, the corresponding bar on the outside of the curve. Before adopting this contraction joint consideration was given to various types with distances between joints ranging from 10 to 100 ft. It was deemed necessary that this contraction joint should (1) not weaken the flume section; (2) should be provided with a filler of some elastic material that would prevent spalling of the concrete due to expansion; (3) should be easily and cheaply constructed and (4) should be watertight. It was decided that the bell-and-spigot joint with either burlap soaked in asphaltum or a wooden filler would most nearly meet requirements.

The economical spacing of the contraction joints was a subject of considerable study. One contraction joint, regardless of distance between joints, was estimated to cost $13.10. The cost per linear foot of flume due to the joints would therefore be inversely proportional to the distance between joints. On the other hand the amount of steel required for temperature reinforcement

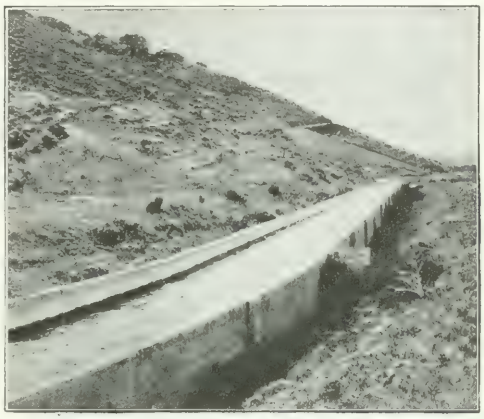


FIG. 2. BELL-AND-SPIGOT TYPE IN PLACE

increases with the distance between joints. Computation based on these two factors showed the economical spacing to be approximately 24 ft.

Experience demonstrated that the results of these computations were erroneous as they did not take into account the fact that all the work of building forms and placing concrete was retarded on account of these joints; therefore, the figure of $13.10 used as the cost of a contraction joint is considerably too low. Later estimates giving proper weight to all these items showed the economical distance to be at least three times the distance used. In fact the amount of longitudinal steel required for temperature reinforcement in a section thus determined would approach so closely the amount needed in a flume without joints that the cost of the two types would be approximately the same instead of being in favor of the contraction joint type as supposed.

Of the two kinds of filler used in the contraction joint, the first was designed to allow the flume to be poured continuously and consisted of a 1 x 6-in. board to provide the elastic filler between two adjacent sections and an 8-in. strip of 22-gage metal coated with asphalt to separate the bell from the spigot and provide the slip joint. It was expected that this board-and-metal strip could be held in position while the concrete was poured on each side simultaneously, completing the joint. It was found to be very difficult to hold this board and the metal strip in place while the concrete was being spaded and they were frequently crowded out of position, to a large measure destroying

the utility of the joint. This filler was therefore abandoned in favor of one made of burlap strips soaked in asphalt.

One objection to a filler of the latter type is that it cannot be placed until after the bells have been poured and the forms stripped, which necessitates the building of the flume in alternate sections requiring twice as many forms to accomplish the same amount of work daily as a flume that can be poured continuously. The fillers were at first made by dipping the burlap strips in hot asphalt. The difficulty experienced in placing them so that they would not wrinkle and form pockets at the joint was overcome by laying the burlap strips in a form of the required length and width and then filling the form with the hot asphalt. A filler made in this manner is much more pleasant to handle, does not wrinkle and makes a better and tighter joint. The slip joint was made by substituting a strip of the burlap and asphalt for the sheet iron.

The location survey was made to fit the existing bench as closely as possible, keeping the flume at all times on an undisturbed and solid foundation. The curves were made true arcs, and at first had center-line radii of 50, 75, 100 and 200 ft. Later the use of the 75, 100

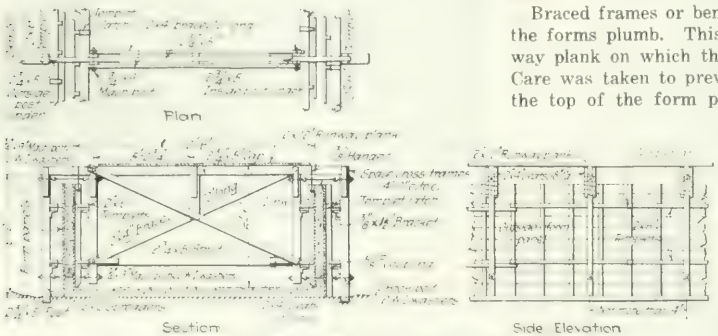



FIG. 4. FORMS FOR NO-JOINT FLUME

and 200-ft. radii curves was discontinued and 50-ft. radius curves only were used. The adoption of the sharper curve reduced the length of curved flume and simplified the form work. About 30 per cent of this flume is on curves and as the form work on curves cost 50c. per lin.ft. more than on tangent, every effort was made in the location to reduce the curvature. This additional amount could be spent on excavation to eliminate curvature.

Teams and scrapers were used as far as possible in the excavation, although considerable hand work was necessary on the hillside in opening it up before the stock could get a footing. After the teams had roughed out the bench some hand work was then necessary to finish the subgrade.

Approximately 450 ft. of re-usable timber form panels were needed for each crew building flume. It was neither practicable nor economical to make sufficient forms to have exactly the proper panel length for all combinations of curves and tangents at the beginning and end of curves; therefore, a part of the panels was made of proper lengths to fit exactly the inside radius on the sharpest curve (which would be the shortest possible panel length) and the remainder to fit exactly the section on tangent (which would be the most common

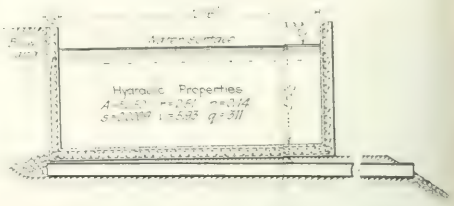



FIG. 3. DETAILS OF NO-JOINT CONCRETE FLUME

Long. Reinf. — ½ in. sq. bars, 4½ in. c.c.
Transv. Reinf. — ⅜ in. sq. bars, 11½ ft. to c.

length used and also an average length on curves). Some combination of these panels would usually either fit exactly or lack only a few inches of closing at the mid point. Wherever this gap was less than 1 ft. a 16-gage sheet-iron plate was tacked on the inside of the form to close it. Where the gap was more than 1 ft. one or more short panels of 1 ft. or 1½ ft. length were used with the sheet iron. A supply of templets, either straight or curved to proper curvature, was made and bolted to the backside of the panels as they were erected to hold the forms to proper alignment.

Braced frames or bents were used to stiffen and hold the forms plumb. This frame also supported the runway plank on which the concrete carts were operated. Care was taken to prevent the frame from resting on the top of the form panels and thus subject the concrete, when initially set, to the vibration incidental to wheeling the concrete carts over the runway.

For the 450 ft. of flume, in use two seasons with some repair work, were worn out after having used to build 6,000 ft. of flume. If used continuously they would have lasted somewhat longer.

Snake River was the only source of water supply available for construction work. Triplex pumps with a capacity of 60 gal. per minute, driven by gas engines, were installed at convenient points along the river, and the water was pumped into temporarily constructed tanks located at points from 60 to 200 ft. in elevation above the flume bench, making a total lift of from 360 to 500 ft. This pumping plant provided sufficient water for all purposes, and was distributed by gravity to camps, stables, mixers and along the flume bench for sprinkling concrete. To prevent freezing during the winter months it was necessary to bury all of the main lines that could not be readily drained to a depth of 2 ft.

### Handling of Materials

Suitable sand and gravel was uncovered at various points along the work ranging in distance from ½ to 3 miles from the mixer sites. The aggregate was screened at the pit and hauled to the mixer sites in horse-drawn 2-yd. dump wagons or by 2-ton trucks equipped with dump bodies.

The gravel was well graded and was screened to a maximum size of 2½ in. In some cases the most available gravel was found in the bed of the river in which case it was hoisted by means of a steam

hoist operating gravel cars on an industrial track, to the road above the flume bench and then distributed by wagons and trucks to the mixer sites.

Portland cement delivered to the nearest railway station was hauled to the mixer sites in 2-ton trucks, where it was stored until used.

Reinforcing steel was purchased in sizes and lengths that would cut with minimum waste. This steel was hauled by truck to a central yard at the work where it was cut and bent to proper lengths and shapes. The bending of this steel was materially expedited by building a rigid bench on which templets of the proper dimensions were fixed and around which the steel was bent to required shapes. After some experience, two men could cut and bend from 350 to 400 transverse bars per day. In placing this steel in the forms crews were able to place two or three times as much steel by using tying tools and tie wire of proper lengths instead of ordinary pliers and straight wire.

As there was not sufficient room on the flume bench for a construction or operating road, it was necessary to build a construction road on the hillside above the flume. While the road was located as near the flume as possible it was in some cases a half mile distant requiring spur roads to be built to the mixer sites.

### Mixing and Placing Concrete

The location of the mixing plants and the transporting of the concrete from the mixers to the forms was controlled largely by local conditions but usually one of the three following described methods was employed:

1. Where the construction road was parallel to and only a short distance from the flume bench and where the flume bench was too narrow to operate a team and wagon, the mixer plants were located on the construction road at ½-mile intervals. Concrete from these plants was hauled along the road in one-horse ⅜-yd. carts to a point below which the flume building was then in progress. The concrete was then spouted from the road to a hopper on the flume bench and distributed from this hopper by hand-carts operated on runways laid on top of the flume forms. The chutes from the road to the flume bench were spaced at 600-ft. intervals requiring the concrete to be distributed by hand a maximum distance of 300 ft. either side of the chute.

2. Where the flume bench was wide enough to permit the operation of teams and wagon alongside the flume the mixer plants were located at ½-mile intervals. A batch of concrete was spouted from the mixer into three one-man size concrete carts. These carts were pushed onto a flat-top wagon and hauled along the flume bench to the forms. As the wagon bed had been built to approximately the same elevation as the flume forms the carts were easily pushed from the wagon onto the runway laid on the forms and the concrete deposited at any desired point. This method was the most economical as it was more flexible than the first and third method and did not require forms to be left in place to act only as a support for the runway as was often the case in the first and third method.

3. Where the construction road could not be brought closely parallel to the flume bench, nor operating roads be maintained thereon, mixer sites were located on the hillside above the flume at approximately 900-ft. intervals and connected to the main road by spurs. The concrete was spouted directly from the mixer to a hopper on the forms from which point it was distributed along the flume by hand-carts a maximum distance of 450 ft. each way from the hopper. Although in many cases this was the only practical method to follow, the cost was somewhat higher than either of the other two methods.

Drainage was provided to prevent surface water or leakage from the flume collecting behind the flume and soaking into the foundation. This was accomplished by laying a 4-in. open joint vitrified tile pipe parallel to the flume, slightly below and on the same slope as the floor. Relief drains were provided every 100 ft. by laying a 4-in. bell-and-spigot tile pipe from the drainage line at right angles and under the floor of the flume discharging over the side of the bench.

The procedure in building this flume after the grading was completed and the drainage system installed was as follows:

The outside forms were set up to line and grade, the reinforcing steel placed and then the inside forms were set up and all forms braced. The floor was poured first and allowed to get a partial set before the side walls were poured. In warm weather the forms were allowed to stay in place one day and in cold weather from two to three days before they were stripped and moved ahead. After the forms were stripped the concrete was sprinkled for ten days to cure it. During freezing weather the concrete was covered and protected from freezing with artificial heat.

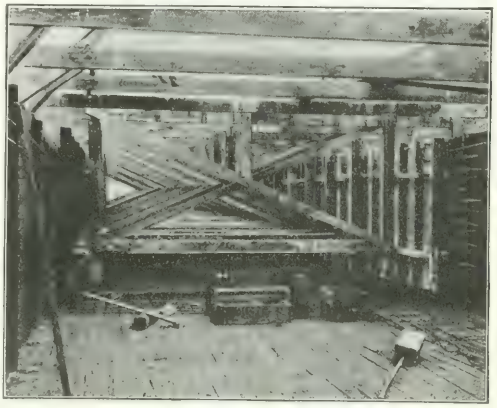


FIG. 5. METHOD OF HANGING FORMS FOR RE-USABLE PANELS FOR NO-JOINT FLUME

The only advantage that the bell-and-spigot type of flume has over the other types is that it requires a less amount of temperature steel, which advantage at the present cost of steel and labor is offset by the greater amount of labor required. The disadvantages are as follows:

1. It is impossible at a reasonable cost to build expansion and contraction joints that are sufficiently water-tight.

2. The leakage from imperfect joints, unless the flume is built on a very solid foundation, is likely to cause settlement which in turn increases the leakage and finally leads to failure of the flume.

3. In climates where the foundation of the flume freezes during the winter months the spigot sections are likely to heave, throwing such sections out of grade and opening the joints so that when the flume is refilled serious leakage occurs.

4. The continuity of the forms being broken at each joint, it is difficult to hold the forms sufficiently rigid to maintain an even thickness of concrete in the side walls.

5. The progress is greatly retarded on account of erecting the forms for the contraction joints, and double the length of forms are required in a type where the concrete is poured in alternate sections as in one which can be poured continuously.

6. The maintenance of this flume will be considably higher than any of the other types.

Of this type a length of 2¼ miles has been built and it is believed that it will give good service for its expected useful life.

### Concrete Flume Without Joints

As the contraction joints were directly responsible for all the objections arising in connection with the bell-and-spigot flume, a flume without joints was designed.

To build such a flume sufficient longitudinal reinforcement must be provided to prevent contraction cracks of sufficient size to permit water to escape. It was computed that with a temperature variation of 70 deg. F. and with sufficient reinforcing steel to force the concrete to crack at 5-ft. intervals the cracks would be so small as not to be objectionable.

The temperature in southern Idaho ranges from about

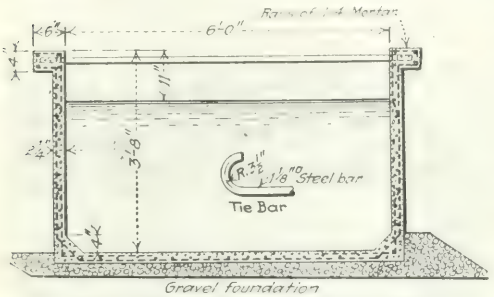



FIG. 6. DETAILS OF THE GUNITE FLUME

Long. Reinf. ⅜ in. sq. rods, 1 in. c. to c.
Trans. Reinf. ¼ in. sq. rods, 10 and 20 in. c. to c.

20 deg. F. below zero to 120 deg. F. above; therefore flumes constructed during the summer months would be subjected to a temperature variation of 140 deg. and would require a prohibitive amount of temperature steel unless some means could be found to take advantage of a lower temperature variation. This was accomplished by building the flume in sections 300 ft. long whenever the temperature was above 50 deg. and leaving 18 in. joints between sections. The longitudinal steel from adjacent sections was allowed to extend unrestrained across the joint permitting the flume to move freely in each direction. During the fall months when the temperature dropped to between 40 and 50 deg. F. these joints were poured bonding all the longitudinal steel together. This method had the same effect as pouring all of the flume at the lower temperature. It was estimated that the length of the sections that could be poured in the summer months would be the length of flume that the longitudinal steel could drag along its foundation without failure, assuming that the flume would be anchored at and pull an equal distance each side of the center point. In the case of curves with a large central angle the joints were placed not more than 150 ft. each side of the curve.

Using ⅜-in. square twisted steel bars with an elastic limit of 55,000 lb. per sq.in., computations showed that 0.65 per cent of steel was necessary to force the concrete to crack at 6-ft. intervals and when the temperature variation was 70 deg. the cracks would be 0.0327 in. in width. However, the cracks would only be 0.013 in. in width at the lowest temperature at which water would be carried in the flume. Using ½-in. bars in the floor, 0.43 per cent of steel was required to force cracks at the same intervals with the same range of temperature. The side walls were designed as vertical cantilevers and required no cross-ties.

The side-wall forms a right angle at the point it joins the floor; while in the bell-and-spigot type of flume, a fillet is used as an extra factor of safety. The fillet can be safely omitted as the flume is amply strong without it and it adds a decidedly objectionable complication in the forms, particularly on curves.

For all practicable purposes this flume is watertight, and no tile drain system is required. Cross-drains under the flume of 12-in. tile or 12-in. square concrete boxes were provided at intervals to carry off storm water.

#### Importance of Formwork

Previous experience showed plainly that the progress and cost of the concrete in this class of work depended largely on the forms. Therefore, a new type of re-usable forms in 16-ft. panels was developed using a minimum amount of material and offering possibilities of rapid erection. On account of the leakage caused by form wires and the time and trouble required in placing them, this method of tying the forms together was abandoned in favor of the use of steel pins which could be removed from the concrete when the forms were taken down. The holes resulting from the use of these pins were plugged with grout as soon as the pins were removed. These forms were designed with an idea of eliminating as much work as possible and at the same time having a set of forms which would not spread when in place. With this in mind, bolts, coupling pins and other labor-saving mechanical devices were used wherever possible. These forms proved to be entirely satisfactory and their use lowered form costs 40 per cent.

Following the installation of the cross drainage, two 3 x 6-in. planks, one on either side and parallel to the center line, were placed at such distances from the center line that they would come directly under the outside of the forms. These planks were placed to exact grade of the foundation and a straight edge was then used with its ends resting on them to level off the subgrade.

The procedure in the erection of the forms and the placing of the steel was as follows: The outside panels together with the posts and templets were set up and held together with the top cross-braces. The steel was placed and the inside panels and posts were suspended from the top cross-beams. The inside templets were placed on the brackets and all securely held in place by the inside struts and braces. Fig. 5 shows the forms and reinforcing steel in position.

After the forms were set up it was only necessary to put a bulkhead in the forms at the end of each day's run, the usual method in this connection being to run as much floor with 4 in. of the side walls as could be poured in the forenoon. The bulkheads were then placed across the flume at this point and in the afternoon the side walls were poured.

It was found when the joints were poured that there was enough variation in the temperature during the time that it took the concrete to set to cause a movement of the steel in the joints, thus tending to break the bond between the steel and the concrete. To overcome this tendency an oxy-acetylene welding outfit was used to weld the reinforcing bars in the joints before the concrete was poured, thus making the reinforcement continuous and preventing any movement due to contraction.

During the warmer weather forms could be removed

from the concrete the day following pouring but as the weather grew colder it was necessary to leave these forms in place for a longer period. The concrete was protected from freezing by covering the structure with burlap and by keeping fires on the inside of the flume. The most efficient kind of stove and the most easily fired was a 15-in. corrugated pipe 10 ft. long. One of these stoves would accommodate long sticks of wood, which saved labor and at the same time produced as much heat as several ordinary sheet-iron stoves.

An average day's work was about 125 lin.ft. of this size flume, containing 0.425 cu.yd. per lin.ft.

Approximately 2 miles of this type of flume have been built and it has proved entirely satisfactory. It has overcome all the objectionable features mentioned in connection with the bell-and-spigot type, and to date has developed no weak point.

### All Gunite Flume

The gunite flume is built without joints and is designed with sufficient longitudinal temperature steel to force the gunite to crack at 24-in. intervals. It was observed after this flume had been built for some time that instead of cracking at 24-in. intervals, a very fine hair crack appeared every 10 in. at the point the transverse steel reduced the gunite section. The walls of the flume are designed as simple vertical beams and the load from the water pressure is transmitted from these walls to the floor and to a coping or rail, reinforced as a continuous beam, built on top of each wall. Tie bars across the top of the flume at 8-ft. intervals connected the copings. The flume was built on a 6-in. gravel foundation which provided ample drainage for any possible leakage from the flume and also the ordinary surface drainage, except at the crossing of small draws where additional tile drains were installed to carry off surface water.

The aggregate used in the gunite was 1 part cement and 4 parts sand. It was found that when this mix was shot onto the forms there was a rebound amounting to about 25 per cent of the sand; the amount of the rebound depending largely upon how well the sand was graded and more particularly upon the percentage of small particles. This rebound was found to contain practically no cement.

The hydraulic properties of a gunite flume are the same as those for other flumes of like section except for the value of $n$ in Kutters' coefficient. It was assumed that for the side walls, which were formed on the inside, the value of $n$ would be 0.014 which is the same value as for concrete with a like finish, but that for the bottom of the flume which was untroweled gunite, the value of $n$ would be 0.018, giving approximately an average value for the flume of $n$ equal to 0.016. An attempt was made to reduce the friction loss in the floor by troweling the surface, but this was abandoned as it was found that this troweling was injurious to the gunite to the extent of reducing it to the density of concrete.

The principal equipment used was two air compressors, two cement guns of the N-2 type and the necessary forms. The compressors had a capacity of 240 cu.ft. of air at 50 lb. pressure. They were portable and driven by direct-connected internal-combustion oil engines, and were located along the flume at 700-ft. intervals. The air was conducted from the compressors about 350 ft. in both directions. The forms were reusable, built of shiplap in panel lengths of 14 ft. and were held in place with a system of cross bracing. The bracing and form panels were designed for rapid erection and removal. Fig. 7 shows the alignment which consisted of a series of tangents connected by curves of 50, 75, 100 and 200-ft. radii. Templets cut to the required radii were bolted to the studding on the back side of the form panels to make the forms fit the curves.

Sand was secured from near-by pits and hauled to the flume bench with teams where it was screened by hand over a ¼-in. mesh. The sand and cement were mixed

FIG. 7. GUNITE FLUME WITH CURVES OF 50, 75 AND 100 AND 200-FT. RADII

dry by hand before it could be used in the cement guns. The cement gun does not mix the aggregate. It is merely a convenient way of placing after it is mixed.

#### Placing Reinforcing Steel

Following the preparation of the subgrade the reinforcing steel, which had previously been cut and bent to proper lengths and shapes in a central yard, was placed in position. The inside wall form panels, which were the only forms needed in gunite work, were next erected. These were securely braced and to them were tied the reinforcing steel where it was held to proper shape and grade. The cement guns were at all times kept close to the work as it was our experience that better and faster work could be done with material hose lines not exceeding 50 ft. in length. The side walls were built first, in two layers of from 1 to 1½ in. in thickness. Next and on the same day the floor was placed and finally, after removing the wall forms and allowing the gunite time to set, the forms for the coping were placed and the coping poured using the rebound mixed with cement in a proportion of 1 part cement to 4 parts sand. Considerable trouble was experienced in obtaining a good job in the floor as the rebound, having no avenue of escape, would tend to collect in piles which, if covered with gunite, would leave weak spots. It is therefore necessary to shut down the machines at frequent intervals and clear away the rebound, a procedure which added materially to the cost.

The forms were left in place until they could be removed without injury to the gunite. In warm weather this requires only five or six hours, but during cold weather from one to two days. This flume was built during the early spring when strong winds prevailed, and was covered with burlap on which water was sprinkled for ten days to prevent the gunite from drying out too rapidly.

An average day's run with two machines, after the men became familiar with the operation of the cement

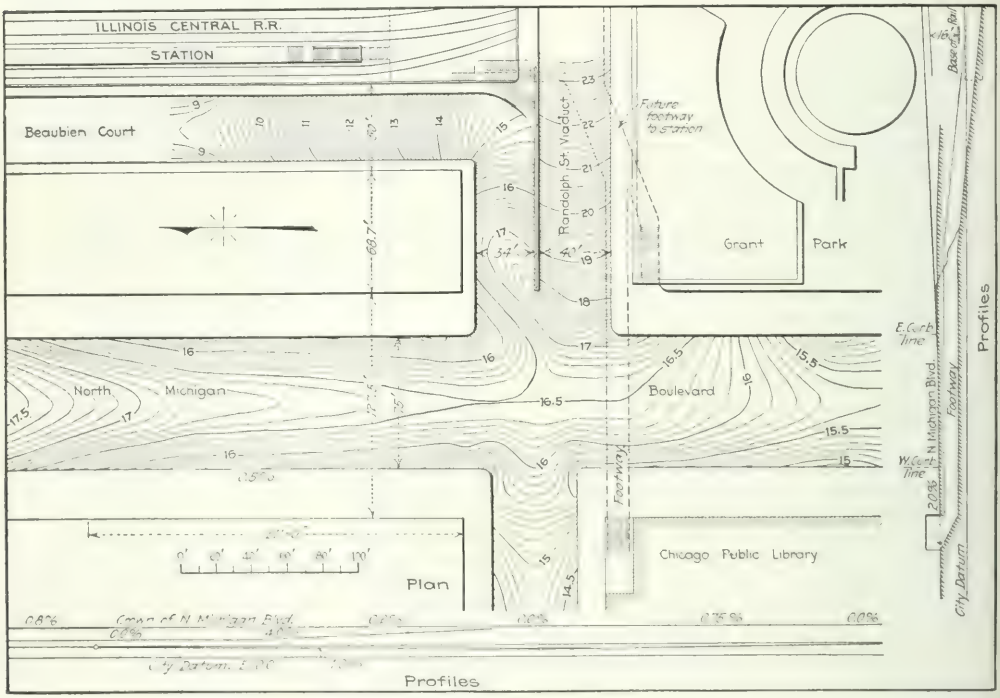
guns, consisted of 160 lin.ft. of completed flume, which is equivalent to 15 cu.yd. of gunite per day of 8 hours for two machines.

This flume, after being in operation for 3 years, has demonstrated its merit as a type to be built on a foundation which will not stand up under any leakage from the flume. Although the floor and sides are only 2¼ in. in thickness, the flume is, for all practical purposes, watertight and has required no maintenance since its construction. There were, however, some disadvantages developed. The coping wall, which had to be poured after the gunite was placed, materially reduced the rate at which the flume could be built. Also the crossties retarded and increased the cost of the form work. Another disadvantage is the increased water area required for a given slope, necessitated by the rough gunite floor. To overcome these objectionable features another type was designed having a concrete floor poured in place and side walls of gunite reinforced as cantilevers.

[*Section II on concrete-and-gunite and semi-precast concrete flumes will appear in an early issue.*]

## Contour Map of Street Intersection

IN ORDER to explain graphically to various municipal authorities a proposed rearrangement of grades at a Chicago street intersection, due to the construction of a footway under Michigan Ave., the Illinois Central R.R. had recourse to a contour map having intervals of 0.1 ft., as shown in the accompanying drawing. Extremely heavy automobile traffic in Michigan Ave. is crossed by traffic to and from the Randolph St. suburban station. From this intersection Michigan Ave. is level toward the south and rises toward the north on a grade which begins at 0.5 per cent and gradually increases to 2 per cent. Randolph St. is level toward the west, but toward the east it divides into two inclines of 4 per cent, one descending to Beaubien Court (for teams) and the other ascending as the approach to the Randolph St. viaduct.




COMPLICATED GRADES AT A CHICAGO STREET INTERSECTION

In planning the reconstruction of the Randolph St. station, it was to the interest of the railway company to raise this viaduct as much as possible, in order to avoid the depression of tracks under the approach. For this reason it was desired to raise the east side of Michigan Ave. about 21 in. above the former grade. With the contour map it was possible to show clearly that such a raise at the southeast curb corner would not be objectionable to the Michigan Ave. traffic. This arrangement was carried out with modifications in constructing the footway shown on the plan (*Engineering News-Record*, Oct. 21, 1920, p. 798).

The contour map was prepared by C. H. Mottier, office engineer, directed by D. J. Brumley, chief engineer, Chicago Terminal Improvement, Illinois Central R. R.

## Wood Preserving in 1920

More than two billion board feet of timber was treated in 112 active pressure wood-preserving plants in 1920 in the United States. According to the Service Bureau of the American Wood Preservers' Association 25,000 tons of zinc chloride and 69,000,000 gal. of creosote oil were used.

# Rapid Renewal of Turntables at Engine Terminals

## Different Methods of Two Railways in Locating and Placing New Table, Removing Old One, and Handling Masonry

IN REPLACING old turntables with others of larger diameter there is the difficult problem of reducing to a minimum the actual time between putting the old one out of service and getting the new one into service, since interruption to roundhouse movements is a serious matter at busy engine terminals. Two very different methods devised by two railways for work of this kind are described below, a difference of special interest being that in one case the old and new tables were made eccentric while in the other case they were concentric. Reference may be made also to the methods of placing a new 100-ft. table for the Missouri, Kansas & Texas Ry. at Oklahoma City, Okla., as described in *Engineering News-Record* of Aug. 18, p. 293.

### Gulf, Mobile & Northern Ry.

With the introduction of new large locomotives on the Gulf, Mobile & Northern Ry. it was necessary to replace a 60-ft. turntable with a new 80-ft. turntable on the same location at New Albany, Miss., in 1920. At the time of replacement a sudden increase in traffic made it impracticable to put the old table out of service and there was no ground available for a temporary Y track.

Eccentric location of the new table solved the problem of replacement under these conditions, its center being placed as close as possible to that of the old table so that the new circle wall would fall entirely outside of the old one. This permitted building the new center foundation and the new circle wall and footing without interfering with the old work. The two centers were 7½ ft. apart and in line with the main lead into the roundhouse. With the new table in place it was necessary to make a slight bend in the other radial tracks, but this does not interfere seriously with the operation and will be remedied when the roundhouse is rebuilt.

When all was ready for changing the turntables, the old table was lifted out bodily by the railway company's 75-ton wrecking crane. This machine was used also to break up and remove the old concrete wall and foundations, some of the masses weighing about 15 tons. The old center block, which did not rest on piling, was lifted out in one piece, the casting being left on it for attaching the crane hook. From the main lead track, extended on cribbing into the pit to within 16 ft. of the new center, the new table was swung into position, the cribbing being then removed to allow the table to revolve. After the table was in operation the interior of the pit was cleaned out and paved with concrete.

Everything possible was done in advance and two days were allowed for making the change. The old table turned its last engine at 8 a.m. one day and the new table turned its first engine at 6 p.m. the next day. No work was done at night, so that the actual time consumed was only about 21 hours. This work was planned and directed by L. W. Duffee, then chief engineer.

In replacing a 70-ft. deck girder turntable with an 80-ft. through girder turntable on the International & Great Northern Ry. at Palestine, Tex., the same center was used, making the new and old pits concentric. The change of tables was made in very short time, the new table being ready for service within 16 hours after the old table had been put out of service. Engine movements to and from the roundhouse were discontinued for only 18 hours.

As the first step, the new concrete circle wall and pit floor extension was built about 5 ft. outside of the old wall, all radial tracks being maintained in service. Track extensions were made of old rails, well reinforced, which when fitted to the rails of the old table would rest upon the new wall. The wood curbing was next removed from the old wall, the rails in radial tracks were cut back to the new line, and the track extensions were placed on the table, so that the 70-ft. turntable operated in the 80-ft. pit.

A precast concrete block 5 ft. in diameter and 2 ft. thick, with holes for anchor bolts and electric conduit, was placed in the old center foundation to give the required increase in height. Four small pipes in this block provided for drilling holes into the old foundation. In the meantime, the old circle wall was broken down by small charges of dynamite and the new circle rail was placed. Preliminary work was completed by the assembling of the new table, with deck and rails laid, the table being then placed and carefully centered on a flat car.

This car was run onto the old table, which was set at right angles from the position for its removal. The track extensions of the old table were then removed to make room for placing framed bents which had been prepared to support the ends of the new table when jacked up clear of the car. Then the old table was swung 90 deg., the empty car was removed, and the table was hauled out of the pit on an inclined skidway.

The old concrete center foundation was then cut down and leveled to the required elevation to receive the precast concrete block, which was lowered into the pit, slung from the underside of the new table and set in place, melted sulphur being used for a thin grouting. Holes were drilled into the old foundation through the pipes mentioned above, steel dowel pins were then placed and the holes filled with sulphur, thus securely anchoring the block to the old foundation. As soon as the center castings were in position the new table was lowered into the pit by the locomotive derrick and was ready for operation.

This work was done by railway forces under the supervision of F. S. Schwinn, chief engineer; R. E. Caudle, division engineer, directed the work in the field.

## English Articulated Trains

An articulated train put in service recently by the Great Northern Ry., England, consists of five cars mounted on six four-wheel trucks, there being a truck at each end and one under each of the short vestibuled connections between the cars. A 40-ft. kitchen car is at the middle of the train with a first class 45-ft. dining car and a 55-ft. coach at one end and a third class dining car and coach at the other end. All cooking is done by electricity. This train is for a four-hour run between London and Leeds, making a round trip daily. The purpose of the design is to reduce dead weight. Thus, the train is 246 ft. long, accommodates 128 passengers and weighs 118 tons on twelve axles. The ordinary train previously used consisted of four cars 60 and 65 ft. long, of which the two dining cars (with kitchen in one car) had six-wheel trucks. This older train was 256 ft. long, accommodated only 110 passengers and weighed 139 tons on twenty axles.

# Nashville Concrete Bridges Show Serious Deterioration

**Rusting of Reinforcement in Columns, Chords and Railing Causes Trouble in Two 12-Year-Old Concrete Viaducts and Trusses—Limestone Screenings Used in Concrete**

REINFORCED-CONCRETE columns, truss chords and railings, parts of two bridges at Nashville, Tenn., are in rather serious condition as a result of the corrosion of the steel reinforcement and the consequent spalling off of large pieces of the covering concrete. While the strength of the structures is not yet so affected as to cause immediate concern, several engineers who have inspected the bridges feel that a continuance of the action would soon bring about a condition where the safety might be questioned. So far no thorough investigation into the causes of the trouble has been made, although the city engineer has repeatedly endeavored to interest the city council of Nashville in such an investigation. The statement of the condition of the bridges given herewith is a result of reports and investigations by several engineers, most of whom are noted in the article.

ELEVATION OF SPARKMAN STREET BRIDGE ACROSS THE CUMBERLAND RIVER AT NASHVILLE, TENN.
(Reprinted from *Engineering News*, Feb. 25, 1909)

The two bridges in question were known when built as the Sparkman St. bridge and the Jefferson St. bridge, although the former is now known as the McGavock St. bridge. They are both over the Cumberland River with approaches over the low lands on either side. The Sparkman St. bridge crosses the river just above the foot of Broad St., in the central part of the city, and the Jefferson St. bridge crosses at a point about three-quarters of a mile below the former. In both bridges the channel spans are steel trusses on concrete piers, and in both of them a part of the approach is earth embankment on each side of the river supplemented by long reinforced-concrete viaducts of trestle bent type except where the Sparkman St. viaduct crosses several tracks of the Tennessee Central R.R. Here heavy concrete trusses carry the approach over the tracks. The Sparkman St. Bridge was described in detail in *Engineering News* of Feb. 25, 1909, p. 199, and Nov. 25, 1909, p. 570. Both bridges were completed in 1910 by Davidson County.

About 1912 the county authorities requested the city authorities to assume control of the bridges and to undertake their maintenance. The city did reluctantly take the bridges over and has since been responsible for them. The city engineering department, however, was not consulted when the bridges were designed nor during their erection and had no voice in the location or design of either structure. They were built by the Cumberland River Bridge Commission, with Howard M. Jones as chief engineer and with the Foster-Creighton-Gould Co. of Nashville, Tenn., as contractors.

The design of the two bridges is practically identical, that is the same type of structure and identical specifications were used, although some of the detail sizes are different. It is in the approaches where the current difficulty is being experienced. These approaches as stated above, are of two types—the concrete truss type and the viaduct approach. These concrete trusses vary in span from 85 to 105 ft. and are of the bow-string curved upper chord type, with vertical posts but no cross braces. The lower chord, which varies from 18 x 30 in. in section in the shorter spans to 18 x 36 in. in the longer, is an important part of the structure as it acts as a tie to take the horizontal components of the end trust. About one-tenth of its area is strengthened by rods and the concrete acts only to protect the steel. The top chord follows practically the line of pressure of the equilibrium polygon resultant from the dead load and is practically all in compression. For dead-load only the pressure is uniformly distributed over the cross-section and has a maximum of 394 lb. per square inch. If in addition to this there is a live-load of 80 lb. per square foot over the roadway the unit stress will be increased to 512 lb. per square inch. A typical lower chord, 36 x 18 in. in section, has eighteen 2¼-in. rods. A typical upper chord, 36 x 40 in. in cross-section, has eight ¾-in. rods with a lacing of ⅝-in. rods 18 in. center to center.

The viaduct, 1,060 ft. long in the Sparkman St. Bridge, is of the trestle type, ranging from 18 to 50 ft. high. It is mainly in 30-ft. spans supported by three transverse columns 24 x 24 in. for the higher part and 20 x 24 in. for the lower. The columns are grouped in bents of six columns, joined by 10 x 15 in. struts and are reinforced with straight rods in the corners. There are service staircases made of sloping reinforced-concrete stringers between sets of small columns erected alongside the viaduct.

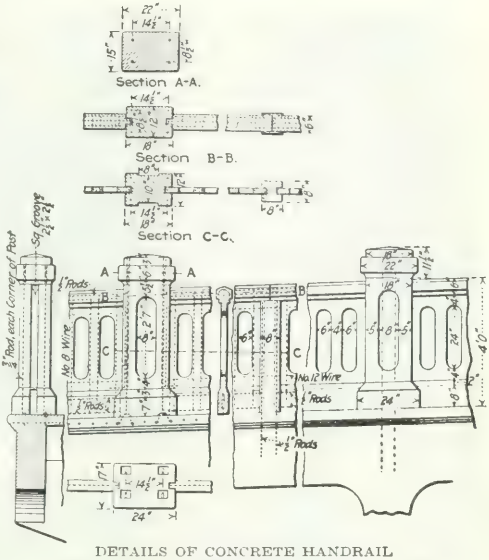
Regarding the present condition of the bridges, W. W. Southgate, city engineer of Nashville, writes as follows: "During the winter of 1913-14 we had a prolonged spell of very cold weather, the thermometer dropping below zero for several days. Very soon after that cold snap one of the main piers of the viaduct approach of the Sparkman St. bridge where the viaduct crosses Second Ave. on a steel plate-girder bridge, revealed a large, vertical crack extending through the coping and several feet down into the main pier. Upon close examination it was found that not only had this main supporting pier spread open vertically, but that the split also extended up through the pedestal on top of the coping supporting the large main reinforced-concrete floor-beam at the junction with the cantilever arm supporting the sidewalk, also splitting the big floor beams.

"This department took steps immediately to repair this dangerous defect and, though it was a rather complex piece of bridge surgery, it was successfully accom-

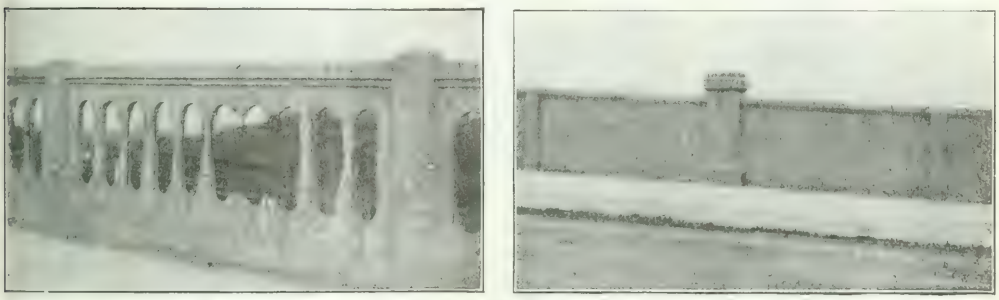
plished and is all right today. The trouble was caused by insufficient allowance for expansion and contraction.

"This department has had since that time to make several similar repairs to several of the main supporting piers of the viaduct on both the Sparkman St. bridge and the Jefferson St. bridge, due to the same oversight in not providing sufficient expansion and contraction leeway in the design.

"Within about three or four years after the city assumed responsibility for the maintenance of the bridges the reinforced-concrete hand-railings of both structures revealed glaring indications of disintegration of the concrete. These handrailings are rather light and airy looking structures, with oblong slits or openings in the panels. Investigation showed that the structure had been erected under careful supervision and inspection, the cement had been carefully inspected and certified, and the work was conscientiously executed. However limestone screenings were used for the very fine aggregate in the concrete instead of sand. This limestone was the product of a quarry that is badly shot and interspersed with seams of shale. The limestone ledges were of a superior quality of rock but apparently no special precaution had been taken to exclude the shale. As a consequence I am satisfied that the limestone screenings used in the mixing of the concrete of this structure were heavily charged with argillaceous




DETAILS OF CONCRETE HANDRAIL
(Reprinted from *Engineering News*, Nov. 25, 1909)



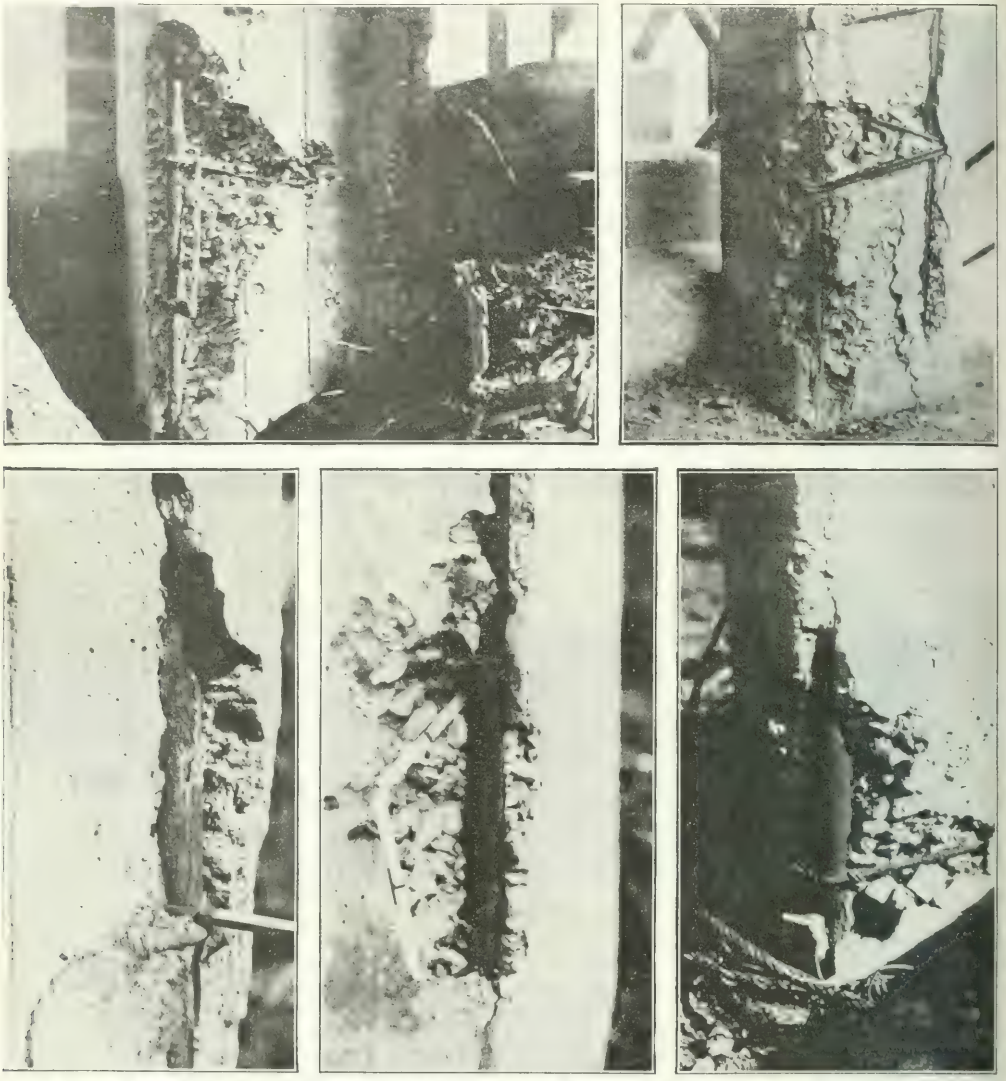
NASHVILLE BRIDGE RAILINGS BEFORE AND AFTER REPAIR WORK

impurities, and that this admixture of shale is certainly one of the causes of disintegration in the concrete."

The detail of the handrailing is given in an accompanying reproduction of a drawing which appeared in *Engineering News*, and the condition of the rail before its repair is also shown just above. The repair work was undertaken in 1916 by the city. The method of repair was very simple. Portable board forms were set up and secured in place on the outside of the handrailing, fitting snugly against it. Where needed, reinforcing steel in the way of wire mesh was inserted in the old handrailing. Then mortar was shot in by a cement gun from the sidewalk of the bridge two panels at a shift. This was allowed to take its initial set. The temporary form outside the handrailing was then taken down and from a suspended scaffold the cement gun finished the outside of the handrailing. The mortar was then troweled to an even surface. The result is shown in one of the views. Some of this work has gone through four severe winters and reveals no signs of disintegration or of checking and cracking, except occasionally where rusting reinforcement is causing cracking in the posts of the hand rail.

Further deterioration of the structure is noted by Mr. Southgate as follows: "An examination of the concrete in the bridge approach reveals that so far disintegration has only occurred where the concrete is exposed to the action of water, that the alternate absorption of moisture and the drying out of the concrete sets up violent stresses therein and produces checks and cracks in the concrete, that the absorption of moisture by the concrete during wintry weather and then freezing causes rapid disintegration. I am further satisfied that the comparatively large percentage of shale in the concrete has upset the physical and probably the chemical equilibrium in the portland cement and has destroyed its strength wherever the concrete is exposed to the weather. A careful examination of the floor-beams and other members of the concrete structure underneath the bridge where these members are completely protected from the effect of the rain and weather, fails to reveal any sign of disintegration. The only sign that I can discover in the concrete is where the latter is exposed to the weather."

Information regarding the condition of the structure that takes a somewhat more serious view of it than does



SOME EXAMPLES OF STEEL CORROSION AND CONCRETE FAILURE IN VIADUCTS AND STAIRWAYS—SPARKMAN STREET AND JEFFERSON STREET BRIDGES

Mr. Southgate's report is given by S. M. McMurray, an engineer of Nashville. Mr. McMurray says:

"The disintegration of the exposed concrete, especially in the Sparkman St. bridge, has become more pronounced with the passing years, so that now all of the exposed concrete work has the appearance of a rude mosaic, the surface mortar having all been removed by the elements. In some places whole sections of the handrailing have fallen out and in others, where stairways lead from the bridges to the streets below, slabs of concrete of considerable size have pulled away from the steel reinforcing which is badly rusted and swelled. This is especially noticeable in the columns which support the stairway, where peeling has taken place and where ingress is offered to moisture and the elements. The unexposed part of the concrete, that is the under side of the approaches and the columns supporting them where not directly exposed to the elements, seems to be in fairly good shape."

A further report on the condition of the two bridges has been made at the special request of *Engineering News-Record* by Prof. Robert H. McNeilly of Vanderbilt University. Prof. McNeilly reports as follows:

An inspection of the two bridges in detail reveals the following facts:

### Sparkman Street Bridge

*West approach up to railroad*—Main column shows disintegration in only a few places. At one point water stands

EXPOSED RODS IN LOWER CHORD
SPARKMAN STREET TRUSS

at a column base and the sidewalk has sunken around the base, which leads me to suspect disintegration of the foundation. Near the center of this approach the expansion of the floor system was not properly taken care of and structural strains caused the tops of several columns to split. This was repaired several years ago. Where these columns were tied to adjoining columns the concrete ties show cracks evidently due to structural strains. Upon the floor system, there is frequently evidence of disintegration caused by the expansion of rusting reinforcement.

*Bow-string concrete truss over railroad*—In two places the concrete has broken away and the heavy lower chord rods (2⅛ in. in diameter) are exposed for a distance of about 18 in. with heavy cracking extending at least 4 ft. along the rod. At one other similar place, the cracking is very pronounced and the condition just as bad. The disintegration takes place in the lower chord below the verticals and seems to be so located due to the water being led down the vertical at this point. In at least 10 per cent of these points below the verticals in these trusses cracks show the beginning of such action. I could not get closer than 15 ft. to these points to inspect them, but I do not believe the trusses are yet in an unsafe condition, as the rods are very large and are heavily bolted through bearing plates at the ends, so they do not depend on the bond with the concrete for their strength.

*Subsidiary stairway structures*—All the stairway structures on west approach are composed of small members and are in a most serious condition. It appears to me that they will fall down in a few years if something is not done.

*East approach*—At least 10 per cent of the main 24 x 24 in. columns show exposed steel or badly cracked corners on the columns of the two outside rows where water reaches them. Fully 25 per cent show incipient cracks. Cracks and exposed steel are also evident in the structural part of the floor system.

*Handrail*—On the entire bridge this is badly disintegrated. Whole panels of the verticals are gone.

ANOTHER BAD PLACE ON THE SPARKMAN STREET TRUSS OVER RAILROAD TRACKS

### Jefferson Street Bridge

*West approach*—Condition of columns, good. I found no evidence of reinforcement exposed. Condition of floor system about the same as in the Sparkman St. Bridge. I found one place where outer edge of sidewalk had disintegrated and fallen. Near the river after columns were built, some heavy plain concrete walls were built as bumpers around the base of the columns. One of these was badly cracked and one wall about 12 x 50 in. x 30 ft. has broken and fallen entirely down. Where this has occurred one of the columns has been repaired but it is probable that this was broken by some blow or strain.

*Stairway*—Condition excellent as compared with those of Sparkman St. bridge. I noted only one place where reinforcement was exposed.

*East approach*—This is in the most serious condition of any part of the two bridges, except the handrails and the stairway structures which do not effect the main viaducts structurally. At least 25 per cent of the columns show exposed steel reinforcement. At least 40 per cent are so badly cracked that one blow of a hammer will expose the steel; both inside and outside the columns are affected. These columns are 24 x 24 in. I measured one place where steel was exposed for 2 ft. and heavy cracking extended 1 ft. below to the ground and 8 ft. above the exposed portion.

EXPOSED STEEL ON STAIRWAY COLUMN

One of the reinforcing rods was calipered. The original diameter was evidently 1¼ in., the present diameter is 1⅞ in., the diameter of the rod with the rust intact about it is 1⅜ in., showing an increase in original diameter of ⅛ in. due to rusting. This approach also shows a bad failure in a cross strut which is hanging by the reinforcement. This is a structural crack, however.

*Handrail*—Early showed serious disintegration and was filled in solid by gun cement and sand. This has been fairly successful.

### Observations on Structures

I regard the important structural members of the Jefferson St. bridge to be in a more serious condition than those of the Sparkman St. bridge although the stairways of the Sparkman St. bridge are structurally in a far worse condition than any portion of the two bridges. (The size of the reinforcement in the concrete truss on the Sparkman St. bridge makes their rusting less serious.)

The columns on the east side of the Jefferson St. bridge sometimes have backwater around them for two or three weeks and a saw-mill with a heavy sawdust pile extends under the viaduct. The water standing on this sawdust pile probably develops organic acids which attack the limestone

of the aggregate, and particularly the limestone screenings used.

There are frequently fogs at Nashville which hang like a blanket over the city night after night and absorb the soft coal smoke of the city with its load of sulphur. This smoke laden fog is often so acid as to cause serious discomfort to one's throat and must contain an appreciable amount of sulphuric acid. This condition is at its worst along the river bank where the fog is densest and receives the smoke of railroads on both river banks. I believe these fogs have in no small degree attacked the limestone screenings and penetrated to the steel, greatly accelerating the corrosion. One sample of the rust when treated with hydrochloric acid gave off unmistakable sulphur fumes.

In the stairway structures the use of 2-in. iron pipe handrails going into concrete posts is especially bad, particularly where the pipes are on an angle going down. These handrails have been attacked and the water probably impregnated with acid has run down the handrail and deposited a load of oxidized iron in the concrete, splitting the columns badly.

There is also a strong possibility of electrolytic action which has been set up with sulphuric acid in the water as a conductor between iron and concrete.

The concrete in these structures was undoubtedly too porous and a greater density could have been gotten by different proportions. Denser concrete would certainly have arrested the disintegration but I believe the vital mistake was the use of the limestone screenings instead of siliceous sand in the mixture. This, however, is an error in judgment which any one might have been led into because the available sand at Nashville is very unsatisfactory and should be carefully washed before being used in reinforced concrete, while the limestone screenings give exceptionally high strength tests in the laboratory.

The safety of the bridges proper is probably not yet affected but the bond between concrete and steel should be carefully renewed in the columns before waterproofing repairs are undertaken.

In connection with the disintegration the following paragraphs from an earlier article on the bridges are of interest.

"Concrete was mixed in two classes, *A* and *B*, *A* concrete of 1:2:4 proportions, and *B*, 1:3:6. Cement limestone dust from $\frac{3}{8}$ in. down and stone from $\frac{3}{8}$ to $1\frac{1}{2}$ in. were the ingredients. This mixture makes an especially white concrete which is of course due to the limestone dust. *A* concrete was used in the 12-in. strip around the outside of the piers and for all the reinforced work. *B* concrete was used in the interior of the piers, retaining walls, and some of the column foundations. The concrete was mixed very wet and frequently the men could stand knee deep in the mass."

Finally, it should be stated, the city engineer, Mr. Southgate, has repeatedly requested that appropriations and provisions be made in the budget for vital and necessary repairs to these bridges, but no money has been available for this purpose until after these reports were written. The city recently appropriated $12,000 for repairs and these are now being made by the city on its own account using the cement gun to protect and build up disintegrated parts.

## Comments

Proofs of the foregoing article were submitted to Howard M. Jones, who designed and supervised the bridges. Mr. Jones says that it has been some years since he saw the structures so that he is not in a position to discuss the present appearance. He thinks the following comments are pertinent:

The concrete was not a "sloppy" mixture. This work was done before the day of placing concrete by spouting methods, and the consistency of the concrete was what would be known at present as a dry mixture. On all the reinforced work it was mixed so as to quake slightly in the barrows. On the large piers in the river it is true that water sometimes accumulated on the top of the concrete. The piers were taken up in 4-ft. horizontal layers, and each 4-ft. section was permitted to set before another layer was put on. All of the reinforced work was made of a 1:2:4 mixture, which I believe is generally recognized as a standard concrete mix for reinforced work. The specifications, however, stated that the mixture might be varied so that in no case should the excess of mortar be less than 10 per cent. As a matter of fact, the contractors objected that we were making them put in too rich a mixture, and tests conducted at Vanderbilt University at the instance of the contractors, seem to sustain the contention of the contractors, and in the final settlement for the bridges we allowed them for excess cement put in over and above the 1:2:4 mixture.

I agree with Professor McNeilly, however, that it is quite probable that a siliceous sand would have made a denser concrete had the same amount of sand been used as the screenings that were used. I am also inclined to agree with the professor that most of the trouble is due to the limestone screenings used for the small aggregate. Before permitting the use of limestone screenings an exhaustive research on the subject was conducted, and every text-book which I consulted at that time recommended highly the use of good calcareous material, and invariably stated that it should be as good or better than siliceous sand. I also investigated from current periodicals the use of limestone screenings for small aggregate and found that for important structures all over the United States limestone screenings had been used as a substitute for siliceous sands. The only available local sand was the Cumberland River sand which was full of vegetable matter, and in addition was very fine grained. It had gotten into bad repute as a concrete material and the failure of a number of structures in Nashville had been attributed to the poor quality of the sand. Laboratory tests conducted by me and others showed that briquettes made from this sand did not attain one-half the strength of briquettes made of Ottawa sand, whereas briquettes made from the limestone screenings invariably attained a greater strength than those made of standard Ottawa sand, and frequently doubled the latter. The nearest available point for good siliceous sand was Memphis, Tenn., several hundred miles away, and to have used it would have made the concrete cost at least a dollar per yard more, which, with the appropriation available, we did not think justified its use.

I have within the past few years heard of a number of other cases where difficulty was experienced when limestone screenings were used instead of siliceous sand, which would seem to indicate that laboratory tests, which usually cover short periods, cannot be entirely relied upon to prove the fitness of concrete materials.

I note that the city has appropriated $12,000 to permit the city engineer to make the necessary repairs and I feel quite sure that Mr. Southgate, the city engineer, will rectify all minor difficulties that may occur from time to time if the city grants him the proper appropriations. I think it should be said that no structure, no matter how well designed or built, can be expected to go along from year to year without some maintenance cost. These bridges have been open to traffic now for twelve years, and if they can be properly repaired for $12,000, it seems to be a very low cost of maintenance.

The handrail design in the first instance was undoubtedly too light and airy. In our efforts to make an artistic handrail at a cheap cost, the panels were made only $2\frac{1}{2}$ in. thick with wire reinforcement. The wires could not be kept in place when the concrete was being placed and were forced too close to the surface. When oxidation took place, and through the freezing and thawing of the winters, these thin rails disintegrated.

What Professor McNeilly has to say of the action of the sulphurous smoke and fogs of Nashville is very interesting to me, and seems to be a reasonable explanation of some of the difficulty.

## Inspection of Williamsburgh Bridge Cables Shows Wire Well Preserved

TAKING advantage of the rewrapping of the cables of the Williamsburgh bridge over the East River at New York City, now in progress, Edward A. Byrne, chief engineer of the Department of Plant and Structures (bridges) of the city, has been carrying on an examination of the condition of the four 18⅝-in. cables of the structure. On Nov. 30 a party of engineers of the Philadelphia-Camden bridge staff inspected this work under his guidance. The rewrapping is carried on by removing successive lengths of the sheet-steel covering and inner waterproofed-canvas wrapping of the cables, and applying a close circumferential wrapping of No. 9 Norway iron wire galvanized. When a section is laid bare the bundle of wires constituting the cable can be opened up by driving in wedges, and the interior examined to any desired depth.

The sections inspected, which were in the Manhattan land span, had the interspaces between wires fairly filled with slushing oil applied when the cables were constructed (Nov., 1901, to June, 1902), and no signs of corrosion were visible except for a few spots of discoloration on the outer layer of wires. In the main span, Mr. Byrne stated, rust discoloration on the outer wires was found at quite a number of places ranging in width from 2 in. to about 6 in. in spots, and generally occurring at the lower ends of the panels and under the seizing at the lower part of the cables.

The waterproofed canvas wrapping lapped over the suspender bands in downward direction, to shed water, but in the course of time the waterproofing hardened and the motion of the structure then loosened the seal and allowed moisture to enter, after which rusting began in the neighborhood of the bands. No damage has been done to the cables that could be estimated in terms of loss of strength, but the fact that corrosion was going on and that scaling and perforation was destroying the ⅛-in. sheet-steel covering was the motive for the present rewrapping.

Still better conditions have been found in the wire-wrapped cables of the Manhattan and Brooklyn bridges, where opportunity is taken from time to time to expose the interior wires and examine their condition. On the Manhattan bridge the cable bands have given some trouble from slipping. This defect has been remedied by modification of details of the cable bands. When slipping occurred the wrapping wire covering the cable between the bands became disarranged and the cable wire was exposed, making prompt replacement of the bands necessary. In such replacement the band is set back to its proper position and a short section of the wire wrapping to either side of the band is renewed. Before this is done, however, the cable wires are wedged apart and the interior examined. These wires, which are galvanized (those of the Williamsburgh bridge are not galvanized) have in no case shown rust. The same thing applies to the cable wires of the Brooklyn bridge, which also are galvanized; no slipping of bands has occurred on this bridge, but there has been slight movement of the cable posts, which support the trusses, at points where the cables pass below the line of the bottom chord, and where this has occurred the wrapping has been renewed and the wires examined. In every case they have been found in good condition.

The bands on the Manhattan and Williamsburgh bridges are attached directly to the cables and the wrapping is done between the bands. On the Brooklyn Bridge the bands and posts were erected after the wrapping was completed.

The Brooklyn anchorage of the Williamsburgh bridge was also examined by the Philadelphia-Camden engineers and the wires found to be in first-class condition.

The anchorage was free of water and showed evidences of high class maintenance. The condition of the structural steel of the Williamsburgh and Manhattan bridges was also examined, and was found to be surprisingly good. Although repainting has been done at intervals of as much as eight or nine years, no structural parts of either bridge have suffered from rust. Except for thin metal in some railings and floor grills, the steelwork of both structures is considered to be in perfect condition.

## Railway Motor Car in Passenger Service

AN EXAMPLE of bus or motor-car equipment for passenger service in place of steam trains or small railways and branch lines is the car shown in the accompanying view, which is now in operation on the Leavenworth & Topeka R.R., a 46½-mile line in Kansas. This car has the frame and driving mechanism of a White 2-ton motor car, but is equipped with a special body and has a four-wheel leading truck and steel flanged tires pressed on the driving wheels in place of the usual solid rubber tires for operating on highways.

MOTOR CAR FOR RAILWAY TRAFFIC

There is seating capacity for 25 passengers, but it is stated that as the car is often crowded it has been proposed to attach a trailer for handling passengers and farm and dairy produce. According to a published statement by O. B. Guffler, vice-president and general manager, the car averages daily receipts of $35 to $40 with an operating cost of $10. This car was adapted to service by the Railway Specialty Co., Atchison, Kans.

### Standardization of Filter Press Plates

The standardization of filter press plates is under investigation by a joint committee representing the Association of British Chemical Manufacturers and the British Manufacturers Association (166 Picadilly, London). In a preliminary report the committee states (London *Surveyor*, Nov. 11, 1921, p. 333) that from details of over 800 cast-iron presses which it has collected it was found that although the sizes were many and various yet 67 per cent of the total fall under one of four groups: 18½, 25, 32 and 38 in. These four sizes have therefore been adopted by the committee as standard and manufacturers have been asked to let the committee know whether they will agree to these sizes.

# Construction Systematized in Soft Ground Tunnel

**Steel Liner Plates Hold Roof With Shallow Cover—Pneumatic Spades Effective—Spoil Trains Run on Schedule—Concrete Deposited Through Chutes Driven Through Ground**

WORKING three 8-hr. shifts at two headings, between 700 and 800 ft. of 11½-ft. circular tunnel sewer are being constructed each month under Seven-Mile Road in Highland Park, a suburban section of Detroit, Mich. This consistently good progress is due to a smooth working organization and to excellent results being obtained with pneumatic spades and steel roof plates and by pouring concrete directly into the forms through pipes driven from the street surface into the tunnel every 13½ ft. While none of these devices is new in tunnel construction, they have been operated together in this instance with such good effect that the results in footage are beyond normal.

The Seven-Mile Road sewer is a part of the new main sewer system being constructed by the city of Detroit. The section being considered is 4,750 ft. long and 11½ ft. inside diameter, with a 16-in. concrete lining. The bore is, therefore, 14 ft. 4 in. In excavating, however, the roof is cut about 3 in. high to allow the roof plates to be placed and concreted in without reducing the net thickness of the lining. This makes the volume of excavation per lineal foot about 4 cu. yd. As the tunnel penetrates firm clay, with only occasional sand pockets, the excavation is complicated only by the shallow cover never exceeding 11 ft. Were the tunnel deeper by its own diameter, the excavation could proceed largely without timbering. The thin covering makes it necessary to hold the roof and also the face when this has to be left standing for a few hours. In another respect the shallow cover has been turned into an advantage by driving pipes through it into the tunnel, for pouring the concrete lining.

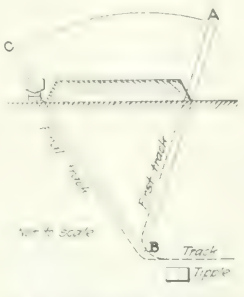


FIG. 1. SPOIL BANK TRACKS SWING RADIALLY

*Surface Equipment.*—A shaft was sunk about midway of the tunnel and here a car elevator was installed hoisting to an elevated track leading over adjacent spoil tipples. Close to the shaft head-frame are overhead bins feeding to a 1-cu.yd. mixer elevated to discharge into trucks. Alongside the mixer bins and within range of a derrick are stockpiles of concrete aggregates. With its apex at the tipples, the spoil area is fan shaped, with a radius of about 1,400 ft. It is a level tract of low ground which is being filled evenly to a depth of about 4 ft. With cement and power houses, shops and office grouped about, the shaft-head outfit, including the spoil bank, is highly centralized.

Incidentally, the method of building up the spoil bank has interest. On *B* as a center, Fig. 1, the track was swung across the spoil area from *A* to *C*, building up the fill in sloping layers as indicated. By keeping the track always on the original ground and dumping against the fill, overturning of the cars was a very rare accident. The practice of particular interest, however, was the use of a small (about 12 hp.) crawler traction tractor for shifting the track. This proved a most useful device for the purpose.

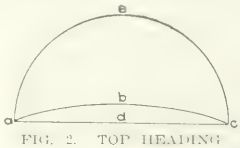


FIG. 2. TOP HEADING EXCAVATED BY ENLARGING SLOT

*Excavation.*—The excavating methods are noteworthy because of the system for handling spoil cars from two headings with one locomotive, because of the steel lagging support for the roof and because of the use of pneumatic spades to break out the clay. Two headings are worked, one each way from the shaft. The procedure is the same at both.

Excavation begins with a full section top heading to a little below the horizontal diameter of the bore. With the pneumatic spades a slot, *a b c d*, Fig. 2, is cut in the face of the heading. Then, with the spades, the roof *a b c* of the slot is enlarged to full section *a e c*. When about 2 ft. of heading has been excavated a ring of steel roof plates is placed and supported from the bench with trench jacks located as circumstances warrant. These operations are repeated until about 20 ft. of heading has been excavated.

The next operation is to place the needle beam shown by Figs. 3 and 7. This consists of two 12-in. I-beams 22 ft. long bolted together through a wooden filler. The rear end of this beam rests on a 12 x 12-in. post set on the invert of the section previously concreted and the remainder is supported on the bench. The trench jacks

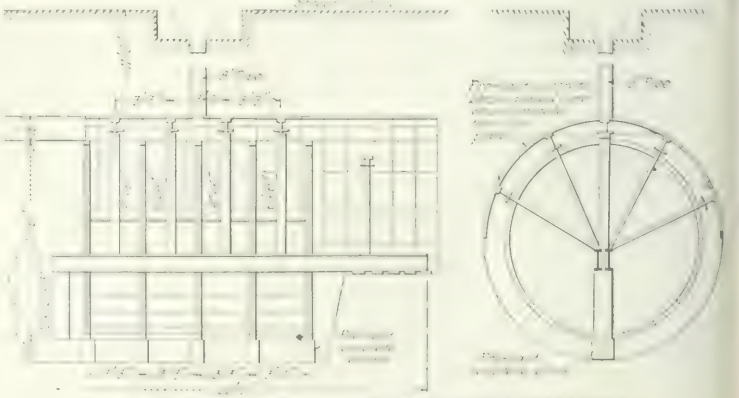


FIG. 3. DIAGRAM OF EXCAVATING AND LINING OPERATIONS

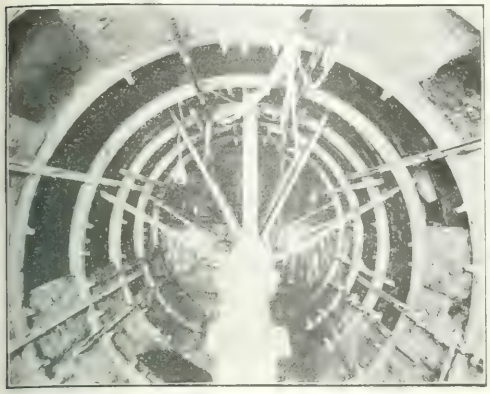


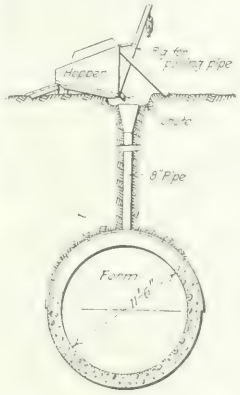
FIG. 5. ROOF PLATE SUPPORTS KEPT CLEAR OF FORM RIBS

are transferred to the needle beam from which they radiate to the roof plates as indicated by Figs. 5 and 7. These roof plates are 16 x 33 in., flanged for bolting and bent to a radius of 7 ft. 1 in. They are made of No. 16 gage steel and cost about $1 each in place.

With the roof carried by the needle beam and the face bulkheaded as shown by Fig. 5, the bench is excavated by spading down a vertical face as indicated by Fig. 7. As shown by Fig. 3 the bench is excavated just far enough for 13 ft. of invert to be placed. This leaves enough bench to support safely the forward end of the needle beam. The excavation is now ready for the first step in concreting the lining.

FIG. 6. DIAGRAM OF TUNNEL SPOIL TRAIN OPERATION

Excavation with pneumatic spades carves out and breaks down the clay in blocks and lumps which can be loaded by hand with very little shoveling. These spades have 5 x 9-in. blades, with hexagonal shanks held in pneumatic coal picks by spring retainers. It has been found that spade construction requires particular attention. Forged steel is required to endure the work and, in forging, a special heat treatment is essential. A hard shank and a soft blade endure best. Spades generally break before they are worn out. The excavated material is handled from the faces to the shaft in 1¼-cu.yd. cars on 24-in. gage industrial track by a Mercury locomotive. Four-car trains are run, and one locomotive serves both headings. This locomotive, for example, (1) picks up four loaded cars at heading *A*, Fig. 6, hauls them to the shaft, and drops them; (2) picks up four empty cars at the shaft, pushes them to heading *B*, and drops them; (3) picks up four loaded cars at heading *B*, pulls them to the shaft and drops them; (4) picks up four empty cars at the shaft, pushes them to heading *A*, and drops them. At the shaft and headings the cars are spotted by hand; sidings provide for the necessary switching and passing movements. To keep the schedule, sixteen cars are necessary, one train at each heading being loaded, one at the shaft being unloaded, and one in route from heading to shaft.




G. 4. OUTFIT FOR CHUTING CONCRETE FROM SURFACE

*Concreting.* — With the bench excavated as indicated by Fig. 3, the invert is concreted. Precast concrete blocks are set on the bottom and on them are erected full-circle form ribs, 3 ft. 3 in. on centers and so located as to come between the radial jacks holding the roof plates. Lagging is placed under the ribs to about the springing line and the invert concrete is poured. Then the floor and tracks can be extended and excavation begun on another section of top heading, while the roof is being concreted. As the roof lagging is placed the radial braces holding the roof plates are replaced by precast concrete blocks inserted between the roof plates and the tops of the ribs as indicated by Fig. 3. The

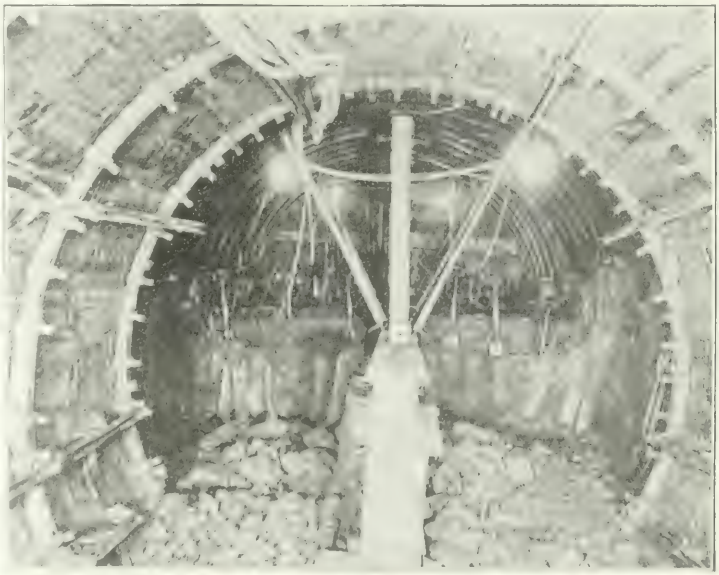


FIG. 7. ROOF PLATES CARRIED BY RADIAL FROM NEEDLE BEAM

concrete is received through an 8-in. pipe from the surface and, in the tunnel, is led by chutes directly into the forms.

Concrete is conveyed from the central mixing plant by a special 2½-ton truck with a 10-ft. wheel base and pneumatic tires. The truck has two 1-cu.yd. Lee bodies set side by side to dump over the tail. At the depositing point there is a hopper arranged as shown by Fig. 7. The holes are forced down by a sort of churn-drilling operation and are located over the center of each section concreted, as shown by Fig. 4. The concrete is mixed wet and there are no complexities in pouring it or in getting the forms filled and the concrete dense.

*Progress.*—Working three 8-hr. shifts in each heading there were completed in August 800 ft. in 720 hr. and in September 782 ft. in 652 hr. This is an average for the two months of a little over 9 ft. per shift. Practically a 13½-ft. section is concreted in each heading each 24 hr. This is not the high record for sewer tunnel in clay in Detroit, but it is a remarkably high average for a considerable period.

Construction is under the direction of C. A. Hubbell, city engineer, Detroit, Mich., with J. M. Dorsey superintendent in charge for the contractors, John F. Casey Co., Pittsburgh, Pa. The contract price was $433,152.

# Timber Above Summer Water Level Perfectly Preserved

## Redwood Grillage Footing of Bridge Pier in Russian River Found Free From Decay After Thirty-Five Years

By C. M. Kurtz

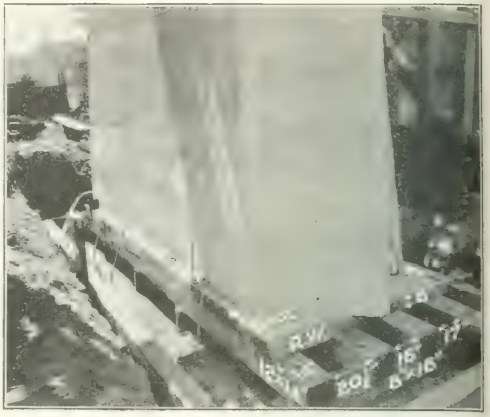
Structural Engineer, Northwestern Pacific R.R., San Francisco

IT IS an old and well established rule in engineering that all portions of piles or timber of a structure's foundation should not extend above the water line.

In some localities, especially cities, the permanence of any given water level can rarely be relied upon. Charles Sooysmith, in *Transactions* Am. Soc. C. E., Vol. 35, page 465, states that in lower New York City the water level at any one point may be materially lowered at any time by pumping from a driven well in the vicinity, or by the constant drainage of some leaking basement or other excavation. As a result of the lowering of the water line, the removal of a building in New York City which had been built on piles driven some 10 or 12 years previously brought to light the seriously decayed condition of the piles, which had not been driven low enough to be kept constantly damp or wet by the ground water.

In constructing the substructures of bridges crossing rivers, the beds of which consist of sand or sand and gravel, it is usually necessary to found the piers upon piles to provide support in the event of underscouring by the stream. That it is not always necessary to have the tops of the foundation piles or all timber-work of such foundations below the extreme low water of the stream was brought to the attention of the writer in August of this year while some alterations were being made to an old pier.

This pier is a member of the substructure of the Northwestern Pacific R. R. Co. bridge crossing the Russian River near Healdsburg, Cal. During the past summer two old spans of this bridge were taken down and two new 97-ft. 6-in. through riveted truss spans erected



BRIDGE PIER GRILLAGE 35 YEARS OLD

in their place. The renewal called for the remodeling of two old concrete piers and the construction of one new pier. The river bed at the site of the crossing is of gravel and sand naturally proportioned for making 1:2:5 concrete. During the summer and autumn the river bed is covered by the stream waters only at the channel near the east or right bank, although the river is temporarily dammed by a low concrete dam a few hundred yards below the bridge to make the water deep enough for bathing and boating purposes in the vicinity.

As the river cannot be depended upon to maintain its channel in its present location, it was decided to extend the concrete of the westerly pier, which supports the end of the west approach trestle and one end of the 97-ft. 6-in. spans, to a lower elevation and so obtain additional security against underscouring that might expose the foundation piles to the action of the current, and later to the drying action of the air. The base of the pier was therefore uncovered, a short sheet-pile cofferdam driven around it, and the sand and gravel of the river bed excavated about 4 ft. below the original bottom of the concrete. At the time of the excavation, the level of the river water was about three feet below the old concrete shaft, as shown in the photograph, taken Aug. 10.

The pier was constructed in August, 1886, and was founded upon a solid timber decking of 8 x 12-in. redwood laid upon 12 x 14-in. redwood sills which capped the piles. Every portion of this timber foundation was found to be in a perfect state of preservation, 35 years after construction. The marks made by the saw with which the decking was trimmed after being spiked in place may be seen plainly, as well as the level of the river water around the piles.

The old timberwork, while well above the various summer levels of the water, had always been covered up with a sufficient quantity of the gravel and sand of the river bed to keep the timber constantly moist. Capillary attraction of moisture from the lowering waters by the sand to the exposed surface of the river bed no-doubt plays an important part in constantly maintaining the damp line so well above the water.

The writer considers this instance of the permanence of timberwork which has not been constantly below the water line as conclusive evidence that it is not necessary in planning foundations to bring the cut-off of the piles

below the extreme low waters of the streams, or the high levels of tidal waters, provided the surrounding backfilling is such that capillary attraction of moisture surfaceward will ensue and will function to maintain a damp section of material above the ground or stream waters.

The pier and its foundation which was brought to light after 35 years of service were constructed under the direction of F. K. Zook, who at the time was chief engineer of the San Francisco & North Pacific R.R. and is now valuation engineer of the Northwestern Pacific R.R. The concrete was machine-mixed, a minimum quantity of water being used, and when placed in the form was well tamped until the mixture assumed a wet appearance. In remodeling, portions of the pier were cut down by air drilling, and the excellence of quality of the concrete as well as the unique reinforcing was revealed. Old cable that had outlived its usefulness in hauling Sutter St. cars in San Francisco was laid in a continuous coil up to within a few feet of the bridge seat. The concrete of the upper portion of the pier was reinforced by short pieces of the cable supplied in generous quantities. All reinforcing uncovered was found to be in excellent preservation. This concrete of 1886 must be listed as one of the earliest examples of reinforced-concrete structures constructed in the United States.

## Cofferdams for the Dnieper River Improvement; Russia

### Rock Drilled in the Dry on Site Enclosed in Timber and Sand Cofferdam Protected by Shield on Upstream Side

By S. N. Petrenko
Civil Engineer, U. S. Bureau of Standards, Washington, D. C.

For channel improvement on the Dnieper River, in Russia, considerable blasting has been done between Kremenchoug and Ekaterinoslav, the work having been in progress for several years before the World War. Drill boats were used formerly but the inconvenience and slowness of the work led to the development of a method of drilling the holes in the dry on areas enclosed within cofferdams. The rocky nature of the river bed was a difficulty in constructing ordinary earth or timber dams, but about 1901 a Russian engineer invented the type of a dam described below and shown in the accompanying drawings.

Assume that a dam is proposed at the area A, Fig. 1. After the spring floods, usually in April, a shield is erected 100 to 200 ft. above the site to divert the current and protect the cofferdam against erosion. This shield is 1,500 to 2,000 ft. long and often occupies more than half of the channel. It consists of braced timber tripods 15 to 50 ft. high, see Fig. 2, set on the river bed and connected by longitudinal beams to carry upright planks. In water over 15 ft. deep three rows of beams are used; one about 3 ft. from the bottom, another above water and the third below water but near enough to the surface to form a working platform in applying the planks.

One end of the bottom beam is attached to the tripod before it is sunk, the other end projecting above water ready for attachment to the next tripod before sinking (see Fig. 3). The face of the shield consists of two layers of 1½-in. plank spiked to the two upper beams. This planking is placed at two or three places simultaneously and as the openings are narrowed the current, increased to 10 ft. per second or more, tends to erode the sand which covers the rock river bed. If this erosion is not stopped it may cause the tripods to shift downstream until they lodge against a rock projection,

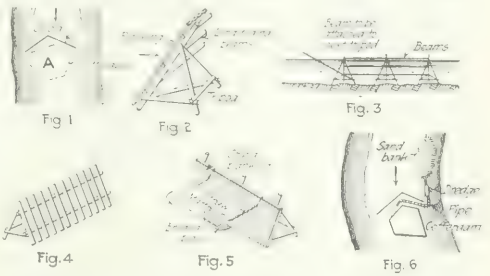


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6

COFFERDAMS FOR ROCK EXCAVATION IN DNIEPER RIVER, RUSSIA

or it may lead to overturning of part of the shield. To check the erosion it is usual to deposit gravel around the tripod legs by dredges.

An effective but expensive form of protection is to place an open or grated shield above the main shield (see Fig. 4) to break the current and cause sand to be deposited above the main shield. The author has used successfully the method shown in Fig. 5. Two long timbers are attached to the upstream sides of the threatened part of the shield and covered with a mattress of straw, gravel being then placed upon it to cause it to sink like a gate. Work on the cofferdam proceeds at the same time. Its construction is similar to that of the shield but with smaller tripods as the silting below the shield raises the level of the river bed.

Hydraulic dredges then pump sand to fill the space between the shield and the cofferdam, as shown in Fig. 6. A great quantity of sand must be placed as it is very fine and much of it is carried away, even by the weak current below the shield. Protection of threatened spots by deposits of gravel or by shield gratings (Fig. 4) may be necessary. With a top width of 20 ft. for a cofferdam in 20 ft. of water the bottom width will be about 150 ft. Centrifugal pumps unwater the enclosed space in about seven to ten days. The pumping plant must be of sufficient capacity to deal with the leakage, which is very heavy at first but is gradually reduced by silting until one pump working two or three hours daily will keep the bottom dry.

For an area of 200,000 sq.ft. with 10,000 to 20,000 cu.yd. of rock to be removed, the construction of the shield will take about 25 days; dam, 20 days; filling above dam, 20 to 25 days; pumping, 8 days; blasting and rock removal, 80 days. These periods overlap more or less, so that the total will be about 150 days. The cost, including bringing the rock ashore, will be about $100,000. This rock is used for various works on the river. About 50 per cent of the timber is salvaged, and as soon as the timbering is removed the river will soon scour away the deposits of sand.

### Exports of Road-Making Equipment

Road-making machinery to the value of $73,108 was exported during September. This shows a slight increase over exports of September of 1920 when the value of such machinery exported was given as $67,169. The figures are those of the Department of Commerce.

# Effect of Impact on Pavement Slabs Shown by Tests

## U. S. Bureau of Public Roads Gives Results of Research on Concrete and Brick Types To Aid Rational Design of Road Surfaces

TEST results of the effect of impact, simulating that produced by heavy motor vehicles, on a number of types of plain concrete and brick-surfaced pavement slabs have just been announced by the U. S. Bureau of Public Roads as the second part of its research program to secure data on which the rational design of road surfaces may be based. The first research project in this particular field, the measurement of the magnitude and character of the forces delivered to a road by motor truck wheels, was reported in *Engineering News-Record* March 31, 1921, p. 553. The second project, dealt with in this article, is designed to throw light on the behavior of various types of pavement under conditions of heavy motor-vehicle traffic. The third project, the results of which have not yet been reported on, covers an investigation of subgrades. The present investigations, dealing with impact effect on slabs, were conducted at the experimental farm in Arlington, Va., and are the subject of a detailed report by C. A. Hogentogler, highway engineer on the bureau's staff, appearing in the October and November issues of *Public Roads*, the official publication of the bureau. The following extracts from the report summarize the scope of the tests, the methods of conducting them and the general conclusions:

THE IMPACT MACHINE

Fifty-six sections of standard types of pavement, each 7 x 7 ft. in plan, were constructed of plain concrete and of monolithic, semimonolithic, bituminous-filled and grout-filled brick, with cushions of sand and screenings on concrete and macadam bases. The slabs were built with ditches alongside, so that conditions of both wet and dry subgrade could be produced.

The mixes employed were 1:1½:3 for the concrete surfaces and 1:3:6 for the concrete bases. In the monolithic brick sections a ⅝-in., 1:1 dry sand-cement mortar was placed on the green concrete base and leveled for receiving the brick, the joints of which were later grout-filled. In the semimonolithic brick construction a 1-in. bed of dry mortar was laid on the base after it had attained initial set. On the bituminous filled sections the hot filler was poured into the joints from a pouring pot with a spout as soon as the bricks were laid and rolled on the different cushions. Both asphalt and tar-sand fillers were used.

In addition, test beams, 13 in. wide and 7 ft. long, similar in material and thickness to the slabs, and 6 x 12-in. compression test cylinders were made.

### Impact Machine

The special machine designed to deliver impact blows to the road slabs, as shown in the illustration, was loaded to represent a 5-ton truck and had 1,800 and 6,000 lb., respectively, for the unsprung and sprung weights. It consisted of a loaded box riding on a 5½-ton spring which, in turn, was supported by a loaded frame or plunger on the bottom of which was a double 2 x 6-in. solid rubber tire. By means of a motor, gears and cam, this plunger or unsprung weight carrying the spring and sprung weight could be lifted and dropped from any height so that the effect produced was identical with that of a truck dropping from one level to another, dropping into a hole or falling to the pavement after striking an obstruction. The plunger was lifted and dropped 6 times per minute.

A specially designed apparatus, supported independent of the impact machine, autographically recorded space-time curves showing the movements of sprung and unsprung weights as well as the vibrations of the slabs under impact blows. These records are the chief source of information on the impact blows.

In addition to the impact tests proper, data were secured on the bearing value of the subgrade soil and its moisture content.

Blows were delivered by the impact machine from various heights of drop from ¼ to 2⅜ in. until the slab failed or, if it did not fail, until 6,000 blows had been dealt. Failure was considered to have occurred with the first crack. At the beginning of the test and after 500, 1,000, 1,500, 2,000, 2,500, and 3,000 blows, the height of fall was ¼, ½, ¾, 1¼, 1⅝, 2, and 2⅜ in. respectively. Slabs which did not fail before 3,000 blows were given an additional 3,000 blows at the 2⅜-in. height; and if failure had not occurred as a result of these additional blows the effort to break them was abandoned. If the settlement of the slab after the first 500 blows was equal to or greater than ¾ in., the drop was not increased for the second 500 blows. A center settlement of this amount generally indicated the beginning of failure.

### Test Data Explained

For purposes of comparison the various sections are grouped into four general divisions according to type of constructions as follows: (1) Concrete surfaces; (2) Monolithic brick surfaces; (3) Brick surfaces on concrete bases with 1-in. sand-cement cushions; (4) Brick surfaces on concrete, macadam, and earth bases with sand and screening cushions.

For each group a table has been prepared which gives in concise form the data necessary for the comparison of the several sections comprising the group. (See Tables I to IV.) The height of fall given in these tables is the maximum drop which the slab resisted and corresponds to the forces given in the column headed "Computed resistance." The values given in the column headed "Failure" correspond to the height of fall which was observed to cause failure.

TABLE I. TESTS OF CONCRETE SURFACES

| Slab No. | Size, Ft. | Thickness, In. | Mix. | Per Cent Moisture | Bearing Value, Penetration 50 Blows, In. | Computed Resist., Lb. | Height of Fall, In. | Force at Failure, Lb. |
|---|---|---|---|---|---|---|---|---|
| 18 | 7x7 | 2 | 1:1½:3 | | | | ..... | ..... |
| 115 | 7x7 | 2 | 1:1½:3 | 18.4 | 1.50 | 7,800 | ..... | ..... |
| 17 | 7x7 | 4 | 1:1½:3 | 21.2 | 2.15 | 14,000 | 0.204 | 14,000 |
| 113 | 7x7 | 4 | 1:1½:3 | 18.4 | 1.15 | 12,800 | 0.162 | 20,400 |
| 16 | 7x7 | 6 | 1:1½:3 | 21.2 | 1.92 | 23,700 | 0.677 | 26,700 |
| 15 | 14x14 | 6 | 1:1½:3 | ..... | ..... | 42,400 | 3.000 | 42,400 |
| 112 | 7x7 | 6 | 1:1½:3 | 20.2 | 2.67 | 21,600 | 0.555 | 26,700 |
| 111 | 14x14 | 6 | 1:1½:3 | 22.7 | 3.20 | 28,000<br>38,900 | 0.975<br>2.410 | 31,300<br>..... |
| | | | | | | 23,900 | 0.688 | 26,700 |
| 10 | 7x7 | 6 | 1:3:6 | 21.2 | 3.31 | 21,900 | 0.575 | 25,700 |
| 124 | 7x7 | 6 | 1:3:6 | 20.1 | 2.40 | 13,200 | 0.171 | 20,400 |
| 14 | 7x7 | 8 | 1:1½:3 | | 2.65 | 33,000 | 1.420 | 34,700 |
| 110 | 7x7 | 8 | 1:1½:3 | 20.4 | 1.97 | 39,200 | 2.480 | ..... |
| 13 | 7x7 | 10 | 1:1½:3 | 22.8 | 2.11 | 39,200 | 2.480 | ..... |

*Concrete Slabs*—The tests of the concrete sections show that slabs of 2-in. thickness are impractical for road surfaces and that slabs 4 in. in thickness can barely resist the static load of the heavier trucks without cracking, so that they surely would fail under impact of such trucks. It is indicated that the 6-in. types are good for a resistance of 21,000 to 24,000 lb. while the 8-in. are good for about 34,000 lb. on subgrades of no less supporting power than those of the test slabs. The indicated resistances of the slabs are: 2-in., 7,800; 4-in., 14,000; 6-in., 24,000; 8-in., 34,000; and 10-in., something over 40,000 lb.

TABLE II. TESTS OF MONOLITHIC BRICK SECTIONS, WITH ½-IN. SAND-CEMENT CUSHION AND 1:3:6 CONCRETE BASE

| Slab No. | Base Thickness, In. | Surface Thickness, In. | Surface Type | Per Cent Moisture | Bearing Value, Penetr. 50 Blows, In. | Comp. Resist., Lb. | Height of Fall, In. | Force at Failure, Lb. |
|---|---|---|---|---|---|---|---|---|
| 25 | 4 | 4 | W.-c. lug | 27.6 | 2.50 | 31,500 | 1.27 | 31,500 |
| 128 | 4 | 4 | W.-c. lug | * | * | * | * | * |
| 121 | 4 | 4 | Repr. | 19.8 | 1.49 | 28,300 | 0.99 | 31,300 |
| 123 | 4 | 3½ | Vert. fiber | 18.3 | 2.35 | 21,000 | 0.53 | 21,000 |
| 21 | 4 | 3 | W.-c. lug | 21.2 | 2.46 | 26,900 | 0.703 | 26,900 |
| 118 | 4 | 3 | W.-c. lug | 18.0 | 1.84 | 21,400 | 0.55 | 26,700 |
| 23 | 6 | 4 | W.-c. lug | 21.0 | 2.76 | 39,700 | 2.58 | ..... |
| 126 | 6 | 4 | W.-c. lug | * | * | * | * | * |
| 120 | 6 | 4 | Repr. | * | * | * | * | * |
| 122 | 6 | 3½ | Vert. fiber | * | * | * | * | * |
| 20 | 3 | 3 | W.-c. lug | 21.3 | 2.58 | 12,000 | 0.13 | 20,400 |
| 119 | 3 | 3 | W.-c. lug | 18.8 | 1.68 | 12,200 | 0.14 | 20,400 |
| 22 | 2 | 4 | W.-c. lug | 23.5 | 2.86 | 22,300 | 0.50 | 26,700 |
| 120 | 2 | 4 | W.-c. lug | 23.2 | 3.25 | 20,400 | 0.50 | 20,400 |
| 24 | 1 | 4 | W.-c. lug | 23.9 | 2.48 | 16,800 | 0.33 | 20,400 |
| 127 | 1 | 4 | W.-c. lug | 23.0 | 2.68 | 18,300 | 0.40 | 20,400 |

* Not tested.

*Monolithic Brick*—In general the results show that the resistance of monolithic slabs is an uncertain quantity, the uncertainty being caused by the fact that the slab acts as a monolith up to a certain point after which it becomes two independent slabs, when a resistance equal only to the sum of the strengths of the two parts can be expected if top and bottom break at the same instant.

*Semimonolithic Brick* — With one exception, the semimonolithic specimens showed less resistance than in the monolithic. The exception was No. 106 which showed resistance equal to that of the sum of the top and base. In general, however, little relation could be discovered between the resistance and total thickness of the semimonolithic slabs. The resistance is possibly affected by the adhesion between the surface and base.

*Brick on Sand and Screening Cushions*—In this group are the grout and bituminous-filled brick surfaces with sand and screening cushions laid on concrete and macadam bases. The resistances offered by this last series of slabs were simply those which could be expected from the grouted brick slabs.

TABLE III. TESTS OF GROUT AND BITUMINOUS FILLED BRICK SURFACES ON CONCRETE BASES AND EITHER 1-IN. SAND-CEMENT OR ½-IN. TAR-MASTIC CUSHIONS

| Slab No. | Base Thickness, In. | Surface Thickness, In. | Surface Type | Per Cent Moisture | Bearing Value, Penetration 50 Blows, In. | Comp. Resist., Lb. | Ht. of Fall, In. | Force at Failure, Lb. |
|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 4 | W.-c. lug, g. filled | 25.0 | 3.12 | 26,400 | 0.85 | 31,300 |
| 105 | 6 | 4 | W.-c. lug, g.-filled | 19.7 | 3.62 | 31,800 | 1.30 | 34,700 |
| 10 | 6 | 3½ | Vert. fiber, asph. filled | 21.2 | 4.40 | 24,600 | 0.733 | 26,700 |
| 103 | 6 | 3½ | Vert. fiber, asph.-filled | 19.7 | 3.71 | 26,700 | 0.53 | 26,700 |
| 8 | 4 | 4 | W.-c. lug, g.-filled | 22.6 | 3.49 | 18,400 | 0.39 | 20,400 |
| 106 | 4 | 4 | W.-c. lug, g.-filled | 17.7 | 1.89 | 31,600 | 1.29 | 31,600 |
| 4 | 4 | 3½ | Vert. fiber, asph. filled | 23.9 | 5.94 | 13,300 | 0.18 | 13,500 |
| 2 | 4 | 4 | W.-c. lug, tar-sand filled | 21.2 | 2.43 | 14,000 | 0.21 | 20,400 |
| 116 | 6 | 4 | W.-c. lug, tar-sand filled | ..... | ..... | 26,800 | 0.88 | 26,800 |

Cushions 1-in. cement-sand, except Nos. 2 and 116, where ½-in. tar-sand was used. Concrete base 1:3:6 in all cases.

TABLE IV. TESTS OF BRICK SURFACES WITH SAND AND SCREENING CUSHIONS AND CONCRETE AND MACADAM BASES

| Slab No. | Base Thickness, In. | Surface Cushion | Surface Thickness, In. | Surface Type | % Moisture | Bearing Value, Penetration 50 Blows, In. | Comp. Resist., Lb. | Ht. of Fall, In. | Force at Failure, Lb. |
|---|---|---|---|---|---|---|---|---|---|
| 104 | 4 | Screngs. | 3½ | Vert. fiber, asph. filled | 19.4 | 2.20 | 15,000 | 0.25 | 15,000 |
| 9 | 6 | Sand | 4 | W.-c. lug, g. filled | 22.2 | 2.43 | 25,300 | 0.78 | 26,700 |
| 11 | 6 | Sand | 4 | W.-c. lug, g. filled | 22.8 | 1.80 | 23,900 | 0.69 | 26,700 |
| 107 | 6 | Sand | 4 | W.-c. lug, g. filled | 18.0 | 2.40 | 29,600 | 1.10 | 31,300 |
| 114 | 6 | Screngs. | 4 | W.-c. lug, g. filled | 18.2 | 2.19 | 28,700 | 1.03 | 31,300 |
| 117 | 6 | Screngs. | 3½ | Vert. fiber, asph. filled | 17.2 | 1.53 | 14,900 | 0.24 | 20,400 |
| 102 | 4 | Screngs. | 4 | W.-c. lug, g. filled | 16.0 | 1.96 | 12,800 | 0.16 | 20,400 |
| 101 | 6 | Sand | 3½ | Vert. fiber, asph. filled | 20.5 | 3.62 | 23,400 | 0.66 | 23,400 |
| 5 | 6 | Sand | 3½ | Vert. fiber, asph. filled | 25.2 | 3.83 | 21,000 | 0.53 | 26,700 |
| 6 | 4 | Sand | 3½ | Vert. fiber, asph. filled | 23.7 | 3.33 | 20,400 | 0.50 | 20,400 |
| 12 | 4 | Sand | 4 | W.-c. lug, g. filled | 23.5 | 2.88 | 14,000 | 0.21 | 20,400 |
| 125 | . | Screngs. | 4 | W.-c. lug, g. filled | 19.6 | | 14,500 | 0.23 | 14,500 |
| 1 | 12 | Screngs. | 4 | W.-c. lug, g. filled | 23.8 | 3.32 | 14,500 | 0.23 | 20,400 |
| 130 | 12 | Screngs. | 4 | W.-c. lug, g. filled | ..... | ..... | ..... | ..... | ..... |
| 3 | 6 | Screngs. | 4 | W.-c. lug, g. filled | 25.2 | 2.98 | * | * | * |
| 131 | 6 | Screngs. | 4 | W.-c. lug, g. filled | ..... | ..... | ..... | ..... | ..... |
| 108 | 4 | Sand | 4 | W.-c. lug, g. filled | 17.8 | ..... | 13,800 | 0.20 | 20,400 |

Base was 1:3:6 concrete, except for last five sections in table where macadam was used. Cushion 1 in. thick, all cases. * Damaged.

It cannot be seen that the cushioning effect of the sand bed in any way increases the resistance of the pavement. Indications are that the grouted 4-in. brick surfaces are just as strong as the 4-in. concrete slabs. Also, in general, it would appear that the sections with bituminous-filled brick surfaces show less resistance than similar slabs with grout-filled brick.

## Test Results Summarized

For the test conditions of size, loading, and support of slabs, as previously described, the following indications are noted:

The resistances shown by 1:1½:3 concrete slabs, 7 ft. square, are very consistent, increasing uniformly with increase in thickness. In slabs 6 in. and more in thickness only primary cracks developed, while 4-in. slabs shattered and punched out at the center. From this it would seem that plain concrete surfaces of 4-in. thickness are inadequate for heavy motor-truck traffic.

The monolithic (brick) slabs in most cases showed less resistance than the 1:1½:3 concrete slabs of the same depth. Failure of the former seemed to result from the shearing of the brick top from the concrete base before full resistance of the monolith was developed. This allowed the specimens to develop at most only the sum of the resistances of the two parts.

With possibly one exception (slab 106) the grouted-brick tops with sand-cement cushions on concrete bases showed less resistance than the monolithic sections.

Grout-filled brick tops with sand and screening cushions on concrete bases showed slightly greater resistances than would be expected from the bases alone.

Grouted-brick surfaces compared favorably with 1:1½:3 slabs of equal thickness.

With few exceptions other than the monolithic slabs, the indications were that failure occurred because of in-

crease of the force of impact rather than by reputation of impacts of the same magnitude.

It was generally indicated that the resistance of the specimens increased with an increase in the bearing power of the subgrade as shown by the subgrade determinator.

There seemed to be no direct relation between the moisture content and the supporting value of the subgrade.

### Practical Application of Results

In all the impact experiments which have been conducted by the Bureau of Public Roads the end which has been constantly kept in view is the development of a rational method for the design of roads to withstand this destructive force.

The manner in which the test results can be utilized is illustrated by the following example in which the conditions assumed correspond to the conditions of the tests:

Let us suppose a concrete pavement is to be designed to sustain safely the impact of a 5-ton truck loaded to capacity. It will be assumed that the character of the road surface and the condition of the tires of the vehicles which will use the road are such that the impact of the vehicles will be equivalent to that which would result by dropping the rear wheels from a height of ¼ in. Let it be assumed also that the pavement is to be designed to span small areas in which it will receive very little subgrade support, a condition similar to that which existed in the tests.

TABLE V. IMPACT CAUSED BY DIFFERENT MOTOR TRUCKS

| Rated Cap. of Truck, Tons | Load, Tons | Load on One Rear Wheel, Lb. | | | Equivalent Static Load for Different Heights of Fall, Lb. | | |
|---|---|---|---|---|---|---|---|
| | | Total | Sprung | Unsprung | 0 | ¼ Inch | 1 Inch |
| 1½ | 1½ | 3,475 | 2,410 | 1,065 | 5,500 | 7,800 | 10,200 |
| 1½ | 1½ | 3,475 | 2,410 | 1,065 | 4,500 | 6,300 | 11,500 |
| 1½ | 2¼ | 4,240 | 3,175 | 1,065 | 4,700 | 10,000 | 16,000 |
| 1½ | 2¼ | 4,240 | 3,175 | 1,065 | 4,900 | 8,900 | 9,200 |
| 2 | 2 | 4,300 | 3,300 | 1,000 | 6,800 | 7,800 | 11,500 |
| 2 | 2 | 4,300 | 3,300 | 1,000 | 6,800 | 8,500 | 13,400 |
| 2 | 2 | 4,300 | 3,300 | 1,000 | 6,800 | 7,900 | 11,000 |
| 2 | 2 | 4,300 | 3,300 | 1,000 | 6,800 | 7,500 | 11,000 |
| 2 | 3 | 4,900 | 3,900 | 1,000 | 7,200 | 8,500 | 14,000 |
| 2 | 3 | 4,900 | 3,900 | 1,000 | 7,300 | 8,600 | 13,700 |
| 2 | 3 | 4,900 | 3,900 | 1,000 | 6,800 | 8,000 | 11,000 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 8,400 | 9,200 | 15,700 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 8,200 | 8,700 | 11,800 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 8,200 | 9,300 | 14,100 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 6,900 | 9,200 | 21,500 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 8,000 | 8,200 | 12,200 |
| 3–3½ | 2½ | 5,150 | 3,450 | 1,700 | 8,700 | 8,200 | 13,000 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | | 10,000 | 19,000 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | 9,700 | 9,700 | 19,000 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | 9,300 | 9,800 | 17,700 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | 9,200 | 11,000 | 17,200 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | 10,000 | 10,000 | 18,000 |
| 3–3½ | 4½ | 7,000 | 5,300 | 1,700 | 10,000 | 11,000 | 15,800 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 11,000 | 12,800 | 18,000 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 11,000 | 12,500 | 19,000 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 9,000 | 10,000 | 16,000 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 9,200 | 10,700 | 15,500 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 9,200 | 9,700 | 13,000 |
| 5 | 5 | 7,900 | 5,950 | 1,950 | 9,500 | | 15,000 |
| 5 | 7½ | 10,600 | 8,650 | 1,950 | 12,200 | 15,300 | 26,000 |
| 5 | 7½ | 10,600 | 8,650 | 1,950 | 12,000 | 13,700 | 21,000 |
| 5 | 7½ | 10,600 | 8,650 | 1,950 | 11,500 | 12,500 | 18,500 |
| 5 | 7½ | 10,600 | 8,650 | 1,950 | 11,500 | 12,600 | 17,200 |
| 5 | 7 | 10,600 | 8,650 | 1,950 | 11,000 | 11,200 | 16,800 |
| 5 | 7½ | 10,600 | 8,650 | 1,950 | 11,200 | 12,100 | 15,800 |

To meet these conditions the designer would refer first to the results of the measurement of motor truck impact. (See *Engineering News-Record*, March 31, 1921, p. 553.) A brief summary of these results is given in Table 5. The table shows the impacts delivered by the rear wheels of trucks of various sizes variously loaded and dropped upon the road surface from three different heights. The average impact resulting from a ¼-in. drop of the rear wheels of a 5-ton truck loaded with 5 tons, as shown, is equivalent to a static load of about 11,000 lb.

Several corrections must be applied to this value before it can be used. In the first place the tabular values represent the impacts delivered by trucks equipped with new solid tires. The tests showed that the use of worn tires might increase the impact by from 15 to 60 per cent. Assuming that the use of badly worn tires will be prohibited by law, let us apply a correction of 30 per cent which will increase the tabular average to 14,300 lb. equivalent static load.

Also, since the tabular values were obtained by the use of ½ x ½-in. copper cylinders, they are less than the true impacts, and it will therefore be necessary to apply a correction. Finally, as insurance against overloaded trucks, and other conditions such as the use of nonskid chains, which would increase the impact, let us double the estimated impact. The tabular values of impact increased by 30 per cent for tire condition and corrected to eliminate the effect of the copper cushion are shown in curves 2, 3 and 4 of Fig. 1. Curve 1 shows the total static load on one rear wheel and curve 5 shows double the value of the corrected impacts for the ¼-in. drop. In each case the impacts or loads are shown in relation to the load carried

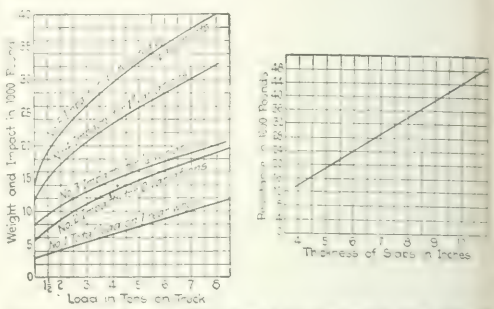



FIG. 1. TOTAL WHEEL LOADS AND IMPACTS FOR TOTAL LOAD CARRIED ON TRUCK (LEFT)

FIG. 2. RESISTANCE OF DIFFERENT THICKNESSES OF 1:1½:3 CONCRETE SLABS (RIGHT)

by the truck. Referring then to curve 5, we find that in designing a pavement for a 5-ton truck loaded to capacity, provision must be made for an equivalent static load of 32,500 lb., which is slightly more than four times as great as the total load on one rear wheel of the truck as shown by curve 1.

Having thus determined the impact for which the surface is to be designed, the thickness required is indicated by the results of the slab tests reported in this article. For 1:1½:3 concrete slabs the average results of these tests are shown in Fig. 2, which gives the resistance of slabs of various thicknesses. Referring to this figure it is found that a 1:1½:3 concrete pavement to withstand the impact of 5-ton trucks loaded to capacity and operated under the assumed conditions must have a thickness of between 7½ and 8 in.

Proceeding in a similar manner from other assumptions it can be shown that the thicknesses of 1:1½:3 concrete required for various sizes of trucks are as follows. For a 1½-ton load, 5 in.; for a 2-ton load, 5.5 in.; for a 3-ton load, 6.4 in.; for 4 tons, 7.1 in.; for 5 tons, 7.7 in. and for a 7½-ton load, 8.9 in.

*These thicknesses are given merely as the results of an example which is cited to illustrate a method of design. They are not to be considered as the proper thicknesses of actual pavements to accommodate vehicles of the several capacities; nor is the curve in Fig. 2 to be understood to represent anything other than the average relation of resistance to thickness in the particular tests which have been described.*

One of the reasons why the results can not be generally applied is that they relate only to the special subgrade conditions which existed at the Arlington experimental farm.

Another obvious reason is that the slab resistances used were derived from tests in which the impact was delivered only to the centers of the 7-ft. slabs, and it is known that this is the most favorable condition. Less resistance would have been offered to impact applied at their edges, and still less to blows delivered at their corners.

These reasons indicate the need for further research. In respect to the subgrade the first need is to devise a

method by which the supporting value may be measured, the next is to find out how and to what extent it is affected by moisture and other natural conditions. These problems solved, it will still be necessary to study the changes which affect the shape of the subgrade, such changes, for example, as are caused by frost and the pounding of traffic, for with rigid surfaces the support offered by the subgrade depends not only on its supporting value but also upon the nature of its contact with the surface. And this study will necessarily include the behavior of the surface as well as the subgrade, for the desired contact may be lost by the movement of the road slab itself. The bureau's tests have shown already that such movement occurs daily as a result of temperature changes.

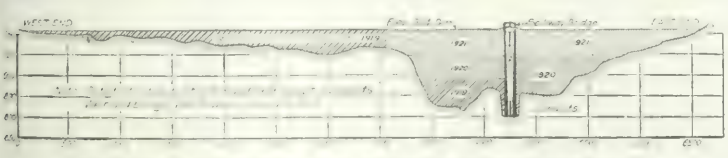
The determination of the edge and corner resistance of the slab presents no great difficulty. It is confidently expected that reliable data on this subject will be developed by tests now under way; and with the knowledge gained it should not be a difficult matter to design all parts of the slab to have equal strength.

What doubt remains as to the intensity of the impact which may be delivered by vehicles operating on actual roads should be cleared up by means of the impact recorder designed by the bureau and awaiting only minor adjustments preparatory to experimental use. This apparatus, attached to a motor truck, will give autographic space-time curves similar to those drawn by the instrument attached to the stationary impact machine, and thereby permit the measurement of impact on actual highway surfaces.

Other tests which are already in progress will yield further data on the resistance offered by bituminous-topped and reinforced-concrete pavements. If the subgrade problem can be solved satisfactorily the information which will ultimately become available should give a very clear conception of the type and thickness of pavement necessary for any given kind of traffic.

## Lockington Dam Completed

LOCKINGTON DAM, the second of the finished hydraulicking operations of the Miami Conservancy District, was completed in October. The structure contains about 1,000,000 cu.yd., is 6,000 ft. long, 25 ft. wide on top, 460 ft. thick (maximum) at the base, and 78 ft. high above the outlet conduit floor. Construction was begun, on hydraulic fill, June 12, 1919, and the progress is shown by the accompanying progress profile.



PROFILE OF LOCKINGTON DAM SHOWING PROGRESS BY YEARS

The dam cost $1,280,000 complete, including engineering, superintendence, depreciation, clerical labor, materials, supplies, and everything expended on construction. The hydraulic fill cost 75c. per cubic yard; the dragline fill at the west end of the dam 23c. per cubic yard; the excavation (rock) for the outlet works and channel 69c. per cubic yard, and the concrete work an average of $9.84 per cubic yard.

Wages during the period of construction varied considerably, rising during the war and falling sharply during 1921. During the period in which the most of the work was done, common labor received from 38c. to 46c. per hour, and good carpenters, 65c. to 80c. per hour.

The price of materials varied widely. The major part of the cement was purchased f.o.b. Lockington for $3.06 per bbl., with 25c. sacks; $2.92, with 15c. sacks, and recently $2.91, with 10c. sacks. Coal was purchased for $4.19 to $4.65 per ton, run of mine, f.o.b., Lockington. Much of the material used was special, and the prices paid are not comparable with prices paid on other work. Barton M. Jones was division engineer in charge of construction.

## Sludge Dewatering With Hot Sulphur Dioxide Gas and Live Steam

EXPERIMENTS with the dewatering of sewage sludge with a mixture of hot sulphur dioxide gas and live steam are being made on activated-sludge at Texas, and on various types of sewage sludge and garbage tankage at Indianapolis by the Maclachlan Reduction Process Co., New York City. A full size installation is under construction at the activated-sludge plant now being built at Gastonia, N. C., after plans by William M. Piatt, consulting engineer, Durham, N. C.

In this process, the hot sulphur dioxide gas is produced by burning crude sulphur in a special type of burner, the resulting fumes being mixed with live steam and blown into the sludge as it flows through a treating tank. The mixture of gas and steam, according to the company named, "has an instantaneous electrolytic effect upon the sludge which destroys its flocculent nature. In the case of sludge having a 98 per cent water content, the sludge after treatment quickly settles to 95 per cent water, which means a reduction of 60 per cent in volume. At the same time the solid particles of the sludge are converted to a granular condition which renders them more easily and quickly pressed." At the Houston plant, the company states, "the gas is applied to the sludge for 2½ min., raising its temperature from 80 deg. F. to 135 deg. F. The sludge is then pressed hot in the filter press already installed in connection with the large dehydrating plant, the cycle being 3 hr. 20 min. This yields a cake containing as low as 74 per cent water, which is then dried in the indirect dryer forming a part of the large dehydrating plant already mentioned."

Continuing the company states: "Experiments with dewatering the Houston gas-treated sludge on sand beds show great promise. Dosing at the rate of 1.3 lb. of dry solids per square foot of sand bed yields a ⅝-in. cake of 64.5 per cent water content in 24 hr. At double this rate a 1½-in. cake with 77.5 per cent water is obtained. Untreated sludge would not drain appreciably in 96 hr., the moisture being reduced only to 96 per cent." The company estimates that its dehydration process would cost from $0.75 to $3.00 per ton of dry solids, depending upon local conditions.

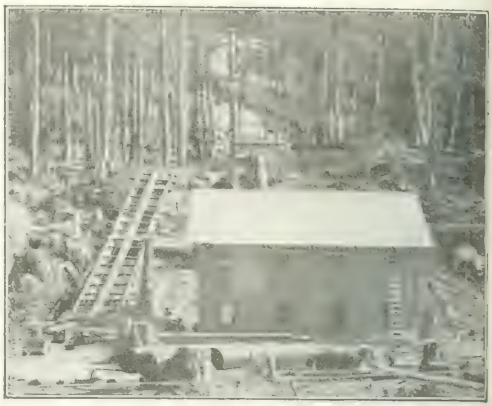
### Waterfront Bulkheads: (Correction)

Titles to illustrations were misplaced in the article on "Waterfront Bulkhead Construction," in *Engineering News-Record* of Oct. 13, p. 614. The larger drawing on p. 614 shows the Chicago work and the smaller drawing on p. 615 shows the Milwaukee work.

# Progress on the Skagit River Power Project

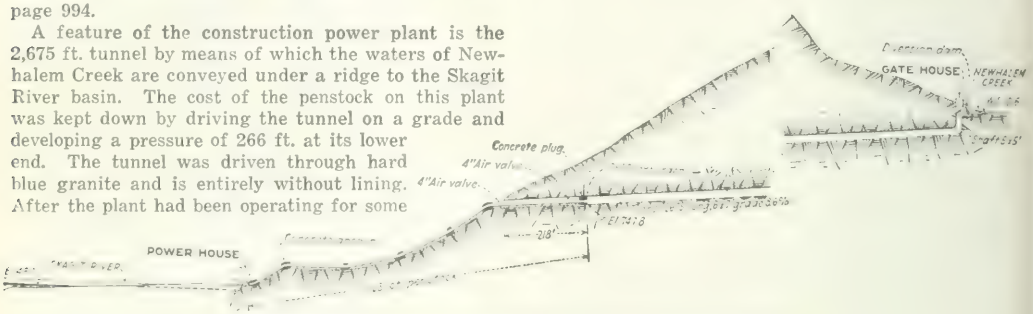
## Seattle Has Completed 23-Mile Railroad and Construction Power Plant—Work on 2-Mile Main Tunnel Is Under Way

WORK is now well under way on the Skagit hydroelectric development which is being carried out as a municipal venture by the City of Seattle. The Gorge Creek plant, the first main unit, is expected to be ready for service in the latter part of 1923. A construction railroad, 23 miles long from Rockport, Wash., the nearest point on existing rail line, was finished early this year; the 3,000 hp. Newhalem plant built to supply power for construction purposes was completed in the late summer and work has just been started on the 10,978-ft. tunnel which is to serve the Gorge Creek Plant. Contract for this tunnel was awarded to the R. C. Storrie Co., San Francisco, for $2,203,865. The general features of the project were described in *Engineering News-Record*, No. 18, 1920, page 994.



TEMPORARY POWER PLANT ON THE SKAGIT PROJECT

A feature of the construction power plant is the 2,675 ft. tunnel by means of which the waters of Newhalem Creek are conveyed under a ridge to the Skagit River basin. The cost of the penstock on this plant was kept down by driving the tunnel on a grade and developing a pressure of 266 ft. at its lower end. The tunnel was driven through hard blue granite and is entirely without lining. After the plant had been operating for some




CROSS-SECTION THROUGH NEWHALEM POWER DEVELOPMENT

weeks the tunnel was unwatered and examined thoroughly without finding any change in cross-section from the original finished excavation. A precautionary measure to prevent leakage was the continuation of the penstock for 218 ft. into the lower end of the tunnel, thus making it possible to plug the tunnel with concrete at this point and remove the pressure from all the lower end on which the overburden is less than 105 ft. No seepage has appeared on the slope of the mountain which the tunnel transverses. The penstock is 1,122 ft, long, and varies in diameter from 33 in. at the upper end to 30 in. at the bottom, with a thickness ranging from $\frac{3}{8}$ in. at the top to $\frac{7}{16}$ in. at the bottom. All joints in the penstock were electrically welded.

CONSTRUCTION CAMP FOR SKAGIT POWER JOB

In the plant a double overhung impulse wheel operating under a head of 510 ft. is direct connected to a 2,2 0 kw. generator. In testing out this unit a 2,100 kw. load was tripped instantaneously to see what the control apparatus would do. Under these conditions, approximately the most severe test that could be imposed, the water-wheel governors allowed an increase of speed of less than 30 per cent, which was considered very satisfactory regulation. At least in part, this close control is ascribed to the fact that each runner on the double overhung unit is controlled by an independent governor. A motor generator set is being installed in the plant to provide D. C. current for the three-mile railroad extending from the saw-mill to the dam site and which it is planned to electrify.

The main construction camp is located on a bend

of the Skagit River, 23 miles by the construction railway from Rockport and about 2¾ miles from the Gorge Creek dam site with which it is connected by a rail road. The camp consists of 14 bunk houses with sleeping quarters for 24 men each, fifty 3-room cottages for the married men, mess house, warehouses, office buildings, etc. With the exception of the married quarters the entire camp is heated from a central heating plant.

The foregoing has been prepared from information supplied by C. F. Uhden, chief engineer, Skagit River Power Project.

## Later Work, Not Education, Raises Professional Status

By Charles A. Holden
Director Professor of Civil Engineering, Thayer School of Civil Engineering

THE EFFECTIVENESS of a pre-college course in engineering education has been demonstrated by those institutions which have required such preliminary training. One advantage of such a course which is generally unrealized is the opportunity offered the student to continue his general college course and then to enter a vocation for which he is better suited if he does not show aptitude in subjects required for an engineering training.

However, the deduction that the status of the medical profession is due to the requirement of an academic training before the professional work is perhaps not warranted, since the standing of the profession was established long before the present educational requirements were formulated.

Factors entirely outside of the educational program as usually interpreted exert a very vital function in the relative positions occupied by the lawyer, doctor, and engineer, and it is largely to the period after graduation that the engineer must look for improvement in his status. By the nature of their professions the lawyer and doctor are brought in intimate association with the members of their community and there develops from this association an interest in community affairs so that they are held in esteem not only for their professional attainments but as vital forces to be consulted in matters affecting the public weal.

The engineer is inclined to berate politics, to consider that his activities are not concerned therewith and to isolate himself from community interests with the inevitable result that he is not a vital force in public matters. His attitude should be exactly the reverse. He should realize that no class of men is better trained for civic responsibility. Community problems are concerned largely with highways, water supply, sewage disposal, bridges, buildings, lighting and similar subjects for which the engineer has a special training. If he has been educated under the definition "engineering, the art of organizing and directing men, and controlling forces and materials of nature for the benefit of the human race," he recognizes that the engineer has relationships with "mind and human action" as well as with "matter and energy."

For other problems which arise he is better prepared than many who are concerned with community affairs for he has been taught first to state the problem, next to indicate the principles which underlie the solution, then to formulate the general statement of the solution and finally to solve it. The first three parts are of fundamental importance and lead to results greatly superior to those where they are omitted, as is too often the case. There are many conspicuous examples of engineers who have appreciated their opportunities and responsibilities and have rendered valuable services to country, state and town. When engineers in general reach a like appreciation, each community may support its engineer as well as its lawyer and doctor.

Then also as to the professions of law and medicine, there is in the public mind much of mystery. It is realized that powers of analysis and a knowledge of previously determined procedure, principles and facts are required to solve the problems involved. Troubles from law suits, sickness and death are ever-present forces, thrusting home the importance of these professions and demonstrating the inevitable penalty experienced through the neglect of their aid.

But a farmer may become a contractor and lay concrete floors and side walks. The previous conditions are greatly improved and the public is not cognizant of the less cost possible to secure as good results by different mixtures of cement, sand and stone, or a different selection of the latter two, nor of the better product which could be obtained at the same cost by the engineer trained in the making of concrete.

The improvement of the status of the engineer must be obtained largely through individual and collective effort after graduation. The educational program should be formulated to prepare for the broad definition of engineering given above. It will realize that the ultimate aim of all education is to assist in improving civilization and that since the engineer is to do this through engineering, the program must include a sound training in the science underlying engineering.

## An Unusual Sewage-Works Combination

AN UNUSUAL combination of sewage treatment elements is found in a plant with a nominal capacity of 1,200 U. S. gal. capacity for a mansion named Olantigh Towers at Wye, Kent, England. This plant, to which nearly two pages of the London *Engineer* of Nov. 4, 1920, are devoted, was designed by Major Hilder Daw, late lecturer on sewage disposal at the South-Eastern Agricultural College at Wye. Aside from the utilization of an existing grit chamber and sewage receiving reservoir, the new plant consists of activation by repumping the sewage some thirty times and discharging it in the face of a horizontal air blast that drives the sewage against "eddy plate" where it is broken up for aëration purposes; sedimentation and sludge digestion, by means of a two-story settling tank, which in section is something like a half of an Imhoff tank; and (3) final treatment by sprinkling or percolating filters with an alternating-tip dosing device.

The sewage is pumped from the receiving tank vertically upward to a point where a thirtieth of it passes on to the sedimentation tank and the remainder drops back into the receiving tank, passing as it falls between the air nozzle and the eddy plate already mentioned. Nearly 300 cu.ft. of air per U. S. gal. of sewage is supplied. Water power drives both pump and air blower.

ANALYSES OF SAMPLES TAKEN AT VARIOUS POINTS IN THE SEWAGE-WORKS AT OLANTIGH TOWERS

| | Parts per 100,000 | | | | |
|---|---|---|---|---|---|
| | Raw Sewage | Storage Tank | Sedimentation Tank | Effluent | Percentage Purification |
| Ammonia, saline | 9 87 | 2 400 | 2 500 | 0 065 | 99.34 |
| Ammonia, "albuminoid" | 1 400 | 0 500 | 0.200 | 0 70 | 95 |
| Oxygen absorbed at 27 deg. C. in 4 hr. | 2.79 | 0.710 | 0.413 | 0.272 | 90.2 |
| Nitrates | Absent | Absent | Absent | 1 25 | .... |
| Nitrites | Absent | Absent | trace | trace | .... |
| Suspended matter* | Absent | Absent | trace | trace | .... |
| Suspended matter* | 744 0 | 68.0 | 22.0 | 1.30 | 99.9 |
| Do. do., coarse | 913.4 | | | | |
| Total | 1,657.4 | | | | |

*The proportion of suspended matter [illegible] "coarse," was obtained by straining the sample through a sieve of about thirty meshes to the inch.

Working at only about one-fourth capacity after apparently some three months of use the treatment at various stages is reported in *The Engineer* to have given the analyses shown by the accompanying table.

The journal quoted also states that "the system of sewage disposal described above is being exploited by the Aer-sed-con Sewage Purification Plant Co., 9-10 Southampton St., Holborn, London, W. C. 1."

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## More Defense for Engineer as Manager

Sir—Mr. Cabot in *Engineering News-Record*, Oct. 27, p. 692, indicts the engineering profession as failing to develop managers of large enterprises. His views are interesting as coming from a firm of well-known bankers, and his sincerity cannot be questioned. However, I take issue with his statements because (1) the supporting evidence is insufficient to justify his conclusion; (2) no indictment of a part of a group is likely to be true of the whole group; (3) as a contrary statement to the views of Mr. Cabot, engineers have cleaned up some infernal messes which have been made by promoters he applauds so highly, and (4) because an engineering training when supplemented by experience in handling men and dealing with business affairs is a most excellent foundation for the management of a very large percentage of the industrial problems and industrial plants of today.

Mr. Cabot has visualized the engineer as a man cold and austere in his beliefs and formulas; a man untouched by the human feelings and passions of the ordinary man. He has sought to interpret him as a sort of business surgeon, a man whose passionate love of detail makes it impossible for him to see the human elements in any business plan. There are many engineers of this type, but to generalize on this basis leads to a fallacious conclusion. I grant that the average engineer is trained in a hard school of exactness, but does exactness make a poor manager? He is a great student of detail, but does a knowledge of detail make a poor manager? He is analytical and perhaps austere in his viewpoint, but does cool judgment make a poor manager? He lacks in the quality of salesmanship; this may make a humble manager but it makes a safe one as he says. Is safety a quality to be laughed to scorn?

Qualities of leadership are improved by training, but they are born in a man regardless of what his training may be and they develop through opportunity. Engineering is a severe task master and an engineer must often maintain a critical attitude. The examples that Mr. Cabot has taken do not include those engineers who have made a success as manager. I venture to say that of late years more men with engineering training have succeeded as managers of large enterprises than men without such training. The names of these men could not be printed on this page—it would be too small. He has forgotten Goethals, Newell, Hoover, Atcheson, Finley, Mulholland, Hammond, Cassatt, Epes Randolph and a host of others. The list is a long one and growing longer every day.

Prior to 1900 very few industrial executives received engineering training. Since 1900 a much larger proportion has received such training and these men are now coming into their own as managers of large enterprises.

Mr. Cabot's example of the management of the railroads is an unfortunate one. During the period in which, as he says, they made money in the hands of promoters, money was made at the expense of the railroads, and when they got in such a terrible mess that no one else could handle the job of straightening them out, they were turned over to engineers and bankers. If bankers and engineers cannot work out the problems of the railroads who else can?

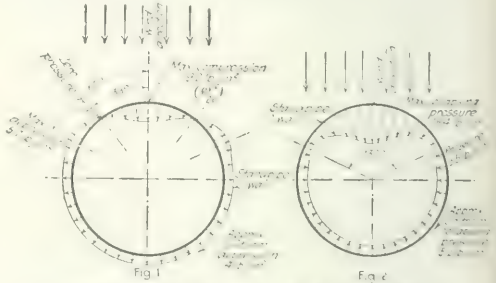
It is amusing to think of engineers as lacking in vision and imagination. The trouble is that real engineers have been so busy thinking and planning in big terms that they have forgotten to convince other people that they are doing this sort of thing. The new era in the profession finds it attentive to public relations and public service. In but a few years the new concept will produce a rich fruition.

Chicago, Nov. 23. C. E. DRAYER,
Secretary, American Association of Engineers.

## Wind Forces on Standpipe Deduced from Pressure-Tunnel Results

Sir—In your issue of Oct. 13, p. 601, appears an article "Repairs to a Wind-Indented Standpipe at Bath, Maine," by C. E. Carter. The photograph of this article illustrates in an interesting way the pressure distribution which we know, by aerodynamical analysis, to exist on the walls of a cylinder when subjected to air flow. In the two diagrams herewith, from tests made in a wind tunnel, there is a good analogy to the wind pressure which caused the collapse of the standpipe mentioned; and from the wind-tunnel test we can deduce the actual pressures, both qualitatively and quantitatively.

The test cylinder is subjected to artificial air flow in the wind tunnel; the pressures produced at various points on the surface are led off through minute holes communicating with tubes on the interior, and they are recorded on suitable manometers. Neglecting small-scale effects and other corrections familiar to the aeronautical engineer, these diagrams apply to the standpipe.



PRESSURES ON CYLINDER IN WIND TUNNEL

Fig. 1 shows the pressure distribution on the outside of the standpipe. In the diagram a vector is drawn at every ten degrees of the circumference, giving by its direction and length the intensity of the force acting. Arrows pointing toward the center are for positive pressures, tending to collapse the standpipe; those pointing away from the center are for negative pressures, tending to stretch the plate. The ends of the vectors are connected by a smooth curve. There is positive pressure over the front 76°, which reaches the theoretical value $\rho V^2/2g$ at the extreme front. At all other points than the extreme front the pressures can be determined only empirically. To the rear of the 38° point they become negative, reaching a maximum 65° off the wind direction, where the intensity is $0.6\rho V^2/2g$ of sign opposite to the front portion. The rear 180° is subjected to "suction" which is substantially uniform and equal to $-0.44\rho V^2/2g$.

Note the buckling moments at the 38° point of the diagram, where the maximum positive pressure moment is added to the maximum negative pressure moment. In the photograph, the point of buckling is in this neighborhood. An interesting feature appearing in the diagram is that portion between 38 and 90°; the suction here tends to draw the surface against the wind.

In order to determine the true pressure which operated in the collapse of the standpipe (assuming the latter empty of water), we have to take account of the chimney effect, i.e. the depression due to flow of wind across the open standpipe mouth. This has been done in Fig. 2, which therefore gives the net forces acting both inside and outside the walls. From the pressures of Fig. 1 a uniform amount is subtracted numerically exceeding $\rho V^2/2g$ by an amount determined in the wind tunnel, and of opposite sign. The net wind effect, as shown by Fig. 2, is that every portion of the empty standpipe is under a stress tending to compress the plate.

E. N. FALES,
Aeronautical Engineer, U. S. Air Service.

Dayton, O.
Oct. 24.

## One Way of Specifying

Sir—Here is an architect's specification for the drains in connection with the foundation work for a church.

*Drain*—Properly prepared to meet any conditions that might arise so that we may prevent an absolute condition to positively avoid any possibility of water at any time, under any condition, entering the cellar."

Evidently he wants a dry cellar!

Hackensack, N. J. CONTRACTOR.

## Analytical Data Essential To Run Mechanical Filters

Sir—Referring to the article on "Analytical Data Essential to Run Mechanical Filters," on p. 353 of your issue of Sept. 1, I venture to predict that the practical laboratory control of water purification will increase rather than decrease during the next 25 years. I agree fully with Mr. Brown that a careful selection of the laboratory tests should be made and in one-man purification plants that the number and frequency of such tests should be reduced to a minimum, but the selection will vary with different classes of water and the plants required for their purification. Moreover, the selection of tests should be made by open-minded men who from experience are capable of deciding upon useful tests which will show the operators what they are doing; will serve as a record of the operation of the plants; will be of value in answering complaints concerning the quality of the water and will be of assistance to the state department of health.

However, I believe that the views of Mr. Brown will make a wrong impression on a considerable number of those who read the article and also on some of the water-works men for whose benefit it was probably written. To a layman interested in one or more water-works from a purely business standpoint, or to those "who cannot qualify even as amateurs" but "pass upon highly technical questions with more of assurance than is assumed by the expert"—as aptly expressed by Edward E. Wall, water commissioner of St. Louis—and especially so when possessed of a little brief authority, great presumption, and a narrow mind, Mr. Brown's paper will come as a welcome reinforcement to bolster up their ideas of the false economy and of the unnecessary refinements of laboratory control of purification plants.

Mr. Brown assures us that "the hardness cannot be reduced by merely reporting it and unless softening is carried on, it has no place in a report." Carrying out his analogy I might say with equal assurance that the mere determination of bacteria in filtered water will make the filters neither more nor less effective; that the making of presumptive or partially confirmed tests for B. Coli will not prevent those in the water from passing on into the distribution system; that the determination of chlorides will not prevent a water supply from becoming salty to the taste; that the determination of iron will not prevent the staining of porcelain fixtures when an excess is present in a water supply; and so on, yet these are not valid reasons for a wholesale omission of such tests.

Mr. Brown apparently has it in for the "37½-deg. C. count" and wishes to make it unquestionably clear that this test stands out as the most worthless member of the "black sheep" of the family of "more or less valuable tests." I will admit that considerable time is consumed in preparing for and in making this test but practically the same amount of time is required for the "20-deg. C. count," which is obtained 24 hours later than the 37-deg. count. Furthermore a 20-deg. incubator is harder to maintain at constant temperature in the laboratory of a small water-works than is a 37-deg. incubator. However, this is not a suitable place for a detailed comparison of the advantages and disadvantages of these two classes of counts and much has been written on the subject. I am of the opinion that the majority of purification and chlorination plants may be operated by the aid of 37½-deg. C. counts so that the effluents will meet the requirements of the Treasury Department, if those in authority wish to meet these requirements.

As a matter of fact, the "Bacteriological Standard for Drinking Water" adopted by the Treasury Department (U. S. Public Health Service) for drinking water supplied to the public by common carriers is more widely used as a standard than any other and includes the following ruling: "The total number of bacteria developing on standard agar plates, incubated 24 hours at 37 deg. C., shall not exceed 100 per c.c." As long as this standard is in use a considerable number of purification plants will have to make 37½-deg. C. counts in order to show that their effluents meet this standard and will have to be guided in their operation by such counts. By making such counts and operating purification or disinfection plants by their aid in order to keep the bacteria below 100 per c.c. how are the operators going to run into the "great and varied difficulties" which Mr. Brown holds up like a red flag? It is more probable that "great and varied difficulties" will result if operators furnish waters to common carriers which do not meet the "Bacteriological Standard for Drinking Water" on account of not carrying on a sufficient amount of laboratory supervision.

In the majority of purification plants I believe that the operator should take the color of the filtered water at least once a day on a catch sample and preferably on a representative composite sample collected during each 24 hours. Why is it a waste of time to check roughly the dosage of alum to the raw water by the determination of the color of the filtered water? Why is it a waste of time to make a permanent daily record of a test which takes such little time in its making and sooner or later will be required as evidence to show that the plant has been operated so as to deliver an effluent of pleasing appearances. In some cities the broad-minded men in charge of the water-works prefer to deliver a water of zero color to the consumers rather than one with a color of 10 p.p.m. From a material standpoint there may be little difference between the two waters but from an esthetic standpoint there is considerable difference and the average consumer will point with natural pride to a clear, sparkling and colorless water. How can such a water be obtained unless the operator determines the color and turbidity? If operators of purification plants, both large and small, would spend more time looking at their filtered water with a critical eye, even if contained only in a 2-qt. bottle of clear flint glass, they would find oftentimes that they are not such wonderful operators as they think they are.

Take the test for residual chlorine which appears to have escaped Mr. Brown's steam roller. This test should be made at every waterworks, both large and small, in connection with the application of liquid chlorine or hypochlorite to a water supply, not only on samples collected near the point of application of the disinfectant, but also on samples collected at one or more points on the distribution system. This test intelligently applied by a man with common sense will be of great assistance to him in regulating the dosage of the disinfectant so as to prevent the addition of a needless excess with the resulting production of tastes. It will also enable him to detect changes in the power of the water to absorb greater or smaller quantities of chlorine so that the dosage may be increased or decreased to obtain the proper disinfection of the water.

In view of the recent developments on the reaction of aluminum sulphate with the alkalinity of a water, it appears to be reasonable to expect that some sort of a practical determination relating to the detection of aluminum compounds will come into use. Even the determination of the hydrogen-ion concentration of a water in the near future by a man in overalls may not be such a wild vision in spite of "great and varied difficulties."

GEORGE C. BUNKER,
Balboa Heights, C. Z., Sept. 24. Sanitary Engineer.

Sir—Mr. Bunker seems to have missed the whole intent of my paper. My purpose was to call attention to the requirements and uses of data by two classes of workers: (1) filter operators; (2) sanitary authorities using the data to judge of the quality of the produced water. My paper stated that the requirements of the two must differ, and the needs of the men producing the results should come

first, while those judging the results without coming in contact with the work should come second. This, I contend, is a plain common sense view of the matter.

It is also stated that the man producing the results should not be overburdened with the necessity of producing a lot of data which, however valuable to the man attempting to judge the quality of the water, is of little or no value to the man producing the results. It contended that the men in actual charge of the plants should have more voice in formulating the methods and standards of analytical data to be used in the work than the men who do none of the actual work of production.

It went further and stated that when the operators decided what data were essential to their needs and requirements, any additional data required by the sanitary authorities should be provided by these sanitary authorities and paid for by them. The best results were deemed the most important matter, the necessary data to enable the operators to produce these results being the first desideratum; the data to enable some one else to judge the results being of secondary importance.

For more than twenty years, the writer has urged the necessity of a better class of operators in mechanical filter plants. There are more than enough sanitary authorities to inspect results but there are entirely too few men to go out and produce them. This is the greatest need of the day and expert operators or men able to develop into expert operators should have every encouragement given them. To load them up with a lot of unnecessary and useless work, as far as they are concerned, is not a policy to encourage them. Where such operators are available, they are fully competent to pass on the needs of their plants and decide on what tests shall or shall not be made to guide them in operation and they should be permitted to follow their judgment. Not even the officials of the U. S. Treasury Department should be permitted to dictate to these men as to how they shall handle their work. In my humble opinion, our state boards of health go entirely too far in attempting to control methods in some states. They may be entitled to demand certain results but it is a serious question if they should be permitted to attempt to control the methods by which these results are to be produced.

Mr. Bunker appears to be ignorant of the fact that the U. S. Treasury Department standard for drinking water supplied by common carriers was not intended to and does not apply to a filtered water supply. It has been stated that this standard, which has not proved satisfactory, is now undergoing study and will probably be changed somewhat in the near future.

As regards the 37½-deg. count, Mr. Bunker is also at sea because of his failure to understand other matters leading up to it. I have no quarrel with this count if properly used nor would I attempt to run a plant without using it to some extent. It is really as essential to good operation as it is to judge of the quality of a water of unknown origin. From the expert operators standpoint, however, its use, as generally employed, is indefensible, Mr. Bunker to the contrary notwithstanding. To state that any plant can be operated to the best advantage by using only the 37½-deg. count is to argue without adequate operating knowledge and experience. To state that it is more valuable as a guide to good operating than the 20-deg. count is to argue from the same viewpoint. Of the two, as far as operating is concerned, the 20-deg. count is an infinitely better guide and will point out danger and difficulty that the other may never even indicate.

The saprophytic far outnumber the pathogenic organisms in most water supplies. Many of these saprophytic organisms will grow on gelatine or agar at 20 deg. C but will not grow on agar at 37½ deg. C. Even though it takes 24 hours longer to get a count on gelatine or agar at 20 deg. than on agar at 37½ deg., the 20-deg. count gives information of vital importance to the operator days or even weeks before the 37½-deg. count can be expected to, even if the latter count ever gives such information. The information thus given by the 20-deg. count is of great importance to the intelligent operation of any mechanical filter plant. In most instances the 37½-deg. count, if it ever gives a hint of such difficulties, does so only when it is too late for the operator to prevent the trouble.

The reasons for this are well known to operators of broad knowledge, experience and skill. With the 20-deg. count on gelatine or agar, and with the settling basins and filters functioning properly, the plates at counting are of the same general character. The proportional distribution of the types of colonies are characteristic and easily noted. There will be no greater preponderance of one type of colony on a raw water plate than on a plate from the settled water or the filtered water, because the action of sedimentation or filtration is non-selective. If, on the contrary, aftergrowths are occurring during sedimentation or in the settling basins, the plates of settled water will show this immediately by a preponderating number of one type of colony on the settled water plate as compared with the plate from the raw water. If the difficulty is occuring in the filters themselves, the filter plates will show the same thing. The 37½-deg. count absolutely fails to give any indication of such conditions.

With the 20-deg. count, the operator is enabled to figure the efficiencies in percentages of removal by settling and by filtration, while with the 37½-deg. count this is not feasible. With the 20-deg. count, the operator therefore has a percentage basis by which he can judge the efficiency of these two steps in the process of purification, of which he is deprived if he uses only the 37½-deg. count. The moment his percentages fall off, he is given a warning that something is wrong and he has a chance to locate and correct the difficulty long before the conditions grew serious enough to be indicated by the 37½-deg. count, even if it is ever indicated by that count. *Ordinarily the 20-deg. count will indicate approaching trouble from two to ten weeks earlier than the 37½-deg. count can be expected to do.*

While the 20-deg. count will do these things, the 37½-deg. count is not without merit and should be used frequently, as a check, this being particularly desirable if the presumptive B. coli tests begin to appear suspicious.

Regarding Mr. Bunker's statements of color and chemical dosage, I would like to inform him that up here, when the raw water carries a color of 10 p.p.m. or less, the ordinary practice is to deliver a filtered water of zero color all the time. In such cases color is not used to determine the chemical dosage and may be ignored with safety, being covered by a general statement that the color in the raw water seldon reaches ten parts per million.

If Mr. Bunker will read the paper in full as presented at the Oklahoma City convention, I am of the opinion he will find I did not neglect the subject of chlorine and he may find I said more about this than he may deem justifiable. As a tomb to bury the mistakes of design, as a covering up for lazy and incompetent operation and letting things go until they get so bad that heroic measures are required to straighten them out, I cheerfully concede chlorine to be the whited sepulcher par excellence.

Taking it by and large, Mr. Bunker admits a good many things in his first paragraph and then proceeds by an interpolation of incompetence in operators to set up a lot of conditions which requires the balance of his criticism to answer.

C. ARTHUR BROWN,
Engineering Bureau-Water Purification,
American Steel & Wire Co., Chicago-New York.
Lorain, Ohio, Oct. 30.

## Engineer Registration at Illinois

Of the 9,084 bona fide resident students enrolled in the University of Illinois this term 1,892 undergraduates have registered in the college of engineering. The courses offered and the number of students in each, are as follows: Architecture, 112; architectural engineering, 129; ceramic engineering, 72; chemical engineering, 218; civil engineering, 336; electrical engineering, 415; general engineering, 43; general engineering physics, 2; mechanical engineering, 418; mining engineering, 86; municipal and sanitary engineering, 10; railway engineering, 51; total 1,892.

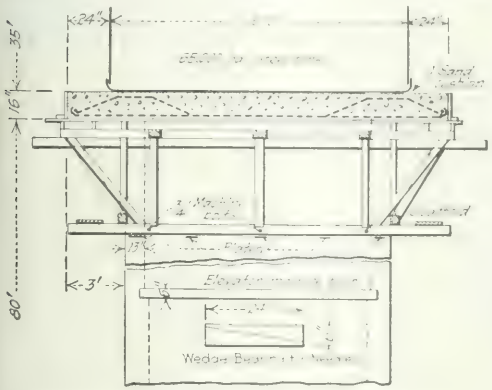
# HINTS FOR THE CONTRACTOR

## Simple Scaffold Carries Floor Center on High Tower

BY GEORGE A. DAVIS
Commissioner of Buildings, South Bend, Ind.

A SUCCESSFUL method of placing a concrete slab on a brick tower carrying a 65,000-gal. water tank, without using shores from the ground or exterior scaffolding, was devised by the writer, in 1920, for the O'Brien Varnish Co., South Bend, Ind. The tower was 14 ft. square and 80 ft. high and the operation was to place on top a reinforced-concrete floor 20 ft. square as indicated by the accompanying drawing.

In constructing the scaffolding the first step was to insert five ¼ x 4 x 4-in. plates in a mortar joint in each




SCAFFOLD BOLTED TO TOWER CARRIES FLOOR CENTERING

of the four walls about 6 ft. below the finished height of the wall. About 2 in. of each plate was inserted in the wall. The projecting parts took the shear of 4 x 6-in. timbers laid thereon and bolted through the walls with three ¾ x 18 in. machine bolts. The 4 x 6-in. timbers were used to scaffold and brace four. The ¾-in. bolts were wrapped with paper to prevent the cement mortar from adhering to them. The 4 x 6-in. timbers were placed and bolted as the walls were built up. Three needle holes were also left in each wall near the top, to take care of three 6 x 6-in. needles crossing each other at right angles. Each wall bearing of the needles was two wedges as indicated by the drawing. The needles were 12 ft. long and were butt-jointed at the center with a splice nailed over the joint. The interior centering was braced up from the last put-log brick scaffold, and the exterior was braced from the 4 x 6-in. timbers bolted to the walls. The joist and decking were laid on top of the 6 x 6-in. needles as shown.

Wrecking the forms was easily accomplished by first removing the 6 x 6-in. wedges, the shores and the braces. The wedges were removed uniformly all around, lowering the whole 6 in. The subsequent operations were: (1) Removing the joists and decking, (2) removing the needles from the inside, (3) filling the needle holes from the scaffold carried on the 4 x 6-in. timbers, (4) drifting out the ¾-in. bolts and lowering away the 4 x 6-in. timbers by two men with ropes from above, (5) rapping loose and knocking out the ¼-in. plates with a long-handled hammer from above and (6) filling the bolt holes and mortar joints displaced by the plates, with glaziers' putty.

## Economy in the Use of Dynamite

THOSE having to do with blasting rock are liable, says a recent article in *Engineering and Mining Journal*, always to use a certain number of sticks of powder for a hole of a given depth, taking no consideration of the quality of material being blasted. If the hole breaks well the operator is satisfied, even though an excess of powder may have been used. The use of a certain number of sticks of "extra" dynamite where an equal number of sticks of a 35 per cent powder would suffice, is apparent waste.

The foreman may, therefore, effect a saving in the use of powder through counting the sticks and by loading with different grades. In a 50-lb. box of extra dynamite there are about 100 sticks, 1¼ in. x 8 in., and 133 cartridges of 35 per cent powder. The higher grade explosive is much more expensive and there are fewer sticks to the box, so the cost per stick is much greater.

## Rusted Pipe Removed from Coupling

SOMETIMES an iron pipe, as in the case of a gasoline-engine exhaust pipe, becomes so rusted into the flange coupling that it cannot be removed. In order not to destroy the flange the pipe can be sawed off about half an inch from the coupling, then a hack-saw cut made through the stub end, lengthwise. A cold chisel is then applied to the outside of the projecting end, at the cut, and by gradually working around the pipe it can be loosened from the threads in the flange, curled up and removed without injuring the coupling threads.—*Power.*

### Rapid Earth Handling on Stanford Stadium

About 90 per cent of the earth work on the stadium at Leland Stanford Junior University in California has been placed and the structure is to be finished in time for the intercollegiate football game on Nov. 19. This job on which construction started June 5 involves the moving of 232,000 cu.yd. of earth and the placing of 800,000 ft. b.m. of lumber in the bleacher structure. Rush construction methods were a prime consideration as the work was undertaken this year only with the understanding that the stadium could be used for the championship game which brings in the biggest revenue of the season. The excavation is being made with elevator graders drawn by caterpillars and delivering to dump wagons hauled by mules. Within a week after the work was started earth was being moved at the rate of 1700 cu.yd. per 9-hour day and this rate was steadily increased to a maximum of 3686 cu.yd. per day using three graders and 200 mules. Earth has been excavated by the graders and loaded into dump wagons at rates as high as 81 wagons per hour, each carrying 2 cu.yd.

# NEWS OF THE WEEK

New York, December 8, 1921

## New York Pier Crane Bids to be Re-advertised

### Board of Estimate Fears Trouble Due to Possible Irregularity of Low Bid Submitted

On Dec. 2 the Board of Estimate and Apportionment of New York City voted to recommend to the Commissioner of Docks that the proposal to furnish thirty-four pier cranes for piers 12 and 13 of the new Stapleton (Staten Island) terminal be re-advertised. This action followed the hearing at which the next to lowest bidder on the first proposal protested against the award to the lowest bidder on the ground that this lowest bid was irregular. The Board of Estimate, from its discussion, seemed to fear legal complications if the contracts were awarded to either the lowest or next to the lowest bidder and made this recommendation to the Commissioner of Docks following his own request for advice. The commissioner has authority to let contracts on his own initiative, but he has stated that he would follow the advice of the board in this case.

The situation developed is a most interesting one to manufacturers and contractors contemplating work for the city. The proposals called for bids on thirty-four cranes, twenty-six to thirty-four of which were to be revolving 2½-ton gantries and eight to none of which were to be 1½-2½-ton combination cranes, there being five alternate bids, depending upon the number of each type to be asked for. The proposals were accompanied by specifications and outline drawings, but required that all bids should be accompanied by such general drawings and descriptive specifications "as will adequately indicate the manner in which the bidder proposes to carry out these specifications."

#### Twelve Manufacturers Bid

Twelve manufacturers submitted bids which were opened Oct. 4, 1921. The lowest two were from Heyl & Patterson, Inc., whose bid on one of the alternate propositions, given here merely for an example, was $370,882. The next lowest bidder was Wellman-Seaver-Morgan Co., whose bid on the corresponding item was $396,435. The variation in the other four items was approximately the same. Accompanying the Heyl & Patterson bid were a set of drawings and certain descriptive specifications. After the opening of the bids Heyl & Patterson wrote a letter to the Commissioner of Docks in which they said: "If there is any instance where any descriptive matter of what we propose to furnish conflicts in any way with the specifications themselves, the specifications of the Dock Department are to apply."

Subsequent thereto, Wellman-Seaver-Morgan wrote a letter to the Department of Docks protesting against the possible award of the contract to Heyl & Patterson on the ground that the specifications accompanying their bid would result in a structure different from and inferior to the structure required by the department's specifications and that therefore the bid was irregular and should be thrown out. They further contended that the subsequent letter to the department conforming the Heyl & Patterson bid to the Dock Department specifications was in effect changing a bid after the opening of the bids and that it should not be accepted.

The dock commissioner contended, however, that the specifications submitted by Heyl & Patterson were surplusage, that he could have required them to furnish the cranes to the department's specifications on the fact that they had submitted their bids on the regular blank forms of the department which carry along with every bid quoted the words "as per specifications," so that their specifications were mere information indicating what they would like to do but in no way binding the department to accept them. The commissioner stated this view to the Board of Estimate, but the board apparently was impressed with the possibility of legal complications, the danger of a taxpayers' suit, although the dock commissioner had an opinion from the corporation counsel stating that in his opinion the commissioner was free to accept the low bid.

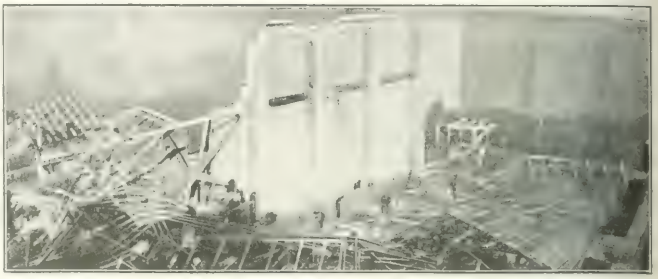


FIG. 1. GENERAL VIEW OF THE COLLAPSED STRUCTURE

## Collapse of Roof of Theater Under Construction in Brooklyn Results in Seven Deaths

### Building Was of Brick With Integral Pilasters Supporting Steel Roof Trusses—No Steel Failure Evident in Ruins

COLLAPSE of the steel roof framing of a theater building under construction in Brooklyn, N. Y., on Nov. 29, resulted in the death of at least seven workmen. The collapse occurred just a few minutes after the workmen had returned from lunch.

The structure, about 80 x 160 ft. in plan, which was to be used as a moving picture house, of about 1,800 seating capacity, had brick walls, its roof of reinforced tile being carried by a series of eight steel transverse trusses spaced about 16 ft. on centers and supported by brick pilasters integral with the walls. The north ends of four trusses were carried past an offset in the north wall of the building by a longitudinal truss one end of which rested on the wall pier at the angle of the offset, and the other end on a steel column. Three of the transverse trusses were supported on the upper chord of this longitudinal truss, the fourth or Truss 1 (see Fig. 2) being supported at its northerly end by a two-angle strut, stayed horizontally to the east end of the longitudinal truss. The column supporting the longitudinal truss was not anchored to the concrete footing and apparently the transverse trusses were not anchored to the brick pilasters, though holes for anchor bolts were found in each of the truss base plates.

FIG. 2. PART OF THE TOP CHORD OF TRUSS 1—BROKEN PILASTER UNDER TRUSS 6

An examination of the site after the collapse revealed that there was no

FIG. 4. SOUTH WALL AND PART OF WRECKAGE—NOTE CONDITION OF PILASTERS

liagonal bracing between trusses. The ›urlins used were 6-in. channels joined ıot on the truss centers but about 30 n. from the truss center lines. A trut connected all transverse trusses ıt the center of the bottom chords.

Examination of the wreckage indiates that the steel column had kicked ut from its footing and lay with its ase about 2 ft. off the pier. Beginning ıt the western end of the building and umbering the trusses in order from to 8 (see Fig. 2) Trusses 1, 2, 3, nd 4 had fallen eastward and their op and bottom chords described almost omplete semi-circles as they lay on he ground. Trusses 5, 6, 7, and 8 ad also fallen eastward though they ere much less distorted than the first our trusses. However, the top chords f 7 and 8 had buckled sharply at the rst panel point from the north end ı two right angles. No similar disortion was noticeable in the other russes, though the purlins kept the russes well tied together. The cause f this buckling is uncertain.

The pilaster which supported the orth end of Truss 5 had crushed parially, and the entire wall from that oint to the west wall of the structure ollapsed entirely. The pilaster under ne south end of Truss 6 also was artially destroyed, but all the other ilasters remained intact, the plates emaining in position on the top of ne pilasters in almost every case. The eneral position of all trusses as they ppear on the ground is shown by ig. 2.

The vertical strut which supported russ 1 bent through an angle of 180 eg., so that the backs of the angles ›rming the strut rested against each ther. The splice plate fastening the ottom of this strut to the west face f the column was torn through at the oint, half of the plate remaining astened to the truss and half to the teel column.

Only at Trusses 1 and 2 of the south ide of the building and Truss 5 on the orth side is there any obvious or narked evidence that the ends of the trusses scraped against the sides of the masonry walls. The south end of Truss 1 scraped along the wall in an easterly direction, about half the distance from the top of the pilaster to the ground. The scraping of the southern end of Truss 2 was considerably less.

In their present positions the steel trusses are in pairs and are held approximately in their proper relative positions by the "fixed" span of the purlins. This condition is indicated in Fig. 2. The horizontal strut connecting the bottom chords of all trusses remains continuous practically throughout its length, being unbroken, though in places distorted.

It is apparent that no failure of the steel was the primary cause of the collapse. All of the main members of the steel trusses remained practically intact, or at least lacking any distortion which might have caused the collapse. The marks on the south wall indicating that the scraping of the south end of Trusses 1 and 2 can be explained by the fact that the north end of the trusses had to remain upon their supports (the longitudinal truss) and therefore required a great deal more force to push them from their pilasters than that required to disengage the other lateral trusses which rested with either end upon pilasters. The fact that the scraping was most apparent at the south end of Truss 1 would indicate that the longitudinal truss inclined slightly inward from the beginning of the failure, a fact evident by the position of the longitudinal truss and steel columns upon the ground.

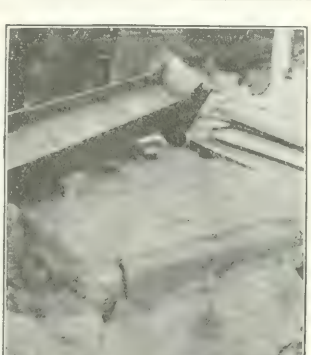


FIG. 5 STEEL COLUMN AND ITS FOOTING—LACK OF ANCHORING IS OBVIOUS

The crushing of the north pilaster of Truss 5 and the south pilaster of Truss 6 may be significant. With the failure occurring in the masonry at the

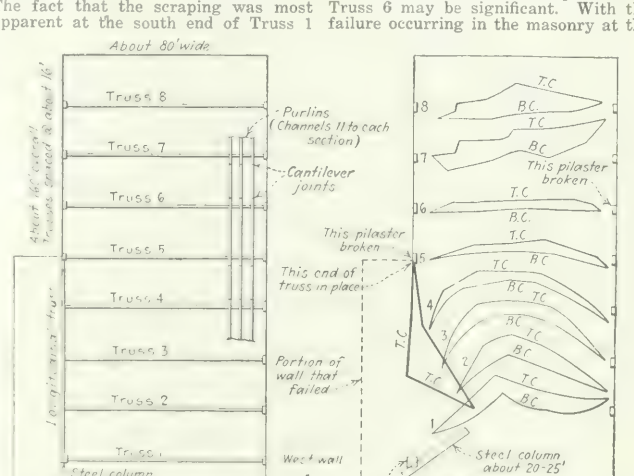



FIG. 6 GENERAL FEATURES BEFORE AND AFTER THE COLLAPSE

## General Contractors Nominate Officers for 1922

Officers for 1922 of the Associated General Contractors of America have been named by the nominating committee of the association headed by W. A. Rogers, Bates & Rogers Construction Co., Chicago, as chairman. Arthur S. Bent, Bent Bros., Los Angeles, Cal., now vice-president, is named as president, and A. P. Greensfelder, Fruin-Conlin Contracting Co., St. Louis, Mo., is nominated for Mr. Bent's unexpired term as vice-president. The other vice-presidents nominated are Sumner Sollitt, Sumner Sollitt Co., Chicago, and George A. Walbridge, Walbridge-Aldinger Co., Detroit, Mich. For treasurer Charles Cummings, Consolidated Engineering Co., Baltimore, Md., is nominated. The new directors named are: C. W. Lundoff, Lundoff-Bicknell Co., Cleveland, Ohio; B. H. Hardaway, Hardaway Contracting Co., Columbus, Ga., Stanley D. Moore, Moore-Young Construction Co., Waterloo, Iowa, and E. W. Shenk, Henry Shenk Co. Erie, Pa.

## Building Trades Employers to Meet in Cleveland

The annual convention of the National Association of Building Trades Employers will be held in Cleveland, Jan. 12-14. The more important subjects to be discussed include the open shop vs. the closed shop; the contractors' association and the law, apprentices, the National Board for Jurisdictional Disputes, relations between the architect and the contractor, and wages.

## Brooklyn Theater Collapse

(*Concluded from preceding page*)

north end of Truss 5, the pull at the top by the purlins and at the bottom by the horizontal strut connecting the bottom chords of the trusses would be sufficient to disengage all trusses from their pilasters. All principal members of the steel framing are undamaged, though a few breaks occurred in the bottom chords and the web members of the trusses. These breaks appear to be the result of the fall.

Despite the fact that there were no anchor bolts in the base of the steel column which supported the west end of the longitudinal truss, it is obvious that the column was well held by the trusses which it supported, and there would be no danger from the unanchored column until some lateral thrust was applied, as would have occurred in the failure of the pilaster at the north end of Truss 5.

An official investigation of the collapse is being undertaken by the Building Department of the Borough of Brooklyn, and the Queens County police authorities are endeavoring to discover if any of the contractors or subcontractors were guilty of negligence or of the use of improper materials. Both of the members of the firm of Rosenthal & Moskowitz, the owners of the building and the general contractors, are held on $15,000 bail each on temporary charges of manslaughter.

No opinion from the Brooklyn Building Department as to the cause is yet available.

## Engineering Office—Club Building Planned in Denver

All this year consideration of an engineering office-club building has been before a committee of the Colorado State Engineering Council. To crystallize plans the Colorado Society of Engineers recently secured tentative plans for a 7-story building containing offices, central drafting room, blueprint facilities, technical library, auditorium seating 500, club rooms, grill and stores on the ground floor. After a canvass of possible tenants, analysis of revenues, and means of financing, the Colorado society presented its findings, which were favorable to the Council with a request for co-operating committees from the constitutent societies. The local branch of the American Society of Civil Engineers has already complied.

### *I. C. C. Closes Chicago Office*

***With its railway valuation work approaching completion the Interstate Commerce Commission closed the Central District office of its Bureau of Valuation, at Chicago, on Nov. 30. The engineering, land and accounting departments have been transferred to Washington.***

## League of the Southwest Schedules Colorado River Conference

A meeting for the purpose of discussing Colorado River problems has been called by the League of the Southwest for Dec. 8, 9 and 10 at Riverside, Cal. The program includes Herbert Hoover, Secretary of Commerce, O. C. Merrill, executive secretary, Federal Power Commission, the governors of Colorado, Nevada and California, A. J. McCune, state engineer of Colorado, Arthur P. Davis or F. E. Weymouth of the U. S. Reclamation Service and F. H. Newell.

The entire Colorado River Commission created by the several states and Congress is also to be present. This commission consists of W. S. Norveil, state water commissioner, Arizona, W. F. McClure, state engineer of California, R. E. Caldwell, state engineer of Utah, F. C. Emerson, state engineer of Wyoming, Honorable F. B. Davis of New Mexico, J. G. Scrugham, state engineer of Nevada, and Honorable Dolph Carpenter of Colorado.

The commission will have its initial meeting concurrently with the general meeting of the League at Riverside. Representatives and delegates from a large number of organizations interested in the development of the Colorado River will be present and plans are being laid for a representative gathering.

## Oklahoma City Defeats $7,100,000 Bond Issue

The voters of Oklahoma City, Okla., defeated a proposed $7,100,000 bond issue for a new water supply, sewage-works, storm sewer extensions, river straightening, parks and new fire equipment on Nov. 26. Approval was given to a $250,000 bond issue for a county hospital. B. M. Hart is city engineer.

## Motor Truck Operators Establish Union Terminal in Minneapolis

Fifteen of the principal companies and individuals operating freight motor trucks out of Minneapolis have organized the Minneapolis Truck Terminals, Inc., and established a union terminal from which their business is being conducted. Thirty-seven lines serving about fifty towns are using the terminal, which is at 724 First St., North, in space leased from the Security Warehouse Co. H. R. Belitz is president and F. P. Raymond secretary of the new concern.

Heretofore the interests represented in the joint enterprise had conducted their business from five or six separate terminals. Minneapolis wholesalers suggested to them the idea of the union terminal, stating that unless such provision were made motor truck rural service would not be considered a valuable adjunct to their trade.

It is understood that there are half a dozen truck lines, mostly small, not yet in the terminal company, but its articles are such that these can be taken in if they should desire inclusion later. Warehouse space will be rented for the present, but the company purposes to erect a building of its own.

## American Concrete Institute To Meet in Cleveland

Initiating a program of holding its annual convention in various cities, the American Concrete Institute will meet in Cleveland, Ohio, Feb. 13 to 16, 1922. The program, as outlined by the Board of Direction, after considering the committee reports which are expected to be ready for discussion, will be spread over nine convention sessions—two sessions a day for three days and three sessions on a fourth day. These will be divided as follows: two sessions for contractor problems—the practical problems on the job; two sessions for concrete products manufacturers; one session on roads; one session on houses; one session on research; two sessions on engineering design and inspection.

## New Water Commission for Kansas City—Bonds Fail

Although the water-works bonds for $11,000,000 voted upon in Kansas City, Nov. 22, did not receive the necessary two-thirds majority, the bi-partisan commission to operate and construct a new plant was elected. It consists of Alexander Maitland, Jr., president, Kansas City Bridge Co., and a member of the American Society of Civil Engineers; George Edwards, formerly Mayor; Louis Rothchild, a retail clothing merchant; and Hughes Bryant, a real estate man. The members, who are to receive $6,000 annually, go into office April 1, 1922.

Engineers of the city backed the water-works campaign. Machine politicians complimented the engineers by saying that they could recognize by the results the precincts in which the engineers worked and that if they could command workers like the engineers, they could "put over anything." It is generally conceded, even by the opposition papers, that the water bonds will carry in the spring election if put up by themselves and not weighed down, as they were at this election, by bonds for work not absolutely necessary.

## A. S. M. E. Considers Equal Rights for Junior Members

Amendments to the constitution of the American Society of Mechanical Engineers (a) permitting junior members to vote and (b) removing the prohibition against juniors holding office were presented at the business section of the annual meeting held Dec. 7 in the Engineering Societies Building, New York.

An analysis of the society's membership shows that the average age at which juniors can join the society is over 25 years. The average age of all juniors is nearly 29 years. Seventy-five per cent of the juniors are graduates of technical schools. The proposed amendments were designed to cause a larger percentage of engineering students to join the society upon graduation and to assume an active interest in its affairs.

## Argentine Proposes Internal Loan For Sanitary Work

A director of the Argentine National Sanitary Works Department has asked immediate authorization to issue 20,000,000 pesos in bonds at 6 per cent interest and 1 per cent amortization, to provide running water to fifteen towns of over 3,000 population, and both water and sewage systems for those over 8,000 inhabitants. Construction of these systems is authorized by law, says a recent report from U. S. Trade Commissioner George F. Brady, but the rate of 5 per cent interest makes it impossible to float the loan.

## A. A. E. Directors Urge Support for Local Public Service

At the quarterly meeting of the board of directors of the American Association of Engineers in Chicago, Nov. 18 and 19, steps were taken to push construction and public service activities immediately through the 220 local units of the association. The meeting decided that the local organizations should stimulate construction throughout the country, especially in municipalities, in accordance with the suggestions and plans of the National Employment Conference held recently in Washington, through active co-operation with municipal, federal and state authorities.

Similar action was also directed to the end that municipal engineering service be improved through an educational campaign for: (1) More certain tenure of office. (2) Having technical engineering work supervised by engineers. (3) Putting compensation on a basis of qualifications and service rendered. (4) Insisting that only the highest grade of engineering service be accepted. (5) Extensive co-operation with local civic organizations. (6) Encouraging engineers to prepare popular articles about municipal work such as paving, sewerage, sewerage disposal, sanitation, water supply, city lighting and city planning. The point was emphasized that this educational work should be more for the general public and not so much for engineers.

First Vice-President A. N. Johnson of the Joint Committee of A.A.E. and the Federated American Engineering Societies reported that a plan of co-operation was being formulated.

## Los Angeles Plans Big Coliseum

Under an agreement with the city and the county of Los Angeles the Community Development Association has undertaken to construct in Exposition Park a coliseum seating 75,000 people and costing approximately $800,000. Construction work will start immediately and will require fourteen months. The contractor is the Edwards, Wildey & Dixon Co., while the architects are John and Donald B. Parkinson. The city and county, in return for an annual rental of the structure, will have equal rights of occupancy with the development association for a period of years, at the end of which time the Coliseum will become the property of

PROPOSED COLISEUM AT LOS ANGELES

the city and county. Los Angeles banks are financing the project.

The Coliseum is to be elliptical in plan, as shown in the accompany architects' sketch, the field being about 30 ft. below, and the seats extending 50 ft. above, the ground surface. The lower tiers of seats will be of concrete construction, while wood will be temporarily employed for the upper sections until the embankment upon which they rest has become stable.

The playing field will be 680 ft. long and 344 ft. wide. There will be 86 exits and entrances.

## Vehicle Tunnel and Bridge Bonds of $15,000,000 Authorized

The New Jersey Interstate Bridge and Tunnel Commission, at its meeting Nov. 29, authorized a bond issue of $15,000,000 to cover expenditures during 1922 for the Hudson River vehicular tunnel and the Delaware River bridge at Camden. According to the estimates of Clifford M. Holland, chief engineer of the vehicular tunnel, that project will require $12,793,000 during the coming year. The state's share of the bridge expenses is estimated at $2,500,000.

The commission authorized the beginning of negotiations to acquire land on the Jersey side for the installation of the tunnel construction plant, although, at the present writing, the agreement with the Erie R.R., involving the ventilating shaft site, has not yet been signed.

## Tulsa Votes Bonds for $6,800,000 Water Supply Project

By a popular vote of 5,957 to 1,702 the citizens of Tulsa, Okla., indorsed a bond issue for an additional water supply, to be brought from Spavinaw Creek. The estimated cost of the project is $6,800,000. An outline of various water-supply schemes at Tulsa was published in this journal Nov. 3, p. 719.

## Large Range of Bids on Yellow River Bridge

### Prices From Five to Fifteen Millions Asked By 21 Bidders—Belgians Are First and Second

Details of the bidding on the Yellow River bridge called by the Chinese Ministry of Communications last spring have just been made available through publication of the figures in the *Journal* of the Association of Chinese and American Engineers (Peking) of August. The board of engineers convened to pass on the bids included five foreign engineers: H. Wilmer, former chief engineer of the Great Eastern Ry., England; J. A. L. Waddell, United States; A. Mesnager, France; L. Dethieu, Belgium; T. Ohmra, Japan.

Twenty-one bidders of nine different nationalities submitted 45 bids, including five Chinese bids, four American, three French, two British, two Japanese, one Belgian, one Austrian, one German, one Anglo-American, and one Franco-American. The bids submitted ranged from $5,000,000 to $15,000,000. The first three prizes were awarded to the Société d'Etude et de Construction, Belgium, first prize; Compagnie Générale de'Extrême-Orient, Belgium, second prize; Etablissement Brossard et Mopin, France, third prize. No fourth prize was awarded as the design which received fourth rank was submitted by the bidder who received third prize, and no competitor was permitted to receive more than one prize. The bids as quoted are:

M. Sughara, Tokyo, $14,972,229.

W. Deydier, Ire St. Gervais, France; $8,462,000 and $9,250,000.

Union d'Enterprises Industrielles, Paris, France; $9,331,263.55.

Societa Nazionale delle Officine di Savigliano, Turin, Italy; $8,310,249.31.

Sidney Y. Powell, Shanghai; $8,709,-454.50; $9,952,648.

Société d'Etude et de Construction, Brussels, Belgium; $14,902,844.82; $10,881,297.10.

The East Asia Co., Dairen, China; $9,736,333.80.

Cleveland Bridge & Engineering Co., Ltd., Cleveland, England; $5,165,232.79.

Arthur McMullen Co. and Minneapolis Steel & Machinery Co.; $12,457,-137.11; $13,369,720; $12,818,074.55.

Etablissement Daydé et Schneider et Cie., Paris; $10,038,665.18; $10,493,-644.88; $10,690,344.25; $11,142,187.62; $10,087,182.22.

Yu Foong Industrial Development Co., Ltd., Peking; $8,927,083.44; $8,198,-693.44; $8,691,983.44; $10,149,245.99; $9,230,995.99; $9,742,555.99; $10,428,-846.64; $9,413,579,970; $8,336,250.

Lam, Glines & Co., Inc., New York; $9,804,187.20.

Establissement Brossard at Mopin, Paris, France; $10,846,682.60; $10,344,-755.98; $10,380,472.57; $10,111,102.80; $10,700,499.18; $9,504,502.31.

Chung Hsi Engineering Office, Shanghai, China; $23,018,347.93.

F. Krupp A. G. of Rheinhausen, and Grün and Bilfinger of Mannheim, Germany; $9,481,944; $8,490,914; $8,-053,400; $7,451,180; $10,786,895; $9,-440,525.

The Kai Cheng Engineering Co., Peking; $14,000,000.

Compagnie Générale d'Extrême-Orient, Paris; $9,299,184.31; $10,490,-981.97.

## Celebrate Completion of Flood Control Work at Erie, Pa.

Erie, Pa., on Nov. 23, celebrated the completion of its Mill Creek flood control works, designed to prevent a repetition of the disaster of several years ago when the stream overflowed its banks, passing through the built-up section of the city for more than a mile and resulting in the death, by drowning, of forty people and a property loss estimated at $2,000,000.

The stream is now entirely inclosed in a 22x18-ft. concrete conduit designed and constructed under the direction of Gannett, Seelye & Fleming, engineers, Harrisburg, Pa. Streets have been graded and paved over the structure and buildings erected on ground that was formerly the open-stream channel. Many acres of land in the heart of the city have been recovered for building purposes.

The engineers in charge of the work have received from the local newspapers recognition not ordinarily accorded to technical men. The Nov. 20 issue of the *Erie Dispatch* carried on the first page a group photograph of the engineering staff and also a picture of the daughter of George K. Richards, resident engineer in charge of the improvement, who had been selected, instead of some politician's relative, to christen the new concrete tube.

## California Starts Test Treatment of Road Sub-Soils

To test different methods of treating adverse sub-soils upon which paving is to be laid, the California Highway Commission is about to institute a series of experiments on a section of road now being constructed in Solano County, from Denverton to Rio Vista. Nine sections each 500 ft. long will be treated as follows:

*Section 1.* This section will be treated to a depth of 12 in. with portland cement in the ratio of 1 part of cement to 10 parts of soil, by plowing and harrowing to secure an intimate mixture. After having incorporated the cement with the soil, the subgrade will be rolled and finished for the concrete pavement.

*Section 2.* The same process will be followed as for Section 1, except that the proportions will be 1:20.

*Section 3.* The same process will be followed as for Section 1, except that the depth of treatment will be 6 in. instead of 12 in.

*Section 4.* The same process will be followed as for Section 2, except that the depth of treatment will be 6 in. instead of 12 in.

*Section 5.* The same process will be followed as for Section 1, except that hydrated lime in the proportions of 1 part of lime to 20 parts of soil will be used in place of portland cement.

*Section 6.* The same process will be followed as for Section 1, except that pulverized limestone in proportions of 1 part of limestone to 20 parts of soil will be used in place of portland cement.

*Section 7.* The same process will be followed as for Section 1, except that no foreign substance will be mixed with the adobe soil.

*Section 8.* The same process will be followed as for Section 1, except that 60 per cent asphaltic road oil will be spread at the rate of 3 to 5 gal. to the square yard.

*Section 9.* The same process will be followed as for Section 8, except that the depth of treatment will be 6 in. instead of 12. in.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

**The American Specification Institute** will hold its first annual conference Dec. 9 in Chicago. Subjects scheduled are on specifications from the standpoint of the law, building material and equipment industries, superintendents of construction and estimators. The purpose of the meeting is to analyze the thoughts of engineers and architests interested in the improvement of specifications for building and engineering structures and their equipment.

**The Associated Pennsylvania Highway Contractors** will hold their annual meeting at the Penn-Harris Hotel, Harrisburg, on Dec. 15. In connection ith the meeting a Highway Conference has been called for Dec. 16, to which engineers, contractors, material producers, equipment manufacturers bankers and surety companies are invited.

**The New York Section, Am. Soc. C. E.,** at its Dec. 9 meeting, will consider the topic, "The Zoning Law—What It Has Done for New York." The opening address will be by Edward M. Bassett, counsel of the New York Zoning Committee, and the other speakers will be Rudolph P. Miller, superintendent of buildings, Borough of Manhattan, Lawson Purdy, secretary and general director, the Charity Organization Society of the City of New York; John P. Fox, executive secretary, the Murray Hill Association, Inc.; and Clarence S. Stein, architect.

**The New England Water Works Association,** at its Dec. 14 meeting in Boston, will be addressed by Peter Payne Deane, New York City on, "Electrical Operation and Control of Gate Valves for Water-Works Systems," and by Thomas H. Wiggin, consulting engineer, Scarsdale, N. Y., on "Two Years in China."

**The New England Road Builders' Association** will hold its first annual dinner at the Hotel Somerset, Boston, Dec. 15.

# Personal Notes

E. N. Noyes, consulting engineer Dallas, Tex., has been appointed engineer for the Dallas Property Owners Association, an organization of business houses in the retail and wholesale district of Dallas, for the promotion of traffic ways, paving, new businesses etc. He will continue as district engineer, City of Dallas Levee Improvement District 10, and will maintain his connection with the firm of Myers & Noyes engineers.

Col. Thomas H. Rees, Corps of Engineers, U. S. A., has been transferred from San Francisco, Cal., to Honolulu, T. H., for duty as Commanding Officer of the 3rd Engineers.

Lt.-Col. Paul S. Bond, Corps of Engineers, U. S. A., has been transferred from New York City to Cleveland, Ohio, for duty as instructor, Engineers, Ohio National Guard.

Isaac Menline, consulting engineer, formerly engineer of design and construction for the Garment Center Capitol Buildings, New York City, and for several years prior thereto assistant engineer in the Bureau of Buildings, Manhattan, announces that he has opened an office in New York City for the practice of engineering.

James M. Owens, highway engineer, city engineer's office, San Francisco, Cal., has left for Honolulu to act in a consulting capacity for the City of Honolulu on paving work.

Major Thomas B. Larkin Corps of Engineers, U. S. A., has been transferred from Washington, D. C., to Tokyo, Japan, for duty as assistant military attache, American Embassy.

Major Thomas M. Robins Corps of Engineers, U. S. A., has been detailed as a member of the board of officers to consider a system of national highways in connection with the rural post roads.

W. H. Schimmel, formerly engineer, maintenance of way, Monongahela Valley Traction Co., Fairmont W. Va., is now chief engineer of the Keeley Construction Co., Clarksburg.

C. H. Birdseye, chief geographer for the U. S. Geological Survey, left Washington Nov. 30 to inspect the map making activities of the Survey in the West and in Hawaii.

George H. Harris, engineer of track and maintenance of way, has been appointed assistant chief engineer of the Michigan Central R.R., with headquarters in Detroit, Mich.

Col. Charles W. Kutz, Corps of Engineers, U. S. A., upon being relieved from his duties as engineer-commissioner, District of Columbia, by Col. Charles Keller, has been ordered to Cincinnati, Ohio.

John R. Leighty, assistant to the vice-president, Missouri Pacific R.R., has been appointed chairman of the engineering committee of the Western group, Railway Presidents' Conference Committee on Valuation, with office at Chicago. He succeeds Howard C. Phillips, who has resigned.

John F. Delaney, formerly Transit Construction Commissioner of New York, has been appointed Commissioner, Department of Docks, suc

ceeding Murray Hulbert who last month was elected President of the Board of Aldermen, of New York City.

W. G. THOMPSON, former state highway engineer of New Jersey resigned his connection with the Lakewood Engineering Co. of Cleveland on Nov. 15. He will devote some weeks to research work, and will continue as consulting highway engineer for the Lincoln Highway Association on the development of its proposed "Ideal Section," with headquarters in Trenton, N. J.

## OBITUARY

SEPTIMUS P. TUSTIN, a senior member of the firm of S. J. Martinet & Co., Baltimore, Md., civil engineers and surveyors, died Nov. 18.

WILLIAM FRENCH DOHERTY, an American engineer resident in Galveston, Texas, is reported by the State Department to have been killed, presumably by rioters, in Bombay, India, on November 19.

CHARLES H. PRIOR, railroad builder, died Nov. 13 in Minneapolis. He was 88 years old and had been a resident of Minneapolis for 50 years. Under his direction, the first line of the Chicago, Milwaukee & St. Paul Ry. was brought into Minneapolis in 1870.

PAUL M. NORBOE, assistant state engineer of California since the organization of the department of engineering in 1907, died Nov. 15. He was born in El Monte, Cal., in 1857 and began his engineering work as a chainman with a government surveying party in the Mojave district in 1877. About five years later he became assistant engineer of construction of canals in Fresno and Tulare Counties, Cal. and served for four years as city engineer of Visalia. Most of his experience was in irrigation and reclamation work.

JOHN B. BATTLE, assistant engineer, U. S. Engineer Office, Mobile, Ala., died Nov. 6. He was born in Sumter County, Ala., in 1875, and from 1895 to 1900 was engaged in surveying work, part of this time with the Seaboard Air Line R.R. From 1900 to 1910 he was with the Engineer Department of the Army on the surveys and construction of Locks 6, 7, 8 and 9 in the Warrior River, Ala., and from 1912 to 1915 was engineer in charge of construction of Locks and Dam No. 17, Black Warrior River. Later he was made engineer in charge of construction of fortifications at Ft. Morgan, Ala.

DR. BINGHAM H. STONE, director of the Vermont Laboratory of Hygiene, died late in October at Burlington, Vt. He took the degrees of A.B. in 1897 and M.D. in 1899 and, later on, of M.S. at the University of Vermont. After post-graduate work at several institutions, he began service with the Vermont Board of Health and continued until his death, as laboratory assistant in 1900, bacteriologist from 1901 to 1904, and then as director. He had been professor of bacteriology since 1904 and of pathology since 1910 in the Medical College of the University of Vermont and university trustee since 1919. He was author of several books on laboratory work.

## BUSINESS NOTES

B. J. WINTERS, for 20 years connected in an engineering and sales capacity with the F. C. Austin companies, is now in charge of the Northwest district of the Austin Machinery Corp., with office in Minneapolis.

PAYNE DEAN, LTD., New York City, manufacturer of Dean control for electrical operation of water, gas and high pressure steam valves, has established offices in Pittsburgh and Chicago, with C. J. Burrage, recently with the Cutler-Hammer Mfg. Co., in charge of the Pittsburgh office and A. H. Kohlbusch in charge of the Chicago office.

H. V. SCHIEFER, who has been connected with the C. O. Bartlett & Snow Co. as chief draftsman, the Grasseli Chemical Co., Cleveland, as labor-saving engineer, and with the Arthur G. McKee Co., Cleveland, as manager of the sintering plant department, has been placed in charge of the Philadelphia office of the Webster Manufacturing Co., Chicago, engineers, founders and machinists.

THE UNITED STATES CAST IRON PIPE & FOUNDRY CO., Burlington, N. J., announces the opening of an office in Cincinnati, O., with Harold G. Henderson in charge of sales.

## EQUIPMENT AND MATERIALS

### New Small Trench Excavator

A trench excavator designed to excavate trenches 12, 15 and 18 in., wide and up to 6 ft. deep has been developed by the Parsons Co., Newton, Iowa. The new machine weighs 12,000 lb. and is only 25 ft. long with the boom extended.

Being carried on crawler tractions, with broad tired wheels under the front or light end, safe operation on soft ground and ability to make short turns are considered to be assured. A four-cylinder 30-hp. gasoline engine provides power. Two special structural and operating details are a fiber friction-disk slip-clutch on the main shaft which slips when obstructions are encountered, and a two-chain arrangement, cushioned by springs, for adjusting the bucket boom. The machine has twelve digging speeds from 1 ft. to 9 ft. per hour and a traveling speed of 1¼ miles per hour.

### Gasoline Electric Shovel

A gasoline engine direct-connected to a dynamo which supplies current to three motors is the power plant employed on a new revolving shovel being marketed by the Marion Steam Shovel Co., Marion, O. A separate motor is used for hoisting, rotating and crowding, a controller having movements identical with the levers on a steam shovel being employed. In fact the machine is structurally a steam shovel with a four-cylinder gas engine and dynamo in place of the boiler, a controller in place of the lever bank and three motors in place of the usual steam engines. The gas engine is 53 hp. and the generator 25 kw.

### Hinged Joint for Jaw Crusher Frames

A new frame construction designed to reduce breakage in jaw crushers has been developed by the Kennedy-Van Saun Manufacturing & Engineering Corp., New York, N. Y. Instead of the usual single-piece casting or

four-piece frame, with bolted mortise and tenon joints, hinged joints are employed. The extremities of the frames are made circular and fastened together by steel pins, which given enough hinge action to the joint to take care of slight movement of the end frames under heavy crushing strains. With this hinge joint construction additional bolts and stiffeners are employed to maintain shaft alignment and the essential rigidity needed in a crusher frame.

### Out of the Ordinary Trade Publications

Details of practice in mixing and laying sheet asphalt pavements are described in a 15-page illustrated pamphlet issued by the TEXAS CO.

Practical methods of waterproofing are illustrated and described in a pamphlet issued by the MINWAX CO., INC., New York.

Discussion and instructions of practical value are contained in a pamphlet on protective coatings for pipe, particularly for underground service, by the NATIONAL TUBE CO., Pittsburgh, Pa.

A series of pamphlets from the TRUSCON STEEL CO., Youngstown, Ohio, furnishes useful data on the selection and installation of steel sash. A pocketbook lists and gives the properties of all the products of the company.

The tyro in steam and gas engine lubrications is given two useful textbooks in recent publications of the VACUUM OIL CO., New York, called "Stationary Steam Engines" and "Oil Engines." Contractors in particular should get the oil engine pamphlet.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Engineering News-Record's Cost Index 1918 to Date

*Engineering News-Record's* Construction Cost Index Number for the months of 1920 and 1921 was published in the Nov. 24 issue, p. 876. The Numbers are here tabulated for all the months from January, 1918, to date. Next week, Dec. 15, there will be an article in these pages showing the standard European index numbers (Germany, England, France and Italy) compared graphically with Dun's "all commodities" index and *Engineering News-Record's* Construction Cost Index Number. The *E. N. R.* Index Number for the months of 1917 will be presented here next week.

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER
(100 in 1913)

| | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|
| January | 184.51 | 198.05 | 206.55 | 230.67 |
| February | 184.51 | 200.50 | 225.10 | 230.67 |
| March | 184.51 | 198.05 | 240.85 | 224.27 |
| April | 186.01 | 191.25 | 265.20 | 213.07 |
| May | 186.01 | 191.25 | 268.90 | 210.82 |
| June | 185.31 | 191.85 | 273.80 | 209.82 |
| July | 188.65 | 193.65 | 265.65 | 203.82 |
| August | 193.85 | 196.65 | 252.00 | 193.07 |
| September | 193.85 | 202.85 | 255.20 | 188.27 |
| October | 193.85 | 202.25 | 255.20 | 182.57 |
| November | 193.55 | 206.85 | 255.32 | 166.32 |
| December | 194.75 | 206.85 | 251.62 | 167.82 |

## Bids Wanted on Big Jobs

Among the jobs on which bids are asked, or will soon be asked in Construction News, pp. 249 to 257, are the following: Street and road work in Ontario to the value of $5,000,000 for Department of Provincial Highways, Toronto; sewers aggregating 31,317 ft. for Philadelphia, amounting to $386,900; ore dock for Superior, Wis., $2,000,000; power and distribution equipment for New Orleans Railway and Light Co., $972,000; hospital for University of Wisconsin, Madison, $1,[illegible]

## Steel Car Orders

Orders for 127 modern steel passenger cars have been placed with the Chicago, Burlington & Quincy R.R., according to [illegible]. Cars were ordered in expectation of increased business next summer.

# Materials—Production and Stocks

## Chief Interest in Lumber—Stock Conditions of Basic Construction Materials in Ten Cities

With the steel industry working at only 40 to 50 per cent capacity, and with mill stocks of finished cement amounting to four to five million barrels, principal interest at present centers in the lumber industry. Steel prices have been declining in step with falling demand; cement prices were recently lowered at many mills; but lumber prices are advancing.

One hundred and eight mills reporting to the West Coast Lumbermen's Association for the week ending Nov. 26, show 59,577,331 ft. of lumber produced; 56,644,824 ft. sold and 52,286,897 ft. shipped. Production was 26 per cent below normal; new business was 5 per cent below production, and shipments were 12 per cent below production. Forty-four per cent of the new business is to be shipped by water. Orders and shipments of Southern pine are well maintained, while production and stocks show decrease.

Reports from 102 manufacturers throughout the country show common brick production 82,000,000 for October, with movements from yards amounting to 80,000,000, according to the Common Brick Manufacturers' Association of America. Burned brick on hand aggregated 230,557,000, with orders for 163,442,000.

The accompanying tabulation does not include sand, gravel and crushed stone for the reason that these materials are nearly always supplied locally in any quantity desired.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example (cement, Boston 12,000 bbls.); time required for delivery of carload lots to city job, example (cement, Boston 5 to 7 days); and stocks on hand in general terms, example (sewer pipe, Denver, plenty).

| | New York | Boston | Detroit | Chicago | Minneapolis | Denver | Atlanta | Birmingham | Los Angeles | San Francisco |
|---|---|---|---|---|---|---|---|---|---|---|
| Sewer pipe | [illegible] | 8 to 10 days | Plenty | [illegible] | [illegible] | Plenty | Plenty | Plenty | 24 hrs. | Sufficient |
| Cement | 24 hrs. | 12,000 bbls. 5 to 7 days | 100,000 bbl. | Few hours | 2,500 bbl., prompt | 7,000 bbl., 48 hr. plant to city | 10 to 15 cars, prompt | 2,000 bbl., 1 to 2 days | Local plant | Sufficient |
| [illegible] | Ample | 2,000 bbl., 5 to 6 days | 5,000 tons | [illegible] | Plenty | [illegible] | 5 to 6 cars. Prompt | 4,000 bbl. | [illegible] | Fair |
| [illegible] dehydrated | Ample | 175 tons 5 to 8 days | Plenty | [illegible] | Plenty | [illegible] | Incl. in above prompt | Incl. in above | [illegible] | Fair |
| | | | | | | | | | 6,000,000, 6 to 8 hours. Monthly sales | |
| Common brick | 24 hrs. | 60,000 | 15 cars | 24 hours | 5,000,000 pr. | 9,000,000 | [illegible] | Plenty | 14,000,000 | Plenty |
| Hollow tile | Plenty | [illegible] | Average | 1 to 6 days | [illegible] | [illegible] | 3 to 4 days | Plenty | 500,000 tons | Sufficient |
| Lumber | Common [illegible] liver 300 M. [illegible] Pine 10 [illegible] | Large retail stocks. Spruce 10 to 14 days yard. Fir 4 to 6 weeks | 10,000,000 ft | | 90 normal, 50,000,000 ft. Coast or South, 21 days Minn. or Wash., 10 | Ample though 70 per cent normal | 10,000,000 ft prompt | Large stocks within 200 miles | 2 to 4 days | Sufficient |

### Stock Conditions in Ten Cities

*New York*—Material stocks generally large. Structural steel available in large quantities on short notice. Stock of wrought steel pipe not large within city limits. Cement warehouses full; 24-hour deliveries to contractors within Metropolitan District. Dealers' stocks of sand, gravel and crushed stone, within city, sufficient to meet all contractors' demands. Pine lumber stocks good, can complete delivery on quantities as large as 300,000 ft. in 9 or 10 days within Metropolitan District. Common brick on hand to fill all demands within 24 hours. Hollow tile supplied by large factories within 26 miles of city.

*Boston*—Brick stocks low, brick being sold as fast as made by two local plants.

*Philadelphia* — Building material stocks generally plentiful. Not much sewer pipe on hand, but demand will be light until spring. Good demand for paving stone and for the common grades of soft woods. Finishing lumber and hard woods scarce.

*Detroit* — Practically no stocks of asphalt carried except by paving contractors. Large supply of river sand on docks for winter; same for gravel and crushed stone. Large stocks of brick at local plants; some contractors make their own common brick.

*Chicago* — Orders for structural shapes and rivets can be filled in a few hours; 200,000 tons reinforcing bars in stock. Gravel and sand can be delivered in carload lots in two to four days; crushed stone in a few hours, stocks being 300,000 cu.yd. Dealers say October and November were the two best months of this year.

*Minneapolis*—Stocks generally good. Cement manufacturers can deliver promptly. Common and face brick plentiful, though 20 to 30 per cent less than a year ago at this time. Some dealers state that stocks are being kept low in anticipation of a freight reduction. Lumber situation noted in the tabulation holds for St. Paul as well as for Minneapolis.

*Denver*—About 1,000 tons structural shapes in stock. Mountain States Lumbre Dealers' Association reports stocks 70 per cent normal; the principal Denver firm has nearly 16,000,000 ft., b.m., in stock. Sewer pipe made in city.

*Atlanta* — Lumber, cement, lime, brick and steel can be delivered on demand. Other materials in about a day

*Birmingham*—Cast-iron pipe cast in several plants in the district. Sewer pipe is manufactured in North Birmingham. Sand is shipped in from Central Alabama, and there is no local supply. Crushed stone is available at a crushing plant in the city, but slag is used in place of stone and gravel. Slag is furnished principally by the Birmingham Slag Co., Ensley, Ala. Cement is available at the Atlas Portland Cement Co.'s plant at Leeds, Ala., 21 miles from Birmingham. Reinforcing bars are rolled at Bessemer, Ala.; structural shapes rolled at Bessemer and Fairfield plants. Several brick plants in the city. Large wholesale stocks of lumber always in local yards, and unlimited supplies are available in a radius of 200 miles.

*Los Angeles* — Sand, gravel and crushed stone can be delivered within 24 hours. The local cement plant can produce 6,500 bbl. per day.

*San Francisco* — Ample stocks of nearly all materials. Cast-iron pipe is supplied from the iron districts in about 90 days. Road oils can be delivered in about a week.

## Trend of Business

That money is easier, that credit is more liberal, is evident to those who have read *Engineering News-Record's* "Trend of Business" published weekly in this section for the last month. Call loan rates have been generally downward since the early part of 1920—from 10 per cent to the present 4½ per cent. In 1915 the rate was 2 per cent and under, the climb beginning in June, 1916. For several weeks the bond market has been remarkably strong. In fact, new securities have been readily sold at prices yielding smaller returns than for many months before. It is interesting to note that Stock Exchange call money rates declined before bond prices began to rise.

On Nov. 4 the New York Federal Reserve Bank lowered its rate from 5 to 4½ per cent on all classes of paper, and reductions of ½ to 1 per cent were made at about the same time by all other Reserve Banks. Present discount rates are: 4½ per cent for New York, Boston and Philadelphia; 5 per cent for Cleveland, Chicago, St. Louis, Kansas City and San Francisco; 5½ per cent for Minneapolis, Richmond, Atlanta and Dallas. According to the "Monthly Review" issued by the Federal Reserve Bank, New York, this reduction was followed by a decline of ¼ per cent (to a range of 5¼ to 5½ per cent) in the open market on prime commercial paper, with 5 to 5¼ per cent the prevailing rate in the last week of November. The following interesting table is given of the advance in the value of Liberty bonds:

| Issue | Closing Price Nov. 19 | Advance Since Oct. 20 | Advance Since Low | Date of Low |
|---|---|---|---|---|
| Liberty 3½s | $95 20 | $3 64 | $9 20 | June 2 1921 |
| Liberty 1st 4s | 94 88 | 2 28 | 11 88 | May 20 1920 |
| Liberty 2d 4s | 94 66 | 2 26 | 13 26 | May 20 1920 |
| Liberty 1st 4½s | 95 10 | 2 32 | 11 10 | May 20, 1920 |
| Liberty 2d 4½s | 94 76 | 2 52 | 13 66 | May 20 1920 |
| Liberty 1st 4½s | 96 34 | 1 80 | 10 74 | Dec. 20, 1920 |
| Liberty 4th 4¼s | 94 88 | 2 46 | 12 88 | May 20, 1920 |
| Victory 4¼s | 99 92 | 0 52 | 5 22 | May 20, 1920 |
| Victory 3¾s | 99 90 | 0 52 | 5 26 | May 20, 1920 |

Evidence of the increasing demand for fixed-income securities was shown by the heavy over-subscription to the $50,000,000 New York Telephone Co. refunding mortgage 6s, noted in these pages, Nov. 24. Of nearly 68,000 subscribers, more than 54,000 asked for bonds of $5,000 or less, to a total of more than $126,000,000, and over 25,000 asked for bonds of $1,000 or less, totaling over $22,000,000. Demand for state and municipal issues exceeded the supply, despite exceptionally heavy issues. Prices rose, so that the better grades were offered to yield about 4¾ per cent, against 5 per cent a month ago, and 5¼ per cent in September.

Indications are that 1922 will be a "bond year." Last week's sales averaged $24,000,000 per day. The distribution in the last three months has been safe; bonds have gone out of Wall Street and scattered from one end of the country to the other. Inquiry for high grade issues is not slackening. Last week's features were the sale of $10,000,000 of Detroit's 4½s, 5s and 5½s; $4,000,000 Michigan highway 5s; $3,500,000 Jersey City 5s; and $2,000,000 each of New Jersey and Philadelphia 5s. The yields average 5 per cent. There were twenty-six separate issues of State and municipal bonds during the week. It is said of the present financial situation that "the speculator is poor and the investor rich."

## Representative Public Bond Sales in November

Despite a flood of offerings, there is a tremendous demand for high grade bonds of all kinds. The general situation is outlined in the "Trend of Business" on this page. Municipal issues are the feature in the first half December. On Dec. 7 Rochester offered $6,000,000 one-to thirty-year 4½s; on Dec. 12 Mississippi will award $1,500,000 general improvement 5s, average maturity 13½ years; on Dec. 15 Buffalo will award $7,360,000 general improvement 4½s. The accompanying tabulation presents some representative sales of November.

REPRESENTATIVE BOND SALES OF NOVEMBER, 1921

| State | Purpose | Amount | Maturity | Rate per Cent | Sold for | Dated |
|---|---|---|---|---|---|---|
| California | Highway | $5,000,000 | 1938–42 | 5 | 109 52 | Oct. 27, 1921 |
| South Dakota | Highway | 1,000,000 | 1931 | 5½ | 102.15 | Nov. 15, 1921 |
| *County* | | | | | | |
| Big Stone, Minn. | Court House | 20,000 | 1931 | 5½ | 100 35 | Nov. 1, 1921 |
| Churchill, Nev. | Road | 25,000 | 1923–32 | 6 | 100.40 | Oct. 1, 1921 |
| Clark, Ind | Highway | 17,900 | 1923–27 | 6 | 100.59 | Sept 28, 1921 |
| | | 35,200 | 1923–32 | | | |
| Cook, Ill | Road | 2,000,000 | 1925–40 | 4½ | 97 6913 | Apr. 1, 1920 |
| Dallas Co. Road Dist. No. 1, Texas | Road | 2,700,000 | ..... | 5½ | 96.75 | Oct. 27, 1921 |
| Jefferson, Ala. | Road | 80,000 | ..... | 5 | 100.00 | Nov. 1, 1921 |
| Lake, Ind | Gravel Road | 12,000 | | 5 | 100 00 | Sept. 15, 1921 |
| Miami, Ohio | Power Plant | 8,200 | Due serially | 6 | 100.00 | Oct. 1, 1921 |
| Ogemaw, Mich. | Road | 28,500 | Due serially | 6 | 100.00 | Oct. 1, 1921 |
| Uvalde, Tex. | Road | 200,000 | 1921–51 | 5½ | 100.00 | Oct. 10, 1919 |
| Bergen, N. J. | Road and Bridge | 644,000 | $34,000–1923–30<br>$49,000–1931–33<br>$50,600–1934–38 | 5½ | 104.01 | Dec. 1, 1921 |
| Cocoa Beach Special Road and Bridge District | Road and Bridge | 300,000 | 1930–40–50 | 6 | 98.57 | Oct. 1, 1920 |
| Brevard Co., Fla. | | | | | | |
| *Municipality* | | | | | | |
| Boston, Mass. | Building Library | $10,000 | 1922–31 | 4½ | 100.00 | Oct. 1, 1921 |
| Brush, Col. | Power Plant | 60,000 | 1942 | 6 | 100 00 | Oct., 1921 |
| Canton, Ohio | Street Improvem't | 4,500 | 1923–52 | 6 | 100.51 | Oct. 31, 1921 |
| | | 3,569 | 1926 | | | |
| Eaton, Ohio | Street Improvem't | 3,000 | 1923–28 | 6 | 100.00 | Oct. 1, 1921 |
| Indianapolis, Ind. | Park | 86,000 | 1926 | 6 | 102.055 | Aug. 22, 1921 |
| | | 65,000 | 1923–44 | 5½ | 101.25 | Dec. 1, 1921 |
| Logansport, Ind. | Park | 13,000 | 1923–31 | 6 | 102 40 | |
| | Power Plant | 50,000 | 1922–31 | 6 | 101.702 | Oct. 1, 1921 |
| Pomona, Cal. | Streets | 200,000 | ..... | 5½ | 100.00 | Oct. 27, 1921 |
| Randleman, N. C. | Municipal imp't | 6,600 | 1923–42 | 6 | 100.00 | Sept. 1, 1921 |
| Sayre, Okla. | Light, water, sewer | 74,500 | 1946 | 6 | 100.00 | July 1, 1921 |
| Seattle, Wash. | City Improvement | 462,015 | 1933 | 6 | 100.00 | Oct. 24, 1921 |
| Verona, N. J. | Library | 15,000 | 1923–37 | 6 | 103.096 | Oct. 1, 1921 |
| White Plains, N. Y. | Sewer | 50,000 | 1924–28 | 6 | 103.188 | Oct. 1, 1921 |
| Asbury Park, N. J. | City Improvement | 100,500 | 1927 | 5½ | 100.38 | Nov. 15, 1921 |

## Wilmington Unemployed Get Work

In an effort to relieve the unemployment situation the Street and Sewer Department, Wilmington, Del., has called on all property owners in the city to have pavements laid. Where the owners fail to comply with the city's request, the city will have the work done and lien the properties. It is expected that this will provide $200,000 worth of paving work.

*Next Week—"Index Numbers of America and Europe Compared."*

## Landis Award Enforcement League Makes Power Felt

Union control of building in Chicago is doomed, in the opinion of those who are in a position to know, if the citizens committee stands by its decision to make contractors and unionists alike carry out the provisions of the award made by Judge Landis several months ago regarding wage schedules and working conditions in the building trades. This fact was brought out in a meeting December 1 in Chicago of about twenty-five secretaries and executive officers of construction interests and material associations, constituent members of the National Federation of Construction Industries by John J. O'Leary of the Citizens' Committee for the Enforcement of the Landis Award. Mr. O'Leary outlined the work accomplished in which he indicated that both unionists and contractors who are refusing to abide by the Landis rules of working conditions as well as wage scales were finding things difficult.

As an indication of what has been accomplished so far by the citizens committee nearly 1,500 carpenters are working in accordance with the award and in defiance of their union. They are protected by 175 guards furnished by the committee. Surveys of jobs are being made and 83 per cent of the

work in Chicago is now reported operating under the Landis agreement. An apartment house builder who had all but closed a $1,000,000 bank loan was refused the money on his declaration that he proposed to ignore the Landis award. After three days' reflection he changed his mind. The majority of financial houses are behind the award. Work on the new Federal Reserve bank building, which is one of the largest unfinished pieces of construction in the downtown district, is to be carried forward in accordance with the Landis provisions.

The committee has incorporated and proposes to stay in operation several years if necessary. A fund of $3,000,000 is being raised to be paid in 10 per cent installments.

## Merger of Steel Companies Likely

A merger of seven independent steel companies, mentioned as being likely within the next few months, would bring together companies which are rated as having a steel ingot capacity of 9,800,000 gross tons a year. The companies mentioned are Midvale, Lackawanna, Republic, Youngstown Sheet & Tube, Brier Hill, Inland & Steel and the Tube Company of America.

The country's total ingot capacity is about 52,500,000 tons divided into 22,500,000 tons for the United States Steel Corporation and 30,000,000 tons for the independents, so that the proposed merger would involve one-third of the independent capacity.

## Dwelling House Construction Increases in 1921

A decided increase in the construction of dwelling houses throughout the country during the first ten months of 1921 has been noted according to information obtained by the civic development department of the Chamber of Commerce of the United States. Construction figures furnished by forty-four important cities show that during the period from January to October, inclusive, about $603,000,000 went into new construction, while during all 1920 the total at the same cities was only $8,000,000 more. During the shorter period this year 57.9 per cent of the total was for dwelling houses as against 36.1 per cent in 1920.

# Weekly Construction Market

THIS [illegible] weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1, the next, on January 5.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.78 | $4.00 | $4.00 | $2.88 | $3.00 | $3.75 | −$3.45 | −$3.75 | $4.00 |
| Structural rivets, 100 lb | −3.00 | 5.25 | 5.50 | 3.43 | 4.15 | 4.25 | 5.50 | 4.25 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.68 | 3.20 | 3.50 | 2.68 | 3.08½ | 3.57½ | 2.90 | 3.75 | −2.75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 54% | 55% | 45% | 57% | 58.9–5% | 38% | 51.8% | 50% | 35.10 |
| Cast-iron pipe, 6in. and over, ton | 47.30@48.30 | +45.00 | 54.30 | 42.60@44.10 | 47.80 | 52.00 | 50.00 | +55.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | −2.30 | 2.69 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | +3.16 |
| Gravel, ¾ in., cu.yd | 1.75 | 1.85 | 2.25 | 1.65 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.00 | 1.25 | 2.25 | 1.65 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.00 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 47.50 | 38.00 | 37.00 | 48.00 | 35.00 | 50.00 | −29.00 | 22.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | 27.00 | 21.00 |
| Lime common, lump, per bbl | 3.3[illegible] | 1.50 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 3.25 | −11.00 |
| Common brick, delivered, 1,000 | −17.40@18.40 | 9.00 | 12.72 | 11.00 | 17.00 | 14.00 | 18.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .0675 | .124 | .0821 – .0792 | | .09 | .12½ | .10 | .08[illegible]@ |
| Hollow partition tile 4x12x12, block | .11120 | .0675 | .124 | .0657 | .... | .10 | .14½ | .11 | .... |
| Linseed oil, raw, 5 bbl. lots, gal | .72 | .79 | .85 | —.74 | .80 | —.90 | 83 | 79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | .35 | | .72½ | .50 | .50@.55 | .75 | .50@.60 | .... |
| Common labor, non-union, hour | .... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | 50@.55 | .50 | .25@.30 |

Explanation of Prices—[illegible] from previous quotations are indicated by [illegible] 45-5% means a discount of 45 and 5 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. New York [illegible] tiles, which are "on trucks." Common lump [illegible] gravel and crushed stone are quoted along[illegible] on job. Chicago quotes hydrated lime in [illegible] Minneapolis [illegible] instead of pine. Brick and hollow tile de[illegible] Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. Denver quotes cement "on tracks"; [illegible] on cars lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump [illegible] both lump and hy per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. San Francisco quotes on Heath tile, 3[illegible] Prices are all f.o.b. warehouses except C. I. pipe, which is mill prices freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per [illegible] Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Exchange is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

## Changes Since Last Week

Prices [illegible] steel are being gradually reflected in warehouse quotations throughout the country. Pittsburgh continues to quote $1.50 on steel shapes and reinforcing bars in large tonnages and $1.60 per 100 lb. in small lots. Quotations on mill shipments remain unchanged.

Structural rivets are quoted in New York [illegible] $3.70; steel shapes in San Francisco at $3.45 as compared with $3.70, and in Seattle at $3.75 instead of $4, one week ago. In Montreal reinforcing bars are quoted at $2.75, a reduction from $3.25 per 100 lb.

Increased discounts on black steel pipe are quoted in New York. Cast-iron pipe has advanced $2 per ton in Seattle.

Cement has dropped 10c. in New York and advanced 4c. per bbl. in Montreal. A decrease of $4 per ton is quoted on common lump lime in Montreal. New York quotes common brick at $17.40@$18.40 per 1,000 delivered. Slight declines in hollow building tile are reported in Minneapolis.

Denver and Chicago both quote reductions of 2c. per gal. in linseed oil.

A Consolidation of Engineering [illegible] and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, DECEMBER 15, 1921 — Number 24

## Society Co-ordination

A STUDY of the calendar of annual meetings of engineering societies discloses the following information:

American Society of Civil Engineers, Jan. 18-19.
American Road Builders Association, Jan. 17-20.
Associated General Contractors, Jan. 17-19.

As if to make doubly sure that the attendance of engineers and contractors shall be limited to only one of these gatherings the committees in charge have not merely selected identical dates, but have chosen such widely separated centers as New York City, Cleveland, and Chicago for staging their sessions. A number of men belong to all three organizations; many hold membership in at least two. It is presumable that they would find it profitable to be present at two or, possibly, all three of the conventions. As matters now stand, however, a single choice must be made. If the Federated American Engineering Societies could only postpone for two weeks its annual meeting in Washington "co-ordination" in arranging important engineering society convention dates would be practically complete.

## Another County Park System

ANOTHER New Jersey county has followed the good example set many years ago by Essex County in deciding to establish a county park system. Reference is made to Union County, south of Essex County, and including Elizabeth, Plainfield, Summit, Cranford, and other New York City suburbs. The Essex County park system has long been noted for its mountain reservations and its city and neighborhood parks. Union County has fine opportunities in the same line. It is gratifying to note the part that has been taken by engineers in promoting and securing the adoption of the Union County park scheme, as stated on p. 978 of this issue. Engineers are particularly fitted for civic work in this field, since they can readily appreciate the advantages not only of park systems but also of securing the land before it becomes occupied and costly and also because their engineering knowledge makes them particularly competent to serve as commissioners in the development and maintenance of parks.

## Highway Standards Progress

THE future is bright for the duplication in the highway field of the excellent standardization work of the American Railway Engineering Association. Last week's technical program of committee work of the American Association of Highway Officials is a clear indication of highway development along proper economic lines. In the highway field as was the case with the railways in the early days, there has been a multiplicity of ideas as to methods, tests and limits in specifications until the contractor or material man who attempts to do an interstate business finds so many varying requirements that he is utterly bewildered. Under such conditions, of course, costs mount rapidly. The association is directing its efforts to bring about some degree of standardization. Looking to the elimination of state-line restrictions the committee on tests has divided the country into nine districts in which geological conditions make materials similar and like limits in specification therefore obvious. Committees have already started on the preliminary work of gathering data of existing practice. The report on standards has brought together a most commendable compilation of the various state standards of such things as slopes, drainage, guard rails, width, loading, thickness, curbing, crown, super-elevation and maximum and ruling grades. Many of these items are susceptible of engineering analysis and if the projected manual of recommended practice were in existence it would soon become standard practice throughout the country.

## The Warren Paving Patents

THE expiration last year of the basic patent (No. 727,505) for the Bitulithic type of pavement controlled by Warren Bros. Co., of Boston, has left many highway engineers in doubt as to the status of the patents under which the company is now operating. In an effort to clarify the situation *Engineering News-Record* presents in this issue a summary of the several patents involved, as disclosed by an examination of the so-called Wallace patents, and an inquiry into the prior art. The aim has been to present the facts in the case, as disclosed by official documents. The publication of this matter comes at a time when the validity of the Wallace patents is the subject of a suit now pending in the federal courts in California.

## The Federal Budget

THE first step toward a reformation of government business methods has been taken. For the first time a federal budget has been submitted to Congress with a fair chance of being observed in the appropriation bill. As noted in the news columns, the amount submitted is as great as that appropriated last year, which on its face does not indicate any great reform, but the reform will come in the cutting down of next year's deficiency appropriations. If General Dawes' system succeeds in persuading Congress that the Executive has really named its minimum necessities and in convincing the executive departments that they must not spend what they do not have, it will have gone a long way toward that necessary reduction of government expense which must precede the response to the loud demand for the cutting down of taxes.

## War's Share

THE BUDGET discloses what we all have known but which deserves reiteration just now—that past wars and present military precautions consume by far the largest share of our annual government expenditures.—For example, in the budget for the fiscal year ending

in June, 1923, the estimate for the war and the navy departments, for pensions, the U. S. Veterans Bureau and for sinking fund and interest on the public bedt, incurred largely for financing the last war, is $2,767,-000,000 out of a total of $3,505,000,000. In other words, less than $800,000,000 suffices for the administrative and constructive work of the government; just another reason for widespread support for the disarmament program which the President has fathered.

### The Joint Committee Discussion

LAST week's first public discussion of the Joint Committee's new tentative specifications for concrete and reinforced concrete made perfectly clear that many clauses in that document were in the nature of trial balloons sent up to test the air, that is the temper of the designers and builders of concrete. This feature of the specifications has been emphasized and re-emphasized, but it will stand reiteration. To many there is in printers' ink some virtue which confers infallibility. In spite of alternate clauses, footnote hedgings and prefatory protestations of doubt, the specifications are being accepted by some as the final word of a group well fitted to pronounce on the present state of the art and science of making and using concrete. It happens, too, that those most disposed to accept unquestioningly the provisions of the specifications are the ones least fitted to decide for themselves any mooted question. They read the word "tentative" at the head of the document but they argue to themselves that so distinguished a body of experts would not set their names to it were they not pretty sure that what it said was correct. That this is so is not the fault of the committee. Taken all in all the procedure adopted seems to be the only one to pursue. For many years we have been saying that the knowledge of concrete is changing and this is as true today as it was ten years ago. Not yet have we arrived at the time when any group, however representative and however expert, can set down incontrovertible dicta regarding concrete. The best that they can do is to work out in as substantial agreement as possible a code which exemplifies current knowledge and submit that code to the discussion of the whole profession. This the committee has done and before the year allotted to discussion has elapsed it will be in possession of many facts and opinions which will enable it much more nearly to approach a consensus of available knowledge and opinion than it has in its preliminary report. But no one must be allowed to forget that the report now before us is not final.

### One Use for an Engineer

FROM the trend of the discussion both on and off the floor at the Joint Committee meeting, it seems that the clause most likely to be removed from the final specifications is the alternate provision placing the responsibility for the strength of the concrete on the contractor. Its obvious faults were clearly pointed out, and the arguments were so conclusive that it seems hardly possible that the committee will allow it to remain. At the same time the probable intent of the clause was consistently overlooked by its opponents. As Professor Abrams well said it is not entirely opposed to the interest of the contractor. It has been common enough for a contractor on any given job to say that he knew how to make good concrete and that if he were allowed to select his own sand and stone and decide on his own method of mixing and placing, free from the annoyance of the theories of the ultra-scientific engineer, he could produce a concrete of more than the acceptable strength and durability. The debated clause would give the contractor just that privilege. The chorus of objection that has gone up from the contracting fraternity against the clause shows that he does not really want it if at the same time he must accept the responsibility that goes with it. Which should show some of the more violent of the contractors that the engineer is some use after all.

### Tax-Exempt Securities

AS IS NOT uncommon the President's message to Congress last week was a business address. The refunding of our foreign loans, the safeguarding of our merchant marine, the tariff, the farmers' plight, railroad rates, reclamation and an industrial court were touched on. We do not propose to discuss these recommendations, but rather to call attention to a recommendation buried near the end of the address which ranks with, or above, any of the recommendations in importance. We refer to the advisability of prohibiting by constitutional amendment the issue of tax-exempt securities. On this subject popular opinion has crystallized rapidly. Even he who runs can appreciate that the sources of prospective industrial capital have been diverted to tax-exempt public securities. What has been to the detriment of private business has tempted development by public authorities. We constantly need enlargement of public-service facilities, but the favoring of them should not be at the expense of private enterprises which, as the President well said, are the "very activities which make our wealth."

### Poor Care of Paving Mixers

MIXER manufacturers report that only one of five paving mixers returned at the season's end to be overhauled shows that it has had reasonable care in operation and maintenance. These figures tally closely with field observations of numerous paving mixers in operation. Besides indicating poor business sense, these conditions speak poorly for the technical proficiency of highway contractors. Obviously if contracting is to maintain successfully its claim to expert skill in constructing, it should be made clear by the workmanlike manner in which contractors operate and maintain expensive machines for construction. The mechanism of a paving mixer is not only extensive but it is correlated so that the various operations will co-ordinate almost perfectly. It needs but a moment's thought to realize that a machine process which by half a score of operations, takes a container of raw materials from a car or truck and places them as mixed concrete on the subgrade inside of two minutes and often in a minute and half, with one minute of the time consumed in mixing, requires precise operation and has to be tuned up to high pitch of mechanical efficiency. Certainly no mixer can be in fit condition for precise operation if it is so plastered with hardened concrete, as manufacturers in some instances report, that it has taken two men a week to clean the mechanism so that it could be overhauled. By the same token no contractor, who allows such a state of affairs to occur with expensive equipment, can justify to highway engineers a claim that he needs higher prices and more liberal specifications.

## New Highway Research Data

ANOTHER addition to the growing volume of highway research data has just been made by the U. S. Bureau of Public Roads in announcing results of the effect of impact on pavement slabs as developed by tests conducted at the Arlington experimental farm. It is clear that the bureau is following a conservative policy in the matter of drawing conclusions from results thus far obtained for the information—summarized last week—is offered with carefully specified qualifications, indicating that the complete story still remains to be told and warning against injudicious use of the results thus far secured. Nevertheless, the test results are of value even though they must be considered mainly as the foundation for later investigations. The bureau's principal highway research program, it will be recalled, involved three elements involved in the rational design of paving surfaces: First, the character and magnitude of loads to be supported; second, the resistance of various kinds of pavement under varied conditions of loading and support; and, third, the condition of support offered by the subgrade.

The preliminary results on the effect of motor-truck impact have already been reported; in last week's issue information on the second element of the problem was given; and announcement of the results of the subgrade studies is promised for the future. So definite a relation has each of these three elements to the ultimate solution that all must be further studied and correlated before workable data for design purposes may be safely used. With the recent enactment of the Federal-Aid Highway Bill, however, assurance is given of funds for continuing the federal government's research program and the publication of results.

## Viewing the Bridge as a Whole

FOR ordinary purposes of engineering planning it is sufficient to have a dissected view of the structure that is to be planned, and deal with the several parts more or less as though they existed alone. Engineering of higher character requires more than this: it rests on a comprehensive view of the structure as a unit, a view in which the interrelation and co-operation of the parts are primarily regarded as an expression of the functioning of the whole. Such a view of the steel bridge may be derived from the admirable Swiss tests on the Suldbach bridge, reported on p. 982, and for this reason they make a basic contribution to bridge and structural knowledge. They tell us much in detail about the behavior of elements of the steel bridge, but more about the behavior of the whole; and by easy extension they apply in little less than full scope to other types of steel structure.

Hitherto engineering conceptions of the bridge as a unit structure—in so far as they existed at all—have been largely based on abstract reasoning, and therefore have lacked the force of conviction that arises from practical demonstration. It has more or less always been understood that structural units which are connected (as is usually the case) by substantially rigid joints form in the aggregate a composite elastic body, which resists load attack as a whole and which is distorted and stressed throughout by every applied force. But this has been understood only in an academic way; realizing the conditions concretely from a practical demonstration is quite another thing. Only such concrete realization can give the engineer full mastery of his structures.

The pioneer engineers understood their structures as integral units, while they had but hazy knowledge of the action of its component parts. Many of their achievements still excite wonder and admiration. The modern engineer, with very precise knowledge of the action of bridge elements, has much less of the unit view, and his work commonly bears the stamp of routine, or at least of conventional solution. This is said with due recognition of the fact that modern problems are themselves mostly of routine character, and that there is not much room for originality in exploring the possibilities in the way of solution. Any comparison of pioneer and modern work, we believe, is likely to show a broader grasp of the structure or problem as a whole (though with serious faults in many a detail) than corresponding modern work. We need this broader comprehension of the bridge as well as of other works; the Suldbach tests help to give it.

From the standpoint of the American engineer, used to large-scale demonstration, it may seem inconsistent to ground so pretentious a claim upon tests made on a small, insignificant bridge. Moreover, we are bound to be surprised at finding our Swiss colleagues willing to spend so much patient and careful labor on a 63-ft. span. The results will not have the same weight as though the work had been done on a bridge four or five times as large. Yet there does not appear to be anything in the scale of the structure or its parts that would make the conclusions inapplicable to bridges of much greater magnitude. The engineer who is inclined to discount the value of the results will find it worth while, we believe, to formulate in definite terms his doubts concerning the general validity of the data before he rejects any part of them. With respect to open-top bridges certainly the general picture of distortion and stress distribution derived from this small bridge should hold with great accuracy for any other. And the engineer's judgment should enable him to transfer quite readily to the case of a bridge with top-chord bracing, and apply the experimental conclusions in suitably modified form.

Detail results, such as those bearing on continuity of the floor, transfer of chord stress through the stringers, and participation of the bottom laterals in the chord action, appear in every case to be available for general application to bridge structures of all sizes and types. It is hardly possible to ignore the transfer of moment at stringer end—connections, the twisting and lateral bending of floorbeams, the excess stress in the wind diagonals, and the extra stresses brought on the connections of all these parts, merely because the bridge was small. Doubtless the very much deeper and stiffer floor construction of American railroad bridges will alter the numerical ratio of some of these effects, but there is no present reason for believing that any of them are reduced to a negligible point. Until proof is given to this effect it will be a safe conclusion to assume that identical actions take place in our bridge floors as found over there.

When the great amount and comprehensive character of the data secured by the Suldbach tests is considered the practical possibilities of well planned research in the field of the civil engineer's structures become apparent. There is hardly a part of the civil engineering field that does not offer corresponding opportunities for fruitful investigation.

# Missouri River Banks Protected by Tree Retard

## Illinois Central R.R. Work—Current Retards of Whole Trees Tied to Concrete Piles Cause Protective Silting

RAPID bank erosion of the Missouri River north of Omaha, Neb., with threatened injury to the line of the Illinois Central R.R., made it necessary for the railway company to take steps early in 1921 for the protection of its property. Checking the current along the bank in order to stop erosion and to promote silting was the method of protection adopted. For this purpose spur dikes or current retards of a patented

FIG. 1. PLANT FOR BUILDING CURRENT RETARDS

type were placed extending from the bank. These consist of whole trees laid as floating mattresses attached by cables to concrete anchor piles.

This protective work was applied at two points, as shown in Fig. 4: (1) For about 750 ft. on the west bank directly north of the Council Bluffs bridge, where the river threatened to cut a channel under the bridge approach; (2) on a stretch of about two miles of the east bank, at a bend known as the Narrows, this work beginning about three miles above the bridge. The location and spacing of the retards are shown on the plan. With the construction of the first retard the silting above the bend was so rapid that the next two proposed retards were omitted. Closer spacing was required where the current struck the bank below the

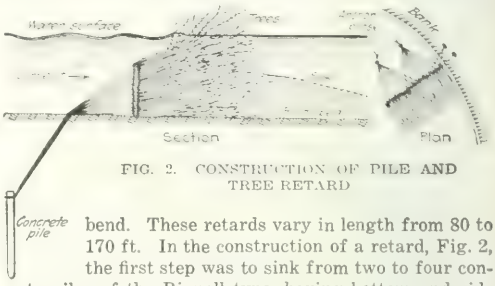



FIG. 2. CONSTRUCTION OF PILE AND TREE RETARD

bend. These retards vary in length from 80 to 170 ft. In the construction of a retard, Fig. 2, the first step was to sink from two to four concrete piles of the Bignell type, having bottom and side outlets for water jets, as described in *Engineering News-Record*, June 23, 1921, p. 1078. The piles were 14 x 14 in. in section, 20 ft. long, weighing about 5,000 lb., and were shipped on barges from Omaha. They have a minimum penetration of 60 ft. below normal water level, the deepest penetration in this case being 96 ft. Thus the pile heads are from 30 to 70 ft. below the river bed, the piles serving only as anchors for the 1-in. and 1½-in. cables which hold the floating retard in place about 100 ft. below the anchorage. Each pile has from six to ten cables run through holes near the heads. The piles are spaced 37½ ft. c. to c., the first pile 20 ft. from shore and the outer pile in 10 to 30 ft. of water.

Trees 40 to 90 ft. high, with 10- to 36-in. butts, were cut along the river bank and loaded on barges to be towed to the site by a steamboat. With the barge moored in position, the butts of a group of 15 to 25 trees were stapled to a ⅜-in. cable, such groups then attached to the anchor cables and hauled off the barge.

A sternwheel steamboat about 112 ft. long was used

FIG. 3. ANCHORED TREE TOPS CUTTING OF BANK AT ILLINOIS CENTRAL R.R. BRIDGE

for this work, having a 35-ft. A-frame or derrick at the bow to handle the piles (see Fig. 1). This boat with a crew of 14 men could sink ten piles to a 90-ft. depth in a ten-hour working day. In connection with the boat there was a gang of 10 to 20 men cutting trees and hauling them onto the barge; also a gang of 8 men with a hoist building the trees into rafts on one barge while the steamboat was towing a second barge. Two steamboats were used on part of the work.

Silting above the retards is slow, particularly during the first twelve months. Below the retard the silting is rapid, varying with the amount of sand which the river is carrying at the time. In a week after completion of a retard there was often a fill averaging 10 ft. deep, 100 ft. wide and 800 ft. long (see Fig. 5). A retard 150 ft. long could be built in about two weeks.

Difficulties were encountered in some parts of the work. Retard No. 1 (see plan, Fig. 4) was intended to close the chute channel beginning above the Pigeon drainage ditch and extending along the east bank, since this chute would ultimately deflect the river towards the east bank. Ordinarily this chute carries a large part of the main flow of the river, but in the spring of 1921 there was not as much water as usual, so that retard No. 6 was the first to be built. In the meantime the river rose to its usual spring stage and the chute scoured out to a depth of 10 to 35 ft. Retard No. 1 was then built as quickly as possible and within a few days after its completion the silting had shut off the water. Quick work had then to be done to complete Nos. 4 and 5 before the chute ran dry.

As soon as these last two retards were built the silting below them proceeded rapidly, so that great efforts were required to complete Nos. 7 to 10 before the sand bars below grew to such proportions as to exclude floating equipment. When these had been completed the railway engineers ordered work transferred to retards Nos. 11 to 13, for the protection of the west end of the bridge. These were 75 to 150 ft. long and the work was accomplished easily, as the main channel of the river was flowing against the bank. After the bridge had been thus protected, retards Nos. 14 and 15 were built on the east bank. Fig. 3 shows one of the retards placed to stop the cutting at the bridge, one of the girders of which is indicated by the dark line at the left.

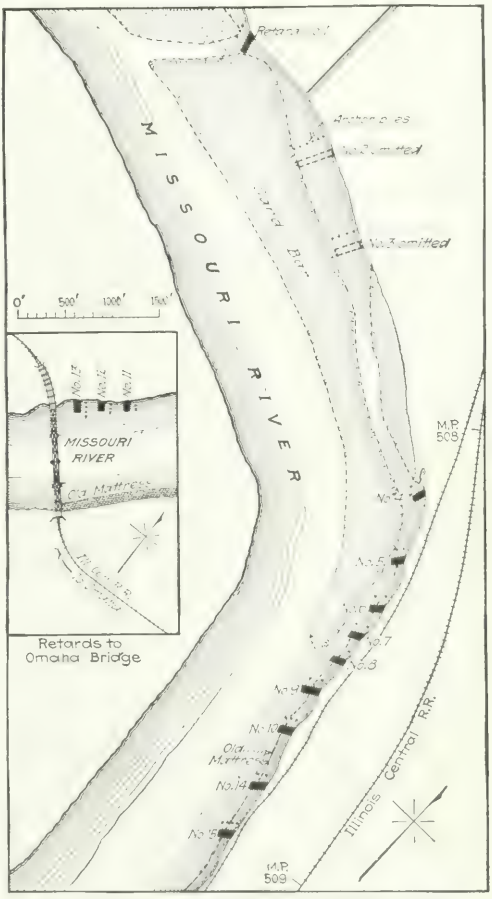



FIG. 4. CURRENT RETARDS ON MISSOURI RIVER

No longitudinal protection is placed between the outer ends of the retards, but the silting extends far beyond them, sometimes forming a bar 800 or 1,000 ft. wide (Fig. 5). In future high water stages, part of the

FIG. 5. EXTENSIVE SILTING CAUSED BY CURRENT RETARDS. FOUR RETARDS INDICATED BY WHITE CHECK MARKS

[illegible] may be washed away, but as the fill between them was deposited at such stages it is not considered probable that it will be affected by future high water. An old mattress along a part of the east bank and extending to the bridge, as shown in Fig. 3, is of ordinary woven brush construction covered with hard red sandstone, but it is in poor condition.

This bank protection work, comprising about 1,500 lin.ft. of retard with 30 anchor piles, was built between May 4 and Aug. 23, 1921. It was done under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.; C. C. Westfall, engineer of bridges, and C. Chandler, assistant bridge engineer. The contractor was the Woods Brothers Construction Co., Lincoln, Neb., which owns the patents on the Bignell pile and on this "Standard" system of retard construction. Wayne Pringle, chief engineer of the company, was in charge.

## New Precise-Leveling Tripod

By J. D. Crichton

[illegible]

IN RUNNING long lines of leveling of high precision the practice of the U. S. Coast and Geodetic Survey has been to have the line follow a railroad right of way and use inspection motor cars or "speeders" as means of transportation. In order to reduce the unit cost of this work the instrument tripod was mounted on an inspection car, thereby eliminating the time necessary to set up the instrument. This arrangement proved to be practical and efficient and has been used in running about 5,000 miles of high-precision leveling. Its efficiency was still further improved by using a second inspection car to carry an adding machine on which the rod readings were recorded directly.

An offset to the advantage of the adding machine for recording purposes developed through systematic accumulation of discrepancies of the same sign between differences of elevations. This accumulation called the "backward minus forward divergence" (abbreviated $B - F$), is the sum, having regard to sign, of discrepancies between backward and forward runnings for a complete line or loop. It is the same value for the whole line as the closure error if the line were run forward through its whole length and backward to the starting point. The aim, of course, is to have the sum total of the discrepancies small. As mentioned above, the use of the second car to carry the adding machine apparently caused a systematic $B - F$ accumulation of negative sign. It was found by experiment that if the second car was ahead of the observing car during half the distance and following it the other half, the $B - F$ curve remained close to zero. This procedure however, did not eliminate errors in sections of the line.

Efforts to remove this troublesome feature took the form of a close analysis of the program of observing, together with experiments performed in the field. The results indicated that the apparent cause was that the line of sight was refracted in passing over the second car, particularly when the line passed close to the recorder's head, as was often the case. To clear the line of sight in passing over the second car, therefore, appeared to be the means of eliminating the difficulty.

On this hypothesis an inclined or overhanging tripod was devised such that the vertical line through the center of the tripod head was about 8 in. outside of the inspection car. The recorder and the adding machine were placed on the opposite side of the second car. The illustration shows the clearance to the line of sight and the appearance of the tripod as used.

About 140 miles of high-precision leveling were run with this arrangement with the second car always following, this being the most convenient relative position of the cars. The $B - F$ divergence curve crossed zero five times and reached a maximum value of eleven millimeters and a final value of eight millimeters. No systematic tendency of the $B - F$ divergence to increase appeared. The ease of manipulation of the instrument mounted on this tripod proved greater than with the old arrangement.

PRECISE-LEVELING INSTRUMENT ON TRIPOD ON RAILWAY "SPEEDER"

The small amount of work done with the overhanging tripod furnishes little evidence on which to judge its merits, but the results available at this time show promise of superiority over the centrally-mounted tripod.

### To Reargue Wyoming-Colorado Water Case

The U. S. Supreme Court has ordered a rehearing of the Wyoming-Colorado water case Jan. 3, 1922. It is a case in equity brought Jan. 11, 1918, by Wyoming against Colorado to enjoin a diversion of water from the Laramie River, an unnavigable river rising in Colorado and flowing into Wyoming.

In this action, according to the November *Reclamation Record*, Wyoming seeks to uphold the claims of certain of its citizens to water rights under the doctrine of prior appropriation without reference to state lines. Colorado contends that all water within its boundaries belong to the state and its people and that the claims of its citizens are in no way subject to the earlier diversions in another state. The government intervened and asserts that all of the rights to the use of water on the arid region secured in accordance with local laws and customs come by government grant alone under the act of 1866 and subsequent acts, state legislation being a mere instrumentality for carrying out the purposes of those acts, that the rights to unappropriated water shall remain in the United States, wholly free from state control and that the rights of prior appropriators are not affected by state lines. An article on "Interstate Water Conflicts" by R. I. Meeker, appearing in *Engineering News-Record*, Jan. 27, p. 157, was followed by a symposium May 5, p. 755, to which a number of representative western engineers contributed.

# The Status of the Warren Company's Pavement Patents

Since Expiration of Basic Bitulithic Patent Last Year the Wallace Patents for a "Composite Pavement" Have Been Featured — Prior Art Reviewed

WHAT is the status of the Warrenite-Bitulithic paving patents?

Judged by the inquiries which *Engineering News-Record* receives, from time to time, this question is puzzling many highway engineers, particularly in view of the fact that the basic Warren patent (No. 727,505), covering the grading of the mineral aggregate to produce "inherent stability" in the so-called Bitulithic type of construtcion, expired last year. Nevertheless, the Warren Bros. Co., with headquarters in Boston and district offices in 14 other cities, is active in the highway building field, particularly in the Southwest and on the Pacific Coast, and is now featuring a "composite pavement," under the name of Warrenite-Bitulithic, covered in patents granted to Edwin C. Wallace, in which two courses of mixed bituminous composition—a relatively thick base containing graded stone and a thin top course or seal coat of what amounts practically to a sheet asphalt surface mixture—are laid separately, *without compression*, and then compacted *simultaneously* by rolling, so as to produce what is claimed to be an "integral mass." In fact, the outstanding claims of the Wallace patents relate to the simultaneous compression of the upper and lower courses of the pavement, the effect of which, as variously described in the several patents, is to "anchor" and to "lock" the two courses together, the thin upper course rendering the pavement impervious to the elements and the lower course, being "possessed of rigidity," acting as the main body of the pavement. The details of the several Wallace patents will be set forth more fully later in this article.

## The Old Warren Patent

It would seem advisable, in the interests of a fuller understanding of the status of the patents covering this type of construction, to go back to the old basic Warren patent and make note of such new developments as have occurred. Under the early patents the Warren company was continually engaged in a widespread campaign of propaganda, both by printed word and personal emissary, with the result that a large yardage of Bitulithic and Warrenite pavement has been constructed —70,386,588 sq.yd. in the 19-year period from 1901 to 1919, according to the company's figures. The old patent was the subject of a tremendous amount of litigation, but in the end the Federal Courts sustained its validity. Scores of city and state highway engineers, contractors, chemists—in fact, experts in every branch of the paving and allied industries—have testified at one time or another in cases involving the Warren patents.

The basic Warren patent under which such a large volume of highway construction was done until a year ago carried United States Patent Office No. 727,505, dated May 5, 1903. It was granted to Frederick John Warren, of Newton, Mass., whose application was filed May 16, 1901 (Serial No. 60,450), and in accordance with the law which grants a 17-year term to the life of a patent, expired May 5, 1920. While the Warren interests have taken out, or acquired, a host of other patents covering paving materials and processes in great detail, No. 727,505 was the one which covered the mineral aggregate grading commonly used in the Bitulithic type of construction and involved the widely advertised claim of "inherent stability." It was this patent which served as the foundation for building up the Warren company's business to its present large proportions, but for the purpose of this review, inasmuch as the patent has expired and may, therefore, be used without liability of suit for infringement by any one who desires to construct a pavement of this type, attention may more profitably be directed to subsequent patents which are still operative and under which the Warren company is now doing business.

## Later Patent Developments

A search of the records of the United States Patent Office discloses the fact that the Warren Bros. Co. has taken great precautions in an endeavor to exclude the possibility of encroachment upon its field, for no less than 52 patents have been granted to individuals of that organization or acquired by them. While this list includes a few patents relating to asphalt and wood blocks, a waterproofing process, bituminous shell roads, and a reinforced-concrete wall, the bulk of them deal directly with equipment or construction methods, manufacturing processes or materials involved in bituminous-type pavements. Of this number, 24 patents have expired and the remaining 28 are still in force. From this imposing list four patents may be cited as the ones which have the most direct relationship to work now under the Warren specifications. All of these four were granted to Edwin C. Wallace, of East Auburn, Cal., from whom control has passed to the Warren organization. The numbers and dates of these patents follow:

| Patent No. | Date Granted | Application Filed |
|---|---|---|
| 959,976 | May 31, 1910 | June 28, 1909 |
| 1,115,259 | Oct. 27, 1914 | Nov. 23, 1910 |
| 1,183,506 | May 16, 1916 | March 4, 1910 |
| 1,183,507 | May 16, 1916 | May 21, 1910 |

In all of these patents the claims, in general, cover a "composite pavement" consisting of two courses, the upper one being a thin layer of bituminous material and fine mineral aggregate, and the lower layer of coarse-graded asphaltic concrete. It is essential, according to the patent claims, that the lower course be *not* consolidated prior to the application of the top course or seal coat. The two courses must be simultaneously compacted in order that the two, according to the language of the patent claim, may be "blended and bonded," and "made a compact and substantially integral mass which is densest at its top."

The claims in each of the foregoing patents are briefly summarized below:

*No. 959,976.*—This patent covers "improvements in composite pavements" and provides for a lower course of mixed bituminous concrete covered, before compression, with a thin layer of fine-graded bituminous topping, the two layers then being compressed simultaneously so as to bond the two layers into one and produce a compact, rigid mass, densest at the top.

*No. 1,115,259.*—The claims, here, are for a two-course

pavement with a relatively hard bituminous cement in the lower course and a relatively soft bituminous cement in the upper course. By the use of large mineral bodies "fissures" are produced in the lower course and into them the material of the upper course is compressed, anchoring the two courses and preventing creeping of the wearing surface.

*No. 1,183,506.*—Here the lower course is constructed by the penetration method, instead of the mixed method described in the other patents; otherwise the process is essentially the same as already described.

*No. 1,183,507.*—This covers an improved process for wearing surfaces and specifies the following construction details: A bottom course of crushed stone from 1½ to ½ in. in size with enough fine matter to regulate the voids within limits of 22 to 28 per cent and a sufficient quantity of bituminous cementing agent to coat the mineral aggregate without filling the voids. The top-course mixture consists of bituminous cement and fine mineral aggregate, passing a screen with 6 meshes to the inch. The top course is "loosely spread" upon the lower course, before the latter has been compressed and the two are then simutlaneously compressed by rolling to secure "an intimate locking of the upper and lower layers."

From the foregoing it is clear that the Wallace patents produce a pavement which is closely analogous to a very thin sheet asphalt surfacing on a close binder, the top layer being generally about ½ in. thick. It will be noted that in all of the foregoing patents one of the main features is the one providing for the interlocking of the two courses, laid originally without any compression, by rolling simultaneously.

### Specifications

Based on these patents the Warren company has issued the following specifications covering an "improved method of laying wearing-surface mixtures," which are quoted from p. 53 of its booklet entitled "A Decade of Improvements in Warren Pavements":

"On the foundation prepared as hereinabove specified, shall be laid the Warrenite-Bitulithic wearing surface described below, so as to have a thickness of 2 in. after thorough compression.

"The wearing surface shall be a mixture of (1) mineral aggregate and (2) bituminous cement.

"*Mineral Aggregate:* Shall be composed of hard, crushed stone or clean, sound gravel, for the coarse material combined with sand (or a mixture of sand and screenings) for the smaller sizes. The size of the particles of the aggregate shall vary from the maximum (about one-half of the thickness of the wearing surface) to impalpable powder.

"The different sized particles of aggregate shall be combined in such proportions as to secure in the mineral aggregate density or low percentage of voids and a useful degree of inherent stability or resistance to displacement.

"If the crushed stone or gravel and sand do not contain enough finely divided particles or impalpable powder to produce a low percentage of voids in the aggregate, the deficiency shall be made up by the addition of any other suitable fine mineral matter.

"*Laying:* The mixture and ingredients thereof shall be maintained at a temperature consistent with good work-

"The mixture when reaching the street shall be hot enough to allow being easily spread and raked and shall

"The coarse mixture shall be placed with hot shovels or forks and shall then be spread with hot rakes. Immediately after the said mixture has been spread and before it has been compacted in any manner, it shall be covered with a mechanically mixed, rich, glossy, bituminous surfacing mixture composed of Bitulithic cement and mineral aggregate not larger than ¾ in. in diameter, except on grades where a coarser aggregate may be used. This mixture shall be spread at the rate of 30 to 50 lb. per square yard and, depending on the sizes of the aggregate, shall contain from 8 to 12 per cent of bitumen soluble in carbon bisulphide.

"*Rolling:* Immediately after spreading the mixtures as described above, the pavement shall be thoroughly compressed by use of 10 to 12-ton, three-wheel, self-propelled rollers. The rolling shall be continued until no roller marks appear."

### Advantages Claimed

In its printed literature the Warren company points out the advantages of its "improved method of laying wearing surface" mixture in the following language:

"Appreciating that, under the old flush-coat method of application of sealing coat, about 80 per cent of the aggregate, spread over the seal coat bitumen to a depth of about ¼ in., is generally ground to powder and washed, blown or swept from the pavement surface, and therefore not available for subsequent wear, we have devised a new and better method of laying the wearing surface mixture, which method not only eliminates the waste of flush-coat materials referred to, but also produces a surface more impervious to the elements than can possibly be obtained under the old flush-coat method.

"The present method consists of first spreading the wearing surface mixture in the usual manner, then, before this has been compacted in any manner, immediately spread over same, a rich bituminous mixture of fine aggregate which is then immediately rolled thoroughly, thus forcing a portion of this fine, rich mixture into the spaces between the uppermost stones of the wearing surface mixture, and also compresses the two mixtures together, so as to produce one compact, integral mass, without any line of cleavage between the two mixtures.

"This produces a pavement surface consisting of a true bituminous concrete having the advantages of great density and inherent stability of the aggregate and also the added advantage of having the surface thoroughly protected from the elements by a thin surfacing of very rich, dense, resilient bituminous mixtures.

"On account of the above mentioned fine mixture being tied into and bonded with the coarser mixture by the rolling, it is possible to make the fine mixture much richer in bitumen than would be practicable with other forms of bituminous pavements, without causing 'shifting' or 'rolling' of the surface. This is a particularly valuable feature of the improvement, because the life of the structure as a whole is considerably lengthened by the protection given to the stone by this plastic, resealing surface."

### The Prior Art

It is now in order to inquire into the prior art—that is, what materials or processes similar to those covered by Wallace were in use or patented prior to the filing of the Wallace applications on June 28, 1909, and thereafter.

On May 18, 1880, the United States Patent Office granted to Davis W. Bailey, of Chelsea, Mass., patent No. 9,207 (reissued) for "composite or concrete pavements"—the term "concrete," in this instance, covers a bituminous, not a portland cement, concrete form of construction. The Bailey patent specifies a three-course pavement, the lower layer of which, however, is essentially a broken stone foundation which need not be considered in a comparison with the Wallace patents. Upon the foundation course is deposited, according to the description in the Bailey patent, a 2½-in. layer of large stones to which a bituminous composition is subsequently applied by pouring, and upon this layer is deposited a 1½-in. layer of a fine-graded asphaltic mixture. The important steps in the process are thus stated:

"Upon this foundation thus acquired I deposit a second

stratum, about 2½ in. thick, of stones of a more uniform size and of from ½ to 2½ in. in diameter, subsequently pouring upon them a quantity of a heated mixture composed of coal tar, asphalt, and oil of pitch, the latter of which is a refuse residuum in the production of resin. Upon this last mentioned deposit of stones smeared and cemented together, as explained, I dump and distribute a layer, about 1½ in. deep, of concrete composed of fine gravel, coarse sand and sifted coal ashes, mixed with a composition of asphalt, coal tar and oil of pitch. . . .

"After having solidified and condensed into a smooth surface the two stratums of stones and composition by the employment of a heavy roller, I apply to such surface a combination of dry fine sand. . . ."

It will be seen that the patent does not expressly state that there shall be only one rolling, but the inference may well be drawn that there is no compression prior to placing the top-course material. Nevertheless, that there may be no misunderstanding, it should be pointed out that the details of applying compression do not seem to be of the essence of the Bailey patent.

Apparently the chief difference between the top courses of the Bailey and of the Wallace patents lies in the fact that Bailey specifies for the mineral aggregate "fine gravel, coarse sand and sifted coal ashes," while Wallace provides for a "mixture produced by commingling sand or crushed screenings (comminuted stone) or both with sufficient bituminous or asphalt cement to form a homogeneous mass." Bailey's mineral aggregate grading for the top course appears, therefore, to be coarser than that of Wallace.

### Two Other Patents

Further inquiry into the prior art discloses two other patents which may be cited. The first, No. 797,404, dated Aug. 15, 1905, granted to George W. Crichfield, of Jersey City, N. J., and William T. S. Crichfield, of New York, N. Y., was for a "monolithic" pavement formed of asphalt blocks; the application was filed Dec. 20, 1904. The second, No. 958,063, dated May 17, 1910, was granted to Joseph Hay Amies, of Philadelphia, for a bituminous concrete surface pressed into a concrete base; the Amies application was filed Feb. 20, 1909.

The Crichfield patent covers a pavement consisting of individual blocks, each made up of two layers of bituminous material of different composition "permanently or inseparably joined together by pressure when in hot, plastic condition." The essential feature of the Crichfield block is a relatively elastic upper stratum or wearing surface and a relatively rigid lower stratum or base. It is true that an essential difference between the Crichfield and the Wallace pavements is that the one is composed of separately molded blocks, while the other is a continuous, integral surface. But an examination of the two patents indicates a great similarity in the general principle of joining the two layers. "Each of these blocks," says Chrichfield, "comprises a base or binder of firm, rigid composition and a wearing surface of a high degree of elasticity, thoroughly and inseparably joined to the base so as to form of the two layers a solid single block." The base course consists of a mixture of hard stone, graded from a 1-in. size down to an impalpable powder, and pure bitumen. The top course consists of a graded sand aggregate and asphaltic cement.

In forming the blocks the two compositions above noted, constituting, respectively, the base and the wearing surface of the pavement, are placed in separate molds, the molds are then superimposed so that the two compositions, in plastic form, lie one above the other. The compositions are then "subjected to extreme pressure tending to force the two layers together," causing them "to adhere firmly and inseparably, forming a solid block." The *form* of applying the pressure obviously differs from that of Wallace, but the result aimed at in each case is a thorough union between the upper and the lower layers of material.

In the Amies patent a pavement is produced by pressing an asphaltic stone mixture into a soft concrete base before the concrete has attained its initial set. In describing his process Amies says:

"This composition, . . . I now spread over the portland cement concrete which I have just laid and before the initial set of the concrete aforesaid can begin, I roll or otherwise compress the bituminous composition, . . . into the soft concrete. I continue this compressing until the bituminous composition is well pressed into the concrete . . . and comes almost to a level with the face thereof."

### English Road "Double-Sealed"

Finally, there needs to be quoted a portion of an article entitled 'Homogeneous Double-Sealed Road Construction," by Frank Latham, Member, Institution of Civil Engineers (London), and borough surveyor of Penzance, which appeared in *Engineering News*, June 17, 1909, p. 675 (condensed from the "Surveyor," London, April 23, 1909). It describes a form of two-course bituminous road construction, developed in 1902, as follows:

"I, therefore, followed up my earlier practice of grouting in the foundation with the preparation of tar compound and upon this sealed foundation, as it now became, I laid 4 in. of fine tar concrete made from the screenings from the stone breaker. *While this layer of tar concrete was quite loose*, it was sprinkled with lias lime and the clean machine-broken stone, broken to 2¼-in. gage, was spread over to a thickness of 3½ to 4 in. and rolled with a 10-ton steam roller. The rolling was conducted quickly at first so as to arrange the layers, and when the road was fairly well formed fine tar concrete was lightly thrown over the surface and brushed into the voids which remained, the whole being then rolled to completion without water. . . . Rolling has been found to be reduced by the adoption of this system. The first, or foundation, seal renders the superincumbent stratum of tar concrete sufficiently mobile to work and squeeze up into the interstices of the macadam stone, hence the layers are arranged; and on completion the whole structure, from the tar blinding (*sic*) of surface voids to (and into) the foundation is rendered homogeneous and free from any dust-producing substances. A road so made is quite waterproof and motor wheels cannot force up the dust from under the macadam coating."

It is apparent that the object here intended is different from that sought in the Wallace patents, but the idea of intimate incorporation of two layers by simultaneous rolling of both is here recognized.

### Conclusion

To highway engineers the chief point of interest in the patent situation reviewed in this article lies in the advantages, if any, in improved road construction actually secured by the simultaneous compacting of the layers of material forming a two-course pavement. The general principle of a seal coat, of course, was recognized long before the filing of the Wallace claim in 1909. The present inquiry, therefore, suggests two questions for the consideration of highway engineers:

Is the single-rolled pavement of the general type cov-

ered by the Wallace patents superior to one double-rolled or otherwise sealed?

If it is superior, have highway engineers, in their practice prior to 1909, actually built pavements in which the principle of the simultaneous compression of two layers of material was employed?

No matter what the answers to these questions may be, the inquiry in this article lays before engineers the salient facts concerning the claims of the patents under which the so-called Warrenite-Bitulithic pavements are being laid. There is now before the U. S. District Court in California a suit for infringement of the Wallace paving patents brought by Warren Bros. Co. and involving Thompson Bros., contractors and Fresno County. At this writing no decision has been rendered.

# Fire Tests of New Post Cap for Mill Construction

## Timber Columns Fitted With Reinforced-Concrete Cap Resist Fire Twice as Long as Columns With Standard Steel Cap

By George B. Muldaur
Underwriters' Laboratories, Chicago

In THE elaborate fire tests of bare and protected building columns summarized by R. E. Wilson in *Engineering News-Record* of July 21 and 28, pp. 106 and 145, it was found that timber columns stand up under severe fire exposure longer than do unprotected metal columns. However, in all cases the action of the column cap accelerated the failure of the wooden column.

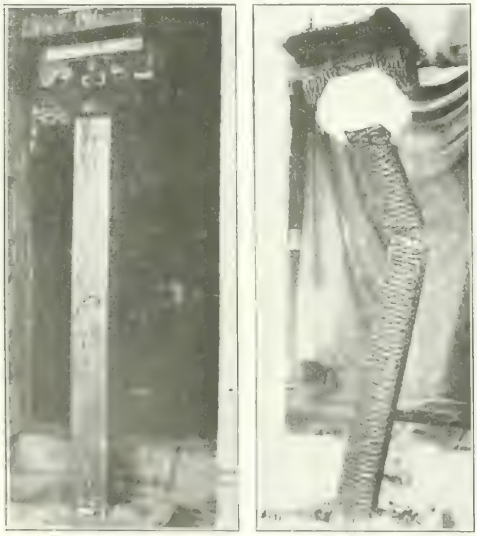


FIG. 1 AND 2. TIMBER POST 12 x 12 WITH CONCRETE CAP BEFORE AND AFTER FIRE TEST

With either cast-iron or steel-plate post caps such as are commonly used in slow-burning mill-construction buildings, Mr. Wilson reported "the full fire resistance of the column itself is not developed" because failure occurs in the metal cap through excessive heating, crushing and brooming of the fibers, followed by slipping or failure of the cap.

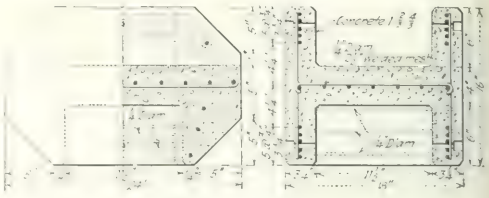


FIG. 3. INGBERG CONCRETE COLUMN CAP

With a better form of column cap, it appeared, timber construction would show even greater superiority in fire resistance to unprotected steel or cast iron framing. S. H. Ingberg, of the Bureau of Standards, subsequently designed a reinforced-concrete post cap, and at the initiative of the National Lumber Manufacturers' Association a series of fire tests of posts fitted with the new cap has been carried out by the Underwriters' Laboratories, Chicago. The results justified the expectations. The concrete post cap proved itself able to develop the full strength of the timber column, and thus to double the length of fire resistance of timber mill construction. It should be added here that Mr. Ingberg has patented his form of cap and has assigned the patent to the public.

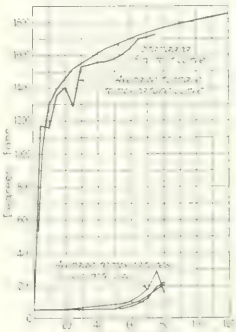


FIG. 4. HEAT INSULATING EFFECT OF CONCRETE CAP

From the previous tests it had been found that 12 x 12 timber posts failed in the high-temperature fire of the test furnace after 35 to 50 min. Check tests of posts of smaller section with steel caps made in connection with the new series tests gave similar results (four tests showed failure after 25, 45, 38, and 42 min.). With concrete caps, on the other hand, six 12 x 12 in. columns stood up for 84, 78, 108, 98, 94½, and 112 min., respectively. In no case did the cap fail or cause premature failure of the column; all the columns carried their load until the body was sufficiently weakened by the burning to fail, whereas in every test with steel caps failure occurred in the cap, as previously mentioned. The effect of the concrete cap is reflected in the readings of thermocouples embedded in the interior of the cap, recording the temperature at the middle of the end face of the post where seated in the cap. With steel caps the temperature at this point rose to 685 deg. F. during the tests, while with the concrete caps the maximum temperature reached was 195 deg. F. (see the temperature curves Fig. 4).

The tests were made in the special column-test furnace of the Underwriters' Laboratories, used also in the prior tests, as described in Mr. Wilson's article. Its interior, or combustion chamber is 7 x 7 ft. in horizontal dimensions by 12 ft. high. A hydraulic jack above the furnace is capable of applying loads up to 545,000 lb. to a member contained in the furnace. The four tests with

steel column caps were made on short posts, about 24 in. long. The concrete caps were tested on a similar short post in one test and on full-length 12 x 12 posts, 10 ft. 10 in. long, in six tests. The result obtained with the short posts is not included in the figures given above for the resistance periods with concrete caps, but as it was greater than any of the others, 124 min., its omission is on the safe side.

In one of the tests the lateral thrust developed by the column at the moment of failure resulted in cracking and breaking the concrete cap. This was not a primary failure of the cap, however, nor did it produce or contribute to the failure of the column. The caps carried no girder loads in the tests, as they would actually.

It should be borne in mind that any conclusions drawn from the test will be valid only for reinforced-concrete caps made in strict conformity with the specifications used in making the caps for these tests. The special mixture of concrete and the design of the reinforcement are factors to be considered.

## Studies in the Life of Equipment

By Edwin Kurtz
Assistant Professor, Electrical Engineering, Iowa State College

THE term "life" when used to denote the length of the useful period of existence of a unit of property has indeed had many interpretations. It is apparent at once that when the life of a given unit is being referred to, little difference of opinion should exist, for the life of a given individual unit is generally fixed.

It is when the term "life" is applied to a group of similar units, of to a given type of equipment that differences of opinion arise. To illustrate, take the life experience of poles tabulated in column 1 of Table I. The data there show how many poles are removed each year, assuming that all were put in service at age zero.

*The Mode.*—Some will contend that the useful life of the pole life there summarized is the time between zero age and that age at which most replacements occur. Referring to the table, the percentage of poles replaced is greater in the tenth year. This age is often called the most probable after-life time. Its statistical name is the "mode."

*The Median.*—Others are of the opinion that the period between zero age and the time when only one-half of the units are in service is the life of such a group of units. It represents the number of years that a unit has an even chance of continuing in service. This would also be 10 years for the data in column 1. The technical name for this function is *Vie Probable*, and its statistical name is "the median."

*Curtate Expectancy.*—It is obvious that the mode and the median cannot be of much value nor possess much significance as far as the whole group is concerned, because no account is taken of the units as a whole. The mode merely concerns itself with the year during which replacements are a maximum and pays no regard to the general distribution during the other years. The median likewise is determined wholly by the 50 per cent point on the mortality curve and also fails to take into account the distribution before and after that time. The "life expectancy" is a much more accurate means of representing the life of a given type of unit. By this term is meant the average number of years, which units of a given age will survive.

To evaluate this quantity the data in column 1 are sufficient. Let the percentages represent units so that column 1 summarizes the life of 100 units. Then, to determine the average after-life time find the sum of the products of age multiplied by the number of units removed during that year. This sum represents the total unit-years lived by the 100 units.

The average number of years each unit can therefore be expected to live is this sum divided by 100. For the data in column 1 the sum of all the products is 993.1 and the expectancy at age zero is 9.931 years.

*Complete Expectancy.*—The curtate expectancy, however, takes no account of the time lived by each unit in the year of replacement. If the removals are uniform during the year each unit will live one-half year additional to the expectancy obtained above, making the complete expectancy 10.431 years. The complete expectancy therefore differs only in that it is greater than the curtate by one-half year.

TABLE I—PER CENT OF POLES REMOVED EACH YEAR

| Age (Years) | Column I | Column II | Column III |
|---|---|---|---|
| 0 | 0.1 | 0.5 | 0.0 |
| 1 | 3.3 | 1.7 | 1.0 |
| 2 | 2.2 | 4.2 | 3.0 |
| 3 | 2.6 | 5.6 | 0.4 |
| 4 | 6.3 | 6.8 | 2.1 |
| 5 | 1.4 | 7.4 | 3.5 |
| 6 | 4.1 | 7.5 | 9.8 |
| 7 | 9.0 | 7.8 | 7.7 |
| 8 | 9.3 | 8.4 | 15.2 |
| 9 | 5.3 | 8.0 | 9.1 |
| 10 | 15.0 | 8.3 | 2.2 |
| 11 | 6.7 | 6.2 | 6.8 |
| 12 | 9.8 | 5.8 | 9.2 |
| 13 | 10.4 | 5.5 | 3.5 |
| 14 | 0.9 | 3.9 | 5.9 |
| 15 | 0.3 | 3.5 | 4.8 |
| 16 | 2.4 | 3.0 | 5.1 |
| 17 | 6.0 | 2.8 | 1.9 |
| 18 | 0.8 | 1.9 | 0.4 |
| 19 | 0.0 | 0.7 | 1.3 |
| 20 | 1.6 | 0.3 | 5.5 |
| 21 | 0.7 | 0.14 | 1.6 |
| 22 | 0.8 | 0.04 | |
| 23 | 1.0 | 0.02 | |
| 24 | | | |
| | 100 | 100 | 100 |

Table I, column 1 summarizes the life experience of 309 poles as found by the Milwaukee Electric Railway and Light Co. The poles were set in dirt. Replacements were due to butrot, bad condition, accidents, too short, and civic improvements. (Data compiled March, 1917.)

Column 2 summarizes the experience of 1,372 wooden poles of the Electric Company of Missouri for the years 1910-1915 inclusive. Of these 1,372 poles, 42 per cent were removed because of butrot, 31.2 per cent because they were too short, 0.8 per cent because they were not heavy enough, 0.6 per cent because of accidents, and 25.4 per cent because of street or civic improvements.

Column 3 summarizes the experience of 248,707 wooden poles as found by *Geh. Ober-postrat Christiani*, Berlin, and published in the *Archiv Fur Post* and *Telegraphie* Nr. 16, August, 1905. The statistics go back for the North-German and even the Prussian telegraph systems to 1852. Poles were treated as follows: Copper sulphate, 89.9 per cent; zinc chloride, 0.4 per cent; dead oil of coal tar, 3.0 per cent; corrosive sublimate, 5.5 per cent.

TABLE II—LIFE STATISTICS ON TELEPHONE POLES

| | Column I | Column II | Column III |
|---|---|---|---|
| Mode | 10 | 8 | 8 |
| Median | 10 | 9.0 | 10 |
| Curtate expectancy | 9.93 | 8.8 | 10.5 |
| Complete expectancy | 10.43 | 9.3 | 11.0 |

The several means described above of defining average life are tabulated in Table II.

# Monolithic Concrete Grain Elevator Poured In Two Weeks

**580 Special Steel Moving-Form Jacks Fabricated—100 Men Kept Busy Jacking—Concrete Material Handling Unique—Capacity 2,000,000 Bushels**

IN THE construction of the New York State Barge Canal grain elevator on Gowanus Canal, New York City, the contractor poured the storage bins, which are 94 ft. 8 in. high and cover a ground area 408 ft. in length and 69 ft. 4 in. in width, out to out of bin walls, in thirteen days of two shifts each. Pouring on the bins began Sept. 27 and on Oct. 9 they had been poured to their full height. That part of the structure upon which the moving-form method of construction was employed, extends from the top of the bottom slab of the bin to the bottom of the slab overlying the bin, and was poured as a monolith, an average force of 300 men being employed, one-third of whom were divided into three gangs that did nothing but jack up the sliding forms. The elevator is a terminal elevator built by the Fegles Construction Co., Minneapolis, for the New York State Barge Canal, and has a storage capacity in its 54 tanks, its 34 inner spaces and its 37 outer spaces or quarter bins, of about 2,000,000 bushels.

The circular storage bins are 20 ft. in diameter, set on 24-ft. centers, are 95 ft. high and are capable of storing 25,000 bu. each. The inner spaces have capacities of 16,000 bu. each, and the outer spaces of 4,000 bu. each. There are five main elevating legs of 30,000 bu. capacity, each, three marine legs of 25,000 bu. capacity, two of which legs are being put in now, the third reserved for future installation. The elevator will also have two marine tower lofters of 35,000 bu. capacity, three gallery lofters of 35,000 bu. capacity and one dryer leg of 15,000 bu. capacity.

The foundation underlying the elevator was put in by the Raymond Concrete Pile Co., New York City. It consists of a 3½-ft. reinforced-concrete mat resting upon wooden piles driven at an average centering of 2 ft., with pile clusters being driven beneath columns. Fig. 2 shows the position of piles, columns, mat reinforcement and the details of the foundation underlying the elevator columns.

The bins are 8 in. in thickness made of a 1:1.6:3.2 concrete mixture. Concrete in the columns, the mat and the slab is of a 1:2:4 mix. The reinforcement in the body of the bins is circumferentially placed flat bars on 1-ft. centers. For the first 65 ft. of height the bars are ⅜ in. x 1¼ in. For the next 15 ft. they are ⅜ in. x 1 in. and for the remainder of the distance ¼ in. x 1 in. The bin contacts are usually 2 ft. thick, though where greater strength is required they are increased to a thickness of 3 ft.

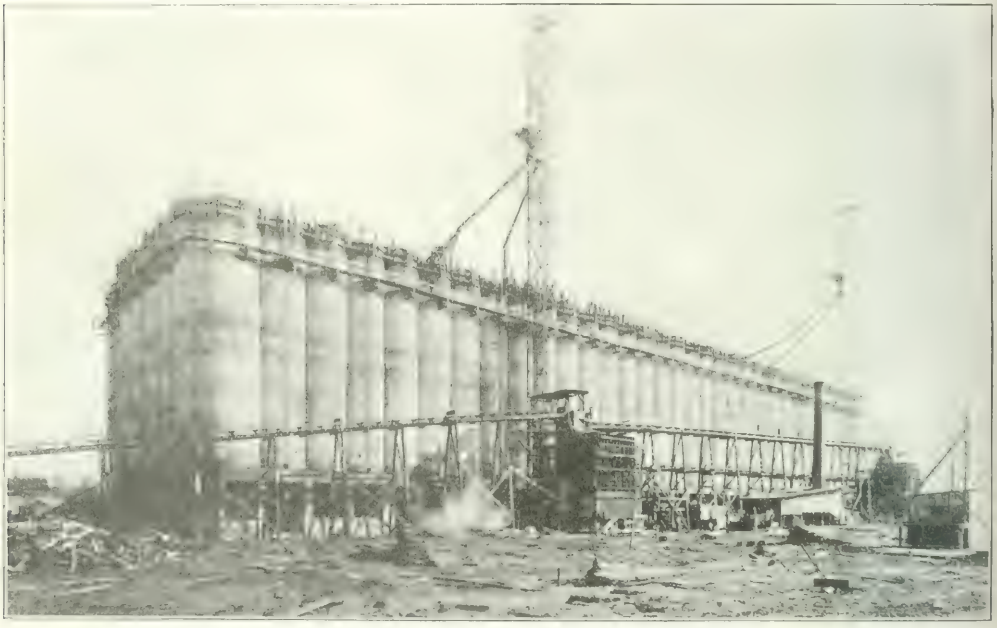


FIG 1. THE BIN WALLS ON THE EIGHTH WORKING DAY

The contractor had fabricated for special use on this job 580 steel screw jacks to support the sliding forms. Fig. 3 shows a close-up of one of these jacks. They are made up of light channels properly stiffened and tied near the midpoints and at one end by lighter channels. Where the main channels are tied near the midpoints they are bent so that the distance between them at the top is about half that at the midpoints. Through the top channel runs the screw, which is made of hollow steel 2 in. in diameter. Between the cross channels and about 3 in. from the screw on either side run two light steel bars securely fastened to the cross channels. On

these bars a steel plate slides, to which are fastened the end of the screw pipe, as well as iron dogs which bite into the jack bars as the forms are elevated. The jack bars are sleeved together and are left in the concrete as vertical reinforcement. Forms are elevated by turning with an iron bar a threaded sleeve resting on top of the jack.

When the screw jacks are being used there are bolted to the inside of the legs near the bottom two clip angles, one on either leg. These clip angles are slipp under the circumferential wales that hold the form sheeting in place. The form for each storage section, whether it be a circular bin, an inner space or an outer space, is rigidly constructed of 2 x 4-in. pieces. Upon this frame the decking is placed. Thus the clip angles support the forms and decking and themselves are supported by the screw jacks resting on set concrete. From the jacks are also suspended outriggers from which workmen apply the finish of neat cement to the bins.

### Materials Handling

One of the interesting features of the construction of the elevator was the manner in which concrete aggregate and cement were handled. All the concrete materials were barged to the site, there being no direct rail connection. The gravel was premixed according to the concrete mixture desired and stockpiled on the site. The plant layout included two hoist towers, each approximately 160 ft. high; two aggregate bins, each with a capacity of about 65 cu.yd., and an elaborate belt-conveyor system. The aggregate was stockpiled at the north end of the site and the cement shed was built at the southern end. A belt conveyor ran from the aggregate stockpile to the first bin situated about 100 ft. from the end of the elevator and then across to the other bin situated at the same distance from the southern end of the elevator. Likewise the belt conveyor from the cement shed ran from the shed to the first bin and then to the north end of the elevator. For the aggregate conveyor there was a two-way spout which discharged either into the near materials bin or carried on across the intervening 200 ft. to the other materials bin. Likewise cement was sent from the cement shed to its near materials bin where workmen took it off or allowed it to proceed to the farther bin where it was discharged. In this manner each of the two mixers was kept continuously supplied with concreting material from one stockpile of aggregate and the cement shed.

From the hoist towers the concrete was handled through either one of two movable hoppers, each of

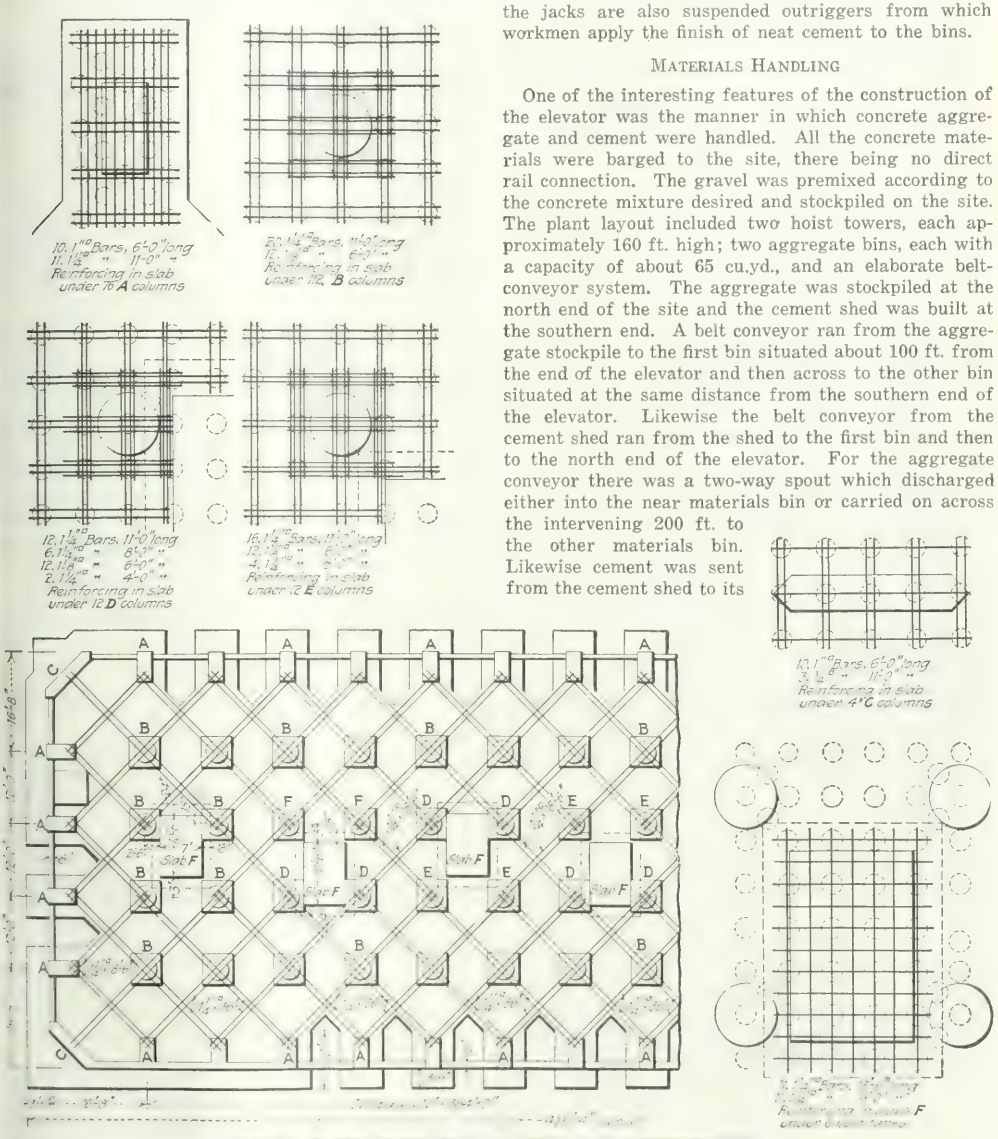

10, 1" Bars, 6'-0" long
11, 1½" " 11'-0" "
Reinforcing in slab
under 16 A columns
20, 1¼" Bars, 11'-0" long
12, ⅞" " 6'-0" "
Reinforcing in slab
under 12 B columns
12, 1" Bars, 11'-0" long
6, 1¼" " 8'-0" "
12, 1⅛" " 6'-0" "
2, 1¼" " 4'-0" "
Reinforcing in slab
under 12 D columns
16, 1¼" Bars, 11'-0" long
12, ⅞" " 6'-0" "
4, 1¼" " 2'-0" "
Reinforcing in slab
under 12 E columns
10, 1" Bars, 6'-0" long
3, ⅞" " 11'-0" "
Reinforcing in slab
under 4 C columns
Slab F
Slab F
Slab F
Slab F
Reinforcing in Slab F
under 6 Columns

FIG. 2. FOUNDATION DETAILS AND MAT REINFORCEMENT

which was set in the approximate center of one-quarter of the floor area of the elevator bins. From these four hoppers the concrete was wheeled in buggies to its place in the wall. About 42 men were all that were required to pour the concrete on the top of the bins and the number of men included in the construction work when the pouring of the bin walls was in operation was about 300. Three crews of about 35 men each were kept continuously employed jacking the sliding forms, the jacks being elevated about an inch at a time. The force of 300 men included ground men, carpenters and those handling steel. This job is one of the few large ones on which numeral steel reinforcing bars have been used and the contractor's engineer took occasion to remark upon the ease with which identification of numeral steel could be made by the average workman, thereby facilitating its placement.

H. G. Onstad was the engineer, and J. B. Fowler, the superintendent, in charge for the contractor. The work was done under plans drawn in the office of the state engineer of New York. Edward W. Anderberg, senior assistant engineer of the state engineer office, supervised the work for the state.

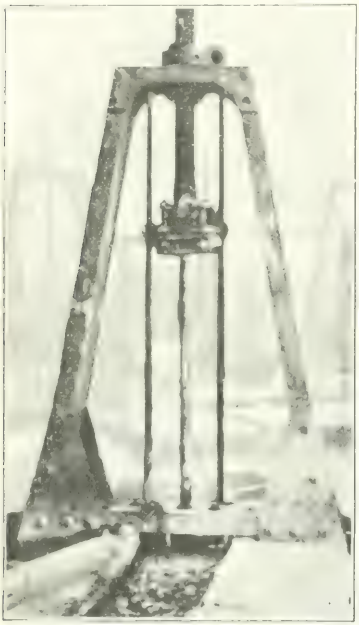
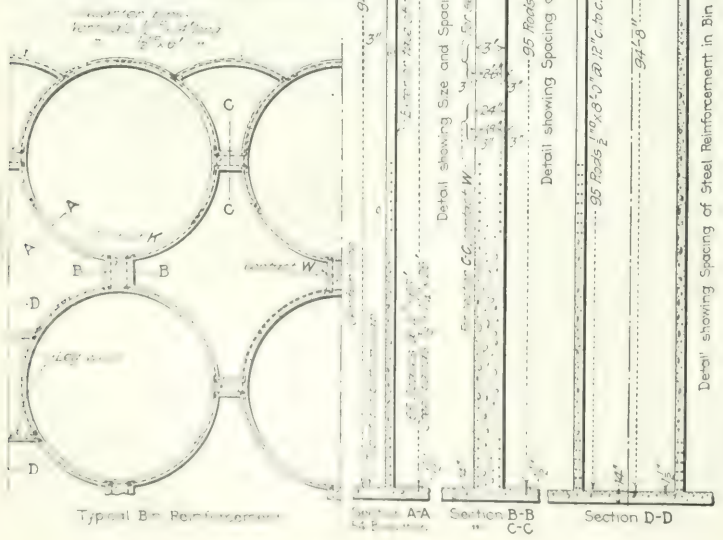


FIG. 3 (LEFT) CLOSE-UP OF SCREW JACK

FIG. 4 (BELOW) DETAILS OF BINS


Top of tanks
Detail showing Size and Spacing of Bin Bands
Detail showing Spacing of Bin Contacts
Center line
Detail showing Spacing of Steel Reinforcement in Bin Leg Well Compartments
Section A-A
Section B-B
C-C
Section D-D

## Chilean Railway Electrification

THE INITIAL electrification of the Chilean railways, according to information recently given out by the Westinghouse Electric & Manufacturing Co., will include 116 miles from Valparaiso to Santiago and 28 miles from Las Vegas to Los Andes. Los Andes is the terminus of the Transandine R.R., a narrow gage line.

Thirty-nine electric locomotives are required for the initial electrification, including six express passenger and eleven local passenger, fifteen road freight and seven switching locomotives. All locomotives will be equipped with Westinghouse motors. The express, passenger and road freight locomotives will be equipped with the Westinghouse system of regenerating braking units, with its modern development. The service in which the local passenger locomotives will operate will not require or justify the regenerating braking feature.

Power supply will be distributed by five substations designed to handle a train movement approximately fifty per cent greater than that existing in 1917, with a further provision for tripling the 1917 traffic demand if necessary. Each station will initially contain two Westinghouse 2,000-kw. motor-generator sets, each set consisting of a 2,800-hp. driving motor and two 1,000-kw. 1,500-volt generators connected in series. These sets will be designed to withstand a 200 per cent overload for five minutes without injury.

Electrification of the railroads in Chile comes as the result of the economies indicated in the report of the commission appointed to study the problem of electrifying all broad-gage lines. The Valparaiso, Santiago and Los Andes branches comprise the broad-gage road in the first zone.

A loan of $10,500,000 for this purpose was subscribed.

# Traveling Forms Cut Expense in Pouring Concrete Stadium

## Timber for Formwork and Labor Involved in Erection and Stripping Reduced to a Minimum—One Form Used for Eight Bays

THE amount of lumber used in the formwork for the construction of a concrete stadium in Pelham Park, New York, was reduced to from one-sixth to one-fourth of what would otherwise have been necessary through the use of a novel traveling form designed for the T. J. Buckley Engineering Co. by E. E. Seelye, consulting engineer, New York City. The stadium is part of a playground development being built in Pelham Park, the funds for the construction of all the structures in the development being supplied by Mrs. I. L. Rice.

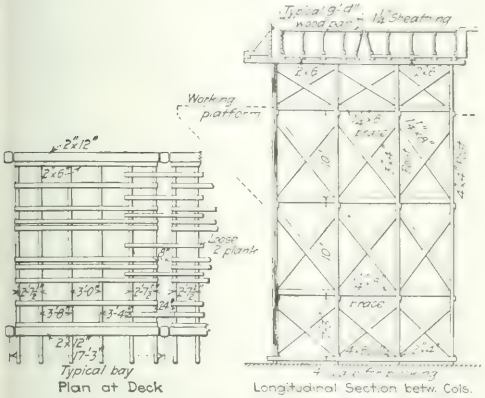



FIG. 1. PLAN AND ELEVATION OF TRAVELING FORM

The playground will be a memorial to her husband. Beside the concrete stadium, there is to be a running track with a 220-yd. straightaway, an outside concrete swimming pool, a large stone bath house, a mother's house and miscellaneous structures. Mr. Seelye is the contractor's engineer for all the work and the same contractor, Thomas J. Buckley Engineering Co., is doing all the construction work.

The stadium is 324 ft. long and 106 ft. wide and is of reinforced concrete. In the rear of the stadium, though practically structurally independent of it, is a reinforced-concrete pedestal upon which rests a bronze statue, weighing 11 tons, of Mr. Rice. The columns of the stadium are spaced laterally 17 ft. 3 in. on centers and longitudinally, generally, 20 ft. 7 in. The two last bays at either end, however, have a smaller spacing. The line of columns at the rear of the stadium are 20 in. square, the next line in from the back 14 x 14 in., and the remaining four 12 x 12 in. The girder has an effective depth of 32 in. There are 29 risers in the stadium of a thickness of 4 in. and a height of 17 in. The treads are 3 ft. in thickness.

When construction upon the stadium was about to begin, the fact that a large amount of lumber would be necessary for formwork, if the forms for the entire structure were put up simultaneously, led to a study of methods which could be used whereby both the lumber and labor could be materially minimized. The result of the study was the design of the traveling form shown.

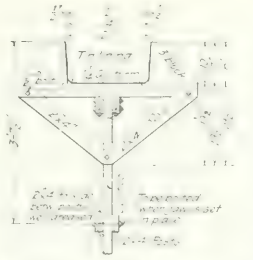


FIG. 2. DETAIL OF COLUMN FORM JAW

The traveling forms were built so that each area included between any four columns was a unit. This made each unit approximately 17 ft. 3 in. x 20 ft. and 7 in. However, forms were constructed for the entire width of the stadium and for the length of two bays. A typical bay unit was built up of 3 x 4 in. or 4 x 4 in. posts, braced horizontally at the bottom and at vertical intervals of 6 ft. x 1½ in. x 8-in. bracing. Lateral bracing of the same dimension was used and the longitudinal bracing at vertical intervals of 6 ft. was also of 1½ x 8-in. material. The posts were braced at the bottom by 2 x 4-in. pieces. The traveler was set upon four 4 x 6-in. sills, spaced equally in a longitudinal direction, and supported on 4 x 10-in.-mud sills. Four-inch wedge blocking was used to true up the traveler and when the forms were to be moved these were knocked out and rollers put in.

The travelers were so arranged that when in place they could be blocked and connected to make a continuous more or less rigid form the entire width of the stand and the length of one bay. The separate travelers extended only to the midpoint of the columns and the column forms were attached to extensible T-braced arms fastened to the traveler. To these arms were fastened collars to fit over the column forms. Enough of these extensible arms were installed, according to the height of the travelers, so that they could be trued up and held rigid in their exact position.

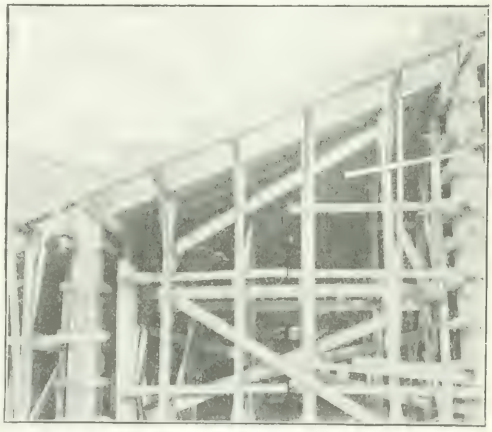


FIG. 3. ONE TRAVELER WITH PANS ADJUSTED READY FOR CONCRETING

The traveler was decked and upon the decks were placed the wooden form pans. There were 28 of these wooden pans all alike. They were built up of 1 x 4-in. lumber and were 2 ft. 3½-in. deep at the rear and 3 ft. 5½ in. deep at the front and sides. Stiffeners 2 in. x 4 in. in dimension were used and these set upon the traveling forms. The pans were built 9 ft. 9 in. in

length, two pans to the bay, properly braced and joined at the mid-width of the bays.

The travelers were built with an outrigger to accommodate the girder forms and one to serve as a working platform. In pouring the slab, the outside line of columns and girder were poured at the same time, so that when the traveler moved up one bay, the approximate alignment could be secured for the traveler from the column and the girder thus poured.

In order to permit the movement of the traveler it was necessary to have a line of movement below the soffits of the transverse girders. This was provided for by the use of wood cores placed on top of the traveler which remained suspended through adhesion when the traveler was moved ahead.

When construction first began on the stadium, the traveling forms extending the width of two bays were joined and the two sections poured simultaneously with a 1-in. expansion joint at the center. The forms then were moved in opposite directions and poured alternately. After several bays had been poured, it was found possible to pour one entire bay in one 9-hr. day. The poured section was then allowed to set and work was done on the opposite side. With this system of form erection, concrete pouring and stripping, and removing ahead of travelers, the same gang of carpenters and concrete men was kept in continuous employment. The concreting plant was located directly in front of the center of the stadium and concrete was chuted from the hoist tower first to the rear of the stadium, thence it was chuted to succeeding lines of columns, girder and slab.

The architects on this work were Herts & Robertson, New York City.

## Bascule Bridge Overbalanced by Careless Handling

A BASCULE BRIDGE was wrecked on Oct. 14 by rolling off its pier, due to careless operation. This apparently unprecedented accident occurred at Gray's Harbor, Wash. The bridge, of the Scherzer rolling-lift type, built in 1914 at a cost of $9,220, was the movable span in a timber trestle carrying a highway across South Bay. It was a single leaf structure of 110 ft. span and 16 ft. width of roadway, about 10 ft. above the water and built for operation by hand. Its track girders were carried on concrete piers with pile foundations.

At the time of the accident the bridge had been fitted with a gasoline engine by the local authorities and trials were being made with machine operation. The bridge had been raised and lowered on low gear and was found to be tail-heavy owing to the wood paving of the roadway having become dried out and worn. The bridge tender having claimed that the span worked too slowly, it was decided to shift from the low to the high gear, but no attempt was made to block the bridge, and it is evident that the brakes were not applied. When the gear was in neutral the bridge, being free, began to rise owing to its being tail-heavy, as noted above.

As soon as it was partly open, a high wind accelerated its movement. Those in attendance ran for safety. Even then the bridge might have been saved if the trestle approach had been built as designed, with pile bents directly under the concrete counterweight in its lowered position. Instead of this, the counterweight landed on a span of wood stringers, which broke, allowing the counterweight to fall and the moving span to roll off the track girders.

No injury was done to the foundations or piers or to the track girders and the tower, these latter parts representing about 40 per cent of the steel in the bridge. Part of the span has been salvaged and work is in progress for the recovery of the rolling heel girders and the machinery. Meanwhile a ferry service has been instituted.

## New Jersey County Adopts Park System

THE temporary park commission for Union County, N. J., noted in *Engineering News-Record*, July 7, 1921, p. 21, as having been created to make a survey and report on a park system for the county, has been made a permanent commission, following an approval of the scheme at the November election. Under state legislation secured in 1895 by Essex County to enable it and other counties in the state to establish county park systems, the Union County Park Commission is authorized to spend $2,500,000 for the acquisition and development of parks. All but one of the members of the temporary commission for Union County have been reappointed, the reappointments including Charles Hansel, consulting engineer, a resident of Cranford, and Caxton Brown, another engineer, resident in Summit.

Mr. Hansel informs *Engineering News-Record* that some three years ago, acting as president of the Cranford Civic Board, he undertook to create a county-wide sentiment in favor of a county park system. In furtherance of this effort, the Union County Park Association was organized in June, 1920, and Mr. Hansel was made its president. This association conducted educational work that resulted in a petition being presented to the presiding Supreme Court justice to appoint the temporary park commission already mentioned. The petition, signed by 32 civic and other non-political organizations, was presented in April, 1921, since which the events already mentioned have occurred.

Preceding the recent election the members of the temporary park commission conducted a campaign throughout the county to enlist support and secure a popular vote for the authorization of the permanent commission. Members of the County Park Association joined in the work. Addresses were made before civic bodies, town councils, women's clubs, and in moving picture theaters. Prizes for the best essay on a county park system were offered through the schools, and committees of school principals and teachers were posted on the subject generally.

### Massachusetts Law Controls Tank Construction

In Massachusetts the construction of "tanks or containers for the storage of fluids other than water" is controlled by a law which requires that permits for constructing, maintaining or using any such tanks must be obtained from the chief of the district police (in the metropolitan district, from the fire prevention commissioner). These officials are required to make rules and regulations for such tanks, subject to the approval of the governor and council. The law, which was passed as a result of the Boston molasses tank accident in 1919, does not apply to tanks constructed principally of wood, or to tanks of 10,000 gal. or less capacity.

# *Training the Engineer for Industrial and Social Service*

Two Engineering Educators Discuss the Professional and Non-Professional Opportunities of the Young Engineer and the Length of Course Justified in Preparing Him for Service

*The following papers, by Prof. Frederic Bass and Prof. Hale Sutherland, were stimulated by Prof. Burr's discussion on the six-year course in engineering before the Society for the Promotion of Engineering Education at New Haven last June.*

*Both authors lay great stress on the need for a broader training and both base their arguments on a high professional conception of the function of the engineer. Prof. Bass holds that the engineer has an unexampled opportunity to project his ideals of service into public affairs and industry; Prof. Sutherland's argument, while differently expressed, has the same purport.*

*The papers deserve a thoughtful reading by all who are interested in the closely related topics of engineering education and the status of the engineer.—EDITOR.*

## *Projecting Professional Ideas Into Business*

By Frederic Bass
Head of the Department of Civil Engineering, University of Maine

A NUMBER of arguments have been presented in favor of the proposition of a six-year curriculum for engineers the first three years of which would be devoted to a liberal training in fundamentals. One of them is that it would eventually result in securing for the engineering profession its proper place in public esteem. This may be a desirable result of such a curriculum but it cannot be considered as an adequate objective. A calling meriting the distinction which attaches to the term "profession" must require of its members an obligation to render service individually and collectively beyond the remuneration or immediate recognition which they receive for their labor. The soldier, the priest, the physician, the lawyer, all are accorded a professional status because their lives are primarily devoted to the solution of the great human problems of preservation of social order, spiritual welfare, prevention and cure of disease, and the administration of justice. It is true that all members of these professions do not take this view of their occupation, but that does not invalidate the definition of a profession. All engineering societies announce service to mankind as the purpose of engineering. Altruism is the essential motive of a profession

### Trusteeship of Wealth

The engineer may look forward to the day when his calling will be accorded a professional standing, but only when the preponderance of engineering thought and conviction is based upon the conception of engineering activity as an agency for devising economic and just solutions of the greater problems of production and distribution. Engineering practice has grown up from the constructive arts as applied to materials; it later adopted the methods of science and developed enormously, particularly in the last half-century, but has been generally considered as limited to mechanical or chemical achievements. An increasing proportion of men receiving a formal institutional training has entered its ranks, men who sense the limitations of the mechanical concept and who realize after having mastered the technic of their chosen province that they have been out of touch with the greater human forces underlying their occupation. Engineering is a part of business and most business today is conducted with an overwhelming regard for immediate profits. While profit is necessary for the continuance of business, the professional man, as a participant, must regard profit as subordinate to the real needs to which the business ministers. A business conducted upon this principle will possess a stability which enables it to successfully meet irregular demands for its product as well as interval disturbances. The professional man, in business or out, must regard himself as a trustee of wealth. This viewpoint is not lacking among the ranks of many of the great financiers and business men of today, nor among the leaders of public life. These men are building for the future in a large way.

Since engineers are, because of the need for their scientific training, entering the management field which includes the technical field, they have before them the prospect of taking an important, if not a dominating influence, in the conduct of commerce, industry, and public affairs, provided that is accepted as the objective of their training. If the engineering fraternity becomes sufficiently impressed with the value of the training now received in engineering schools in accurate observation, correct analysis and interpretation, and the design or formulation of constructive programs, can visualize its beneficial application to business, public and private, can add to it the professional sense of trusteeship, and can bring pressure to bear upon engineering education to accept this greater range of vision, engineering need not remain a subordinate occupation; it will attract the highest type of man because his opportunities will not be subject to the limitations of the present.

### Length of Course

If it be the objective of engineering to provide merely for the routine investigation, designing, construction and operation of structures and equipment used for production or distribution, the usual four-year college course is probably too long, but if it be the mission of engineering to carry its analytical and synthetic methods into the business of which it is a part, then the four-years' course is insufficient either to attract or to train the type of man who must master not only material but great social and economic problems. Not only a longer course of study is needed but a different type of study, one motivated by an ideal and provided with a practical program.

Mathematics and physics are generally regarded as the sole fundamental studies in an engineering course because they supply the knowledge of natural law and the means of correctly interpreting it. But a comprehensive knowledge of history, political science and economics is none the less essentially fundamental in the training of the engineer of the future. Not only should these subjects be included in a professional engineering curriculum, but they should be connected definitely with the problems of industry. Frequently the engineering student has an opportunity to get a smattering of these subjects, or of their subdivisions, but they are often regarded by him as incidental, because taught as having only incidentally a relation to engineering. The same observation may be made of means of personal expression. The engineer is usually taught to express his thought almost exclusively in the form of mathematics, graphical drawings, and structural or machine design. Excellent as are these concise means, he almost universally is deficient in the facile use of written and spoken language. His poverty in this respect is the subject of common observation. He is confined too exclusively to his adopted method and thereby loses the power to communicate with groups of men whose thought runs perhaps in parallel but different channels. The engineer's training tends to narrow channels which are frequently worn so deep that he, working industriously at the bottom, never looks over the top, and often cannot if he will. The usual engineering course needs more language, both oral and written, English and foreign.

The engineering student needs to know where his work in its simpler phases impinges upon that of individuals and groups in other occupations and professions; as a practicing engineer later he will then appreciate where it overlaps and merges in more complex situations and the path which his non-engineering associates have travelled in arriving at the

point of juncture with him, as well as the ground which they occupy at the time. Every professional engineer should better understand non-engineering people and their various modes of thought, expression and action, the reactions among groups, and especially their significance at this unprecendented period of world history.

### Curricula of Various Lengths

Having set an ultimate objective and marked out some of the means by which it may be reached, it becomes possible to discuss the features of an education which will prepare engineers for their destinies. The plan of a six-years' course, the first three years given to a course in the college of liberal arts followed by three years in engineering, presumes that a broad foundation is laid in the first period. A foundation suitable for any superstructure generally requires some preliminary excavation, which in the situation before us means an opening of the student's mind by exciting his interest and motivating his study. The means by which this can be done must be by a co-ordinated curriculum, administered by men who know its meaning and purpose. Many of the instructors in the junior years of colleges of liberal arts today are themselves highly trained specialists who have won their places by research in restricted fields. Moreover such colleges are as a rule divided into departments, one might almost say compartments, without sufficient means of inter-communication. If the earlier years of a student's course can be so planned that he can pursue courses in English, economics, political science and language in parallel with engineering and have their inter-relations made evident to him there can be no doubt but that an ideal training would result, but this correlation should be assured before such a plan as Professor Burr purposes is adopted. As expressed by Dean Cooley of the University of Michigan, a "ribbon" system instead of a "block" system should be used. The ribbons should be woven into a substantial fabric.

The point is made that all of the students desiring to pursue engineering cannot afford to do so if the course is made as long as five or six years. This is no argument at all; there are today many boys desiring to study engineering who cannot afford to take the necessary four years from productive effort; should we therefore reduce the course to three years or one? There is nothing inviolable or sacred about the figure four; if the demands for the best service which the engineering profession can give require five or seven years, then it becomes the duty of the engineering schools to furnish that training.

Probably the lengthening of the curriculum would result in fewer students. No doubt it would at first, have a very marked effect of this character, and possibly a permanent one. This would leave the demand for draftsmen and field, shop or office assistants unsatisfied. It is in all probability true that a considerable number of young men enter and graduate from four-year engineering courses who would have done better both for themselves and the colleges in which they studied to have terminated their course at the end of two years. These are men who have the type of mind that develops almost wholly through practical experience, men who may be satisfied with or who may be limited to action in the more restricted fields of engineering. Concurrently with the introduction of longer courses in engineering, the present four-year courses should be retained or better shortened to three or two years and as experience dictates, revised in character. Graduates from such courses should be given a certificate of graduation, possibly conferring a title, such as: "Graduate in Engineering from Junior College."

The writer is of the opinion that these shorter courses should be offered in universities only in localities where there are no other schools to give them, such as Wentworth Institute in Boston or the Dunwoody Institute in Minneapolis. State universities must, on account of the expediencies of their situation, often develop with less freedom than the endowed universities and consequently be required to administer courses not really of collegiate grade.

In any course of engineering, it is the opinion of the writer that a close identification of the student's classroom work with the practice of engineering and with industry should be maintained. It required enormous persistence, patience and labor to establish the co-operative courses at Cincinnati, but the experiment has been successful and in modified forms the plan is being followed elsewhere.

It cannot be maintained as a simple proposition, that all engineering courses should be standardized at six instead of four years. But it can be truly said that the engineering profession has before it a formidable task in projecting its ideals of service and its scientific methods into public affairs and industry and that in this greater task a more broadly-trained engineer will be required than in the past. The combined efforts of teachers of engineering and of the most farsighted men of practice in engineering will be necessary to study the present situation in the light of future demands in order that a well-balanced program may be formulated for the training of members of the future profession of engineering. Such a study should be amply financed over a period of several years.

* * *

## *Visioning the Opportunity of the Engineer*

By Hale Sutherland
Assistant Professor of Structural Engineering, Massachusetts Institute of Technology

THAT ANY particular engineer is a professional man is often a very debatable question: That engineering is a profession can hardly be questioned, although its qualified practitioners, fully entitled to professional status, are not yet sharply defined as a legal group by any general system of licensing as is the case with our doctors and lawyers. The clear-cut definition of the Century Dictionary may be used to establish this contention: A profession is a "vocation in which a professed knowledge of some department of science or learning is used by its practical application to the affairs of others, either in advising, guiding or teaching them or in serving their interests or welfare in the practice of an art founded on it. * * * The word implies * * * an application of such knowledge to uses for others as a vocation as distinguished from its pursuit for one's own purpose."

In arguing the case the tendency often has been to emphasize the technical qualifications of the engineer, the extent and depth of his specialized knowledge, and his expert judgment. But an essential element of professional work is the application of this expert knowledge to the use of others. The professional man deals always with clients to whom he owes a peculiar loyalty, yet he may not favor one client at the expense of another and in the largest sense his loyalty is to society, the sum of all possible clients. The humanitarian ideals have always bulked large in the thought of the learned professions and the masses have always turned to these groups for leadership even outside their limited fields of professional knowledge.

This standing apart of the professional man as bound by purpose to a larger end than his own individual advancement is of immense significance. The struggles of opposing interests and ideas in our civilization today are so tremendous, the results so uncertain and of necessity bound to be so far-reaching that the average man stands uncertain and aghast. He is sure of but one thing and that is that there must be less of conflict, more of co-operation, and this principle he applies to the solution of all difficulties, large and small. In this judgment he is supported by the sociologists who tell us that the advance of civilization is measured by the advance of the idea of co-operation. Now the spirit of co-operation is pre-eminently the spirit of the professional man and one writer has gone so far as to say that society progresses in the measure that additional groups of workers take as their own the standards and purposes of the profession. So in the larger view of things the demand of the engineer to be counted as standing with the minister, the doctor and the lawyer, is not a mere seeking of selfish preferment, but is a declaration of his recognition of his function in the work of the evolving race, of his duty to place his specialized knowledge at the disposal of society for the advancement of all. Anyone who has read of late the writings of engineers supporting their claim

cannot have failed to note the large place taken by the thought of community loyalty.

The justice of Prof. Burr's plea for the full professional training of the engineer is therefore easy to establish. Every engineer should grasp the full significance of the demand he makes when he seeks recognition as a professional man. No engineer can understand the significance of this claim and merit the higher rating unless he has gained a sympathetic knowledge of mankind's advance up from the savagery of the prehistoric past into the complex and disordered present. Only such knowledge can face intelligently and without prejudice the pagan logic of the reactionary and the maudlin sentimentality of the radical whose clamor confuses our ears these days. Wisdom and good will are needed to solve the problems that threaten civilization and the professional man is bound by his loyalty to a leading part in their solution.

### Historical Knowledge Needed

The sympathetic knowledge that will command this loyal purpose must of necessity include certain definite subjects: The story of the life of man on this globe from his earliest beginnings to the present, the story of the various community groups he has formed and now maintains, their varying fortunes, the organization and direction of these groups, the ways in which they have made and now make their living, the nature of their environment, the laws of the natural world in which man lives, and the efforts he has made to arrive at an understanding of life by rational inquiry and by emotional evaluation. History, the humanistic sciences (sociology, economics, government), natural science and mathematics, philosophy, literature: Here are five fields of learning in which a man must have real understanding if he is to comprehend the significance of the vast evolutionary procession in which we move and work intelligently for progress. And of course to perform his special task in society the professional man must have expert knowledge and ability in his chosen specialty. Can the engineering profession do less than demand that in the future its members receive a training of this scope?

One of the most vital and interesting of recent contributions to educational discussion is Mr. H. G. Wells' proposition that the backbone of education is history. He is asserting the same thesis that is here maintained, that the schools should open to us the broad horizons of the evolving world race and set our own interests and purposes to racial ends. He is not greatly interested in dynasties and dates but he is very much concerned with getting a clear picture of what man is like, his ways, thought and doings, past and present, that explain man today and the world situation by which he is faced. He makes this background of the past and the vast conflict of the present very live and real in his "Outline of History." One comes from a reading of that book with a vivid idea of what the word "history" really means and with a vast aversion to the scholastic deadness that so often masquerades by that name.

### "Scholastic" Knowledge Deadly

As history requires to be related to the living processes of the present so all subjects are under the same necessity if they are to have living force. That which is studied for itself, for its own interest or beauty, is a scholastic, a dead thing. When this principle is adhered to a course in Latin has living value: What are our memories of our schoolboy Latin? When this principle is disregarded our courses in history, social science and literature become dead and vapid scholasticisms. So it is not enough to outline a curriculum. Nor will it be enough to specify, "All courses shall be so arranged and taught that the significance of the subject in the life story of humanity shall be plain." The end can be attained only by ensuring that our teachers be men of vision first and scholars second.

The colleges are in a very self-depreciatory mood at the present time. They complain that their graduates are narrow in range of knowledge and interest and too often self-centered in their view of life. Our engineering schools join in these complaints and add that the average of student technical ability and initiative is far from what it should be. Of course the prime trouble lies in the roots of human nature, in our inertia, our content to remain without understanding and to live on the plane of least effort: or briefly it lies in our being asleep, unaware of the tremendous drama in which we move and of the immense possibilities that await the active player of his part. The schools have failed because they have not awakened their students to life and action. They have not awakened their students because they have not convinced them that there is any vital connection between their studies and the daily life of the world, because they have not introduced eager young minds to the fresh and stirring human problems that awaken imagination and purpose. (A fine statement of the problem is to be found "The Liberal College" by President Meiklejohn of Amherst. The outline of the fundamentals of liberal knowledge here given follows his argument.) The curriculum is largely to blame in all this: it contains too much of the scholastic: its range is limited, leaving great gaps in the student's knowledge of life. We teachers are more to blame; we have taught too much from the academic and not enough from the human point of view: we have not had enough life in ourselves to awaken life in others.

### Conclusions

Perhaps at the present stage of growth of our race these failures were inevitable. We all know how few are the men and women whose horizon extends beyond their own petty concerns and how heavily our own spirits move. But in endeavoring to set forth the essentials of a proper training for the engineering profession we should face these failures and do what we can to ensure that henceforth the young men who receive our engineering degree not only shall have been made familiar with a certain range of facts and ideas, but that they shall possess, as a class, vigor of mind and life, broad sympathy and purpose, qualities that grow with properly directed labor in humanistic studies. Properly speaking, then, this end should be attained as a result of the strictly collegiate work and such should be the sturdy quality of the men who matriculate in engineering henceforth.

A large part of the difficulties of technical education will disappear when the men who seek that training come to our schools with alert and vigorous mental power. The present immaturity and low average of ability result in courses definitely low in standard of rigor and accomplishment. The rest of the reform in technical schools is largely one of detail—the pruning of overcrowded curricula and courses, the maximum possible elimination of the merely informational, the giving of more time to economic and industrial factors, increased emphasis on disciplinary studies and basic principles.

## Compensation Damages for Typhoid Death

The Ohio Court of Appeals has decided that "death from typhoid fever caused by drinking impure water is compensable under the Workmen's Compensation Statute" of Ohio (decision of Sept. 12, 1921; the Industrial Commission of Ohio v. Cross et al). The decision is thus summarized in *Public Health Reports*, Nov. 11, 1921. "The decedent was employed by the city park department as inspector of certain construction work. The only drinking water available in the vicinity of the place where the construction work was being done was from a spring near by. After the decedent was taken ill, the spring water was examined by the health department and found to contain typhoid fever germs. In the course of the opinion the court of appeals said: 'While there might be an extended discussion and difference of opinion as to what is meant by the term 'injured,' in construing the term as used in the statute, we do not think the legislature meant that the injury must be caused by the application of external force. The man was as much injured by the contracting of typhoid fever as if injury had been inflicted by external force.'"

# Suldbach Tests: A Swiss Study of Bridge Action

**Exhaustive Measurements on 63-Foot Single-Track Pony-Truss Span Under Test Axle and Lateral Loads—Continuity of Stringers—Chord Stress in Floor—Top-Chord Bending**

A REMARKABLE study of bridge action carried out in Switzerland throws valuable light on questions of continuity due to interaction of the separate elements of truss bridge framework. It affords the clearest picture of the behavior of a pony-truss structure that has ever been obtained experimentally, and it defines the interrelation of the various parts of the floor construction and their relation to the bottom chord and crossframe construction virtually for the first time. No publication of the data or the results has yet been made, although the tests were carried out three years ago. The following abstract of the investigation is based on a manuscript copy of the report, supplied by M. Rôs, secretary of the Swiss Bridge Builders and Structural Fabricators Association, which carried out the work as part of the ambitious research-test program outlined in *Engineering News-Record* of June 30, 1921, p. 113.

*Bridge Data.*—The bridge tested is a single-track railway span, one of a pair on double-track line of the Lötschberg Ry. over the Suldbach near Mülenen. It is a pony-truss parallel-chord span 63 ft. 4½ in. long center to center of end bearings, comprising eight panels of 7.92 ft. each. The trusses are 7.89 ft. deep center to center of web connections, and 8.18 ft. deep over all. The roadway width center to center of trusses is 16.42 ft. and the two lines of stringers are spaced 5.90 ft. apart. The panel length of the bottom lateral system is two truss panels. The truss web system comprises posts at all panel points and crossed diagonals in each panel. The rails rest on wooden cross-ties on I-beam stringers.

The truss chords are single-web T sections consisting of a web plate 14 x ½ in., two angles 3⅝ x 3⅝ x ⅜, and one or two cover plates 14 in. wide. The posts are star sections of four angles 2¾ x 2¾ x ⅜ in.; the compression and counter diagonals two 7-in. channels or two T's back to back, the tension diagonals two 7 or 9-in. flat bars. The floorbeams are 20-in. plate girders connected to the posts by triangular bracket plates extending the full height of the posts, 22 in. wide at the base (24 in the case of the end post) by ⅜ in. thick, spliced into the floor-beam webs. The stringers are single 12¾-in. I-beams.

*Test Methods.*—All the tests were made under *static* loading, using a single concentration of known amount. For vertical loading, a single-axle test load of 24.9 metric tons (27,440 lb. per wheel) was provided. The test axle was arranged at mid-length of a four-wheel truck, with vertical adjustment enabling the full weight of the truck to be concentrated on it when in position for test. Horizontal loading of the top chord was provided by a straining tackle with spring-scale dynamometer (Fig. 1), which could be put in place between the top chords and by which a horizontal force of 4,408 lb. acting to pull the top chords together was applied.

Measurements of stresses, deflections and slopes were made on various members of floor, trusses and laterals, usually under a succession of different positions of the test load. In most instances the results were plotted in the form of influence lines (showing the variation of effect at a given point under a traveling load, plotted along the travel of the load). The deflection and slope measurements checked closely with the stress measurements, but in some cases the former served to bring out a particular effect more prominently. A sufficient number of extensometers was used at any one measuring point (compare Fig. 1, right-hand view) to give the stress at the principal corners of the cross-section, so that the true mean stress could be determined as well as the amount of vertical and lateral bending and torsion. The torsion of various members was determined directly by clinometer measurements, which were also used in determining the change of slope of a point on floorbeam, post or stringer during the travel of a load.

The tests with horizontal force applied to the top chord gave little or no information additional to that furnished by the vertical-load measurements. Tests with simultaneous horizontal and vertical loading con-

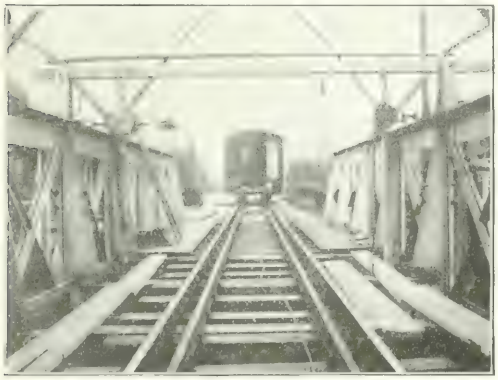


FIG. 1 STRESS-TEST ARRANGEMENTS ON SULDBACH BRIDGE
At left, strain yoke for lateral loading of top chord; test truck in rear. At right, extensometers, deflection recorders, and clinometers on stringers.

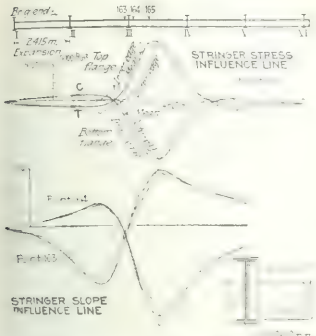



FIG. 2. STRINGER STRESSES; INFLUENCE LINES FOR STRESS AND SLOPE

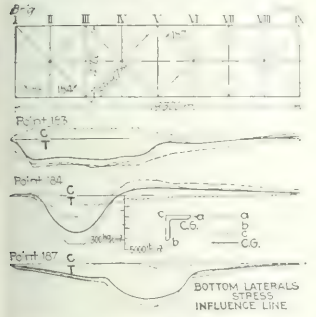



FIG. 3. STRESSES IN BOTTOM LATERALS

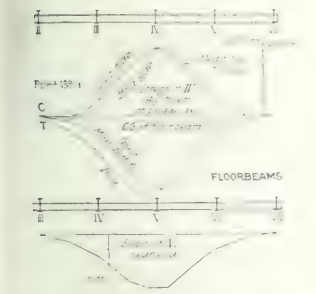



FIG. 4. FLOORBEAM STRESS AND SLOPE INFLUENCE LINES

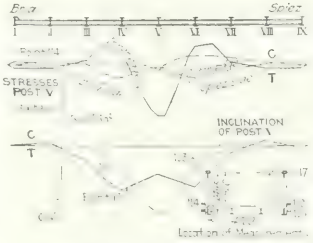



FIG. 5. BENDING IN POST BRACKET PLATES

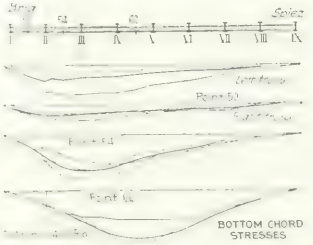



FIG. 6. VERTICAL AND LATERAL BENDING IN BOTTOM CHORD

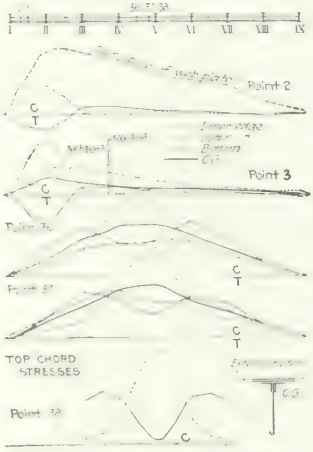



FIG. 7. TOP-CHORD STRESS INFLUENCE LINES

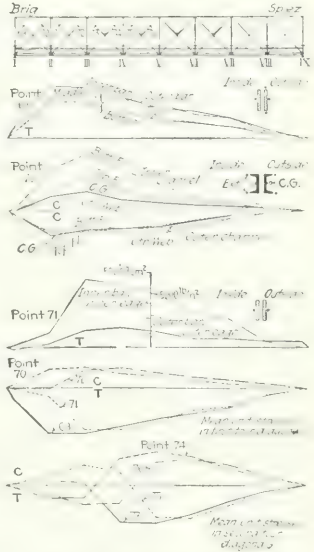


FIG. 8. DISTRIBUTION OF STRESS BETWEEN TWO WEB SYSTEMS

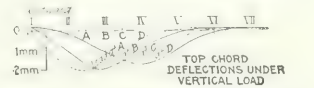



FIG. 9. TOP-CHORD BENDING UNDER VERTICAL LOAD; ELASTIC CONTINUITY

FIG. 10. CLINOMETER READINGS ON CROSS-FRAMES UNDER HORIZONTAL LOAD AT MIDSPAN

irmed the applicability of the rule of superposition. With a single exception, the following summary reports only vertical-load measurements.

*Stringer Continuity.*—Some typical results of the stringer measurements are shown in Fig. 2. Curves are given of flange stress at the third-point of the third panel, and of angular deflection at points in the second and third panels close to the floorbeam between these panels; all the curves are drawn as influence lines. They exhibit the continuity of the bottom chord at first glance. The stress curve, which is rather more symmetrical and consistent than those obtained in some of the other panels, is remarkable in indicating the effect of the general deflection of the span and the floorbeam deflection; reverse bending does not begin as soon as the load passes off the stringer, but only when the load has passed some distance beyond the first tie in the next span. The sketch of the stringer connection to the floorbeam given in the figure shows that the attachment is not superior in rigidity to that ordinarily used.

The measurement of slope at two cross-sections in adjoining panels, these sections being on opposite sides of the same floorbeam, brings out the continuity of the stringers even more clearly, though the difference between the curves for the two points is not explained by the data.

The curve of stress at center of gravity of the stringer, derived from the measured flange stresses and shown by dash-and-dot lines in Fig. 2, theoretically indicates participation of the stringers in the transmission of bottom-chord stress, but the effect is considered to be within the limits of experimental error. The effect of

floor tension was found more definitely in the lateral bending of the floorbeams and in the stresses of the bottom lateral system.

With respect to the latter, the specimen stress influence lines given in Fig. 3 are instructive. In all three cases they show a resultant tension, especially pronounced when the load is in the two panels of the laterals nearest the point of measurement. As these curves were taken under vertical loading, the stress in the laterals is due to the elongation of the chords and to the spreading of the bottom chords near the loaded panels by the stretch of the bottom flanges of the floorbeams. Probably the stretch of the bottom flange of the stringer while bending under load also plays a part in creating tension in the laterals. It is to be borne in mind that the laterals are riveted to the bottom flanges of the floorbeams at the intersection points, which connection resulted in introducing a number of apparent anomalies into the lateral as well as the floorbeam stresses.

The pronounced bending in the members of the lateral system and the inequality in stress distribution between the two diagonals of a single panel (see lower curves in Fig. 3) also invite attention.

### Beam and Chord Behavior

*Floorbeam Stresses.*—Continuity of the floor is further demonstrated by the measurements of floorbeam flange stresses, one set of which is plotted in Fig. 4, an influence line of stress of the floorbeam three panels from the expansion end. It will be seen that very pronounced bending exists in the floorbeam for some time after the load has passed off the tributary stringer panels. The four separate curves shown by light, full, and dotted lines respectively represent the two edges of upper and lower flanges respectively, and the heavy full lines (derived from the others) refer to the middle of the flange width. The stresses in the opposite edges of either flange give clear evidence of considerable sidewise bending of the floorbeam, reversing under the load.

Clinometer measurements near the ends of the floorbeams were also made during the passage of the test load; one influence line is included in Fig. 4. It gives evidence that there was downward bending in the floorbeam while the load remained within two panels of it, and thus tends to show that the truss deflection played a negligible part in its effect on the behavior of the floor, and that the continuity of the floor itself was the dominant feature.

*Crossframe Action.*—Two sets of observations, out of a large number, on the behavior of the crossframe (floorbeam, posts and bracket gussets) are reproduced in Fig. 5, together with a location diagram. They refer to the mid-span frame (V). The influence diagram of stresses in the posts and brackets at track level (point 114) shows very pronounced bending in the post, of reversed direction, as the load moves along the span. While the major bending is that in the plane of the floorbeam, with pronounced tensile stress along the inner edge of the bracket plate when the frame in question is loaded, there is also a decided bending in the longitudinal direction, reversing as the load passes the crossframe.

Slope measurements by clinometer made at the top and at two points near the base of the crossframe, as indicated in the location diagram, bring out the influence of the lateral deflecting tendency of the top chord upon the crossframe action. The slopes near the base of the frame are very regular, and quite in accord with the floorbeam bending as shown in Fig. 4; the slope at the top, however, decreases as the load comes on the floorbeam of the crossframe in question, evidently due to an outward pressure exerted by the top chord tending to resist the distortion of the crossframe. Apparently this action accounts for the tensile stress developed at the inner edge of the bracket plate, shown in the stress diagram.

*Chord Stresses.*—While the chord-stress measurements show diagrams that in general check closely with what would be expected, a number of interesting anomalies appear.

In the case of the bottom chord, decided differences in the behavior of the corresponding members of the two opposite trusses are found in certain cases. The end panel presents such a case, as shown by the curves for point 50 in Fig. 6. While the mean tension is pretty much the same for both chords, the chord of the left truss has two pronounced irregularities, one being an abnormal excess of stress when the load is near the first panel point, and the other a very decided upward bending of the chord, shown by high tension in the upper edge of the chord web-plate, which persists for all positions of the moving load. The former effect may arise from irregularities of tie bearing, but the other, lying in the truss itself, is possibly due to a kink in the member which tends to straighten out under tension. Near mid-span the bottom chord appears to behave more normally, with slight downward bending as might be expected to result from the general deflection of the span. There is little lateral bending shown either here or in the end panel, each of the measuring points being at the center of a panel.

### Top Chord Irregularities

Much greater irregularities appear in the top-chord stresses, Fig. 7. At point 2, the extensometer at the bottom edge of the chord web was located over a web splice, and here a highly abnormal compressive stress appears. There is obvious lateral bending, the member bending inward presumably by the effect of the crossframe distortion, though the maximum does not occur until the load reaches the first panel-point. At midpanel, point 3, the lateral bending is even more pronounced. However, the greatest lateral bending (compare points 36, 37 and 38) occurs at a panel point (38), where it approximately doubles the extreme-fiber compression. At the quarter point and middle of the panel (37 and 36) the lateral bending amounts to only about 50 per cent increase of the mean stress. The general downward bending of the span is indicated by the deficiency in stress at the bottom edge of the web at 36, and a pronounced secondary-stress effect possibly representing the shear deflection in the loaded panels is revealed by the downward bending appearing at 37. These curves are typical of the others obtained from the top-chord measurements.

*Diagonals.*—The double web system makes the diagonal stress measurements of peculiar interest. As the compression and counter diagonals are stiff and the tension diagonals flexible (two flats), unequal distribution of stress between the two systems might be expected. From the measurements plotted in Fig. 8 it appears that any differences of this sort are much smaller than the differences between inner and outer bar of a member and the bending and twisting stresses in

the channels of the compression diagonals. However, after elimination of these, by taking mean stresses computed for the center of gravity of the member, as is done in the two lower diagrams, it appears that the tension diagonals take considerably higher stresses than the compression diagonals in the end panels, and somewhat higher stresses even in the center panels, where the same section is used (two T's, $4\frac{3}{4}$ x $2\frac{1}{2}$ x $\frac{3}{8}$ in.).

*Lateral Bending of Top Chord.*—The preceding curves are influence lines. Bending of the top chord is shown in a more readily intelligible way by the geometric plots, Figs. 9 and 10. Fig. 9 is for vertical load, Fig. 10 for horizontal load. For the former the lateral deflections are plotted, so that the curves represent the actual shape of the chord (in plan view) to greatly exaggerated scale. As in each of the four curves only one point is loaded, the chord deflection is controlled by the crossframe action. With load at mid-panel, the lateral ordinate of the top chord is greatest at mid-panel, though the deflecting force is applied through the frame at the panel point. The curves show a remarkably perfect degree of elastic action in the top chord, and give complete assurance that the top-chord action and stress distribution with respect to lateral bending proceed strictly in accordance with elastic hypotheses. In fact, the lateral continuity of the chord is great enough to cause the chord to pull the crossframes at some distance from the loaded region outward from normal position.

More complete proof of this latter point is furnished by the slopes of the posts (for half the span) under horizontal load. Fig. 10 plots the curve for a load of 1,400 lb. lateral pull on the top chord at mid-span. In this case the only vertical action exerted is that due to the reactions resulting from the elastic continuity of the floor which is bent down at the frame where the transverse pull is applied, by the downward bending of the floorbeam. If this action, however, were controlling in the transmission of top chord deflections, the greater slopes at the points of outward bending would occur in the lower portion of the posts, whereas the diagram shows that the slope at top of post is greatest throughout the span.

## Conclusions

*Analysis of Results.*—Exhaustive analysis of the results of the measurements by comparing them with theoretical calculations yielded some noteworthy results.

The twisting tendency of the stringers, due to the outward thrust of the lower fibers of the tie and the concentration of tie load on the inner flange, was small, the two effects almost balancing. The maximum eccentricity of tie load (inward) was found to be less than 1 inch. Study of the stringer continuity indicated that slackness of the connections to the floorbeams reduced by one-half the negative moment at the ends of the panel, even after allowing for yielding of supports.

Reduction of stringer moment below the simple-span moment, mainly by continuity and only in very minor degree by rail distribution, averaged about $12\frac{1}{2}$ per cent at mid-span and 31 per cent at one-sixth the span from the support; but as side thrust and torsion effects increased the extreme-fiber stress from vertical bending alone by amounts of 28 to 49 per cent, it was concluded that it is justifiable to neglect the continuity as compensation for the neglect of thrust and eccentricity of loading. The end shear was found to be slightly reduced (by $\frac{1}{4}$ to $\frac{1}{3}$). The results were interpreted as indicating that if full continuity be counted on, the stringer connections should be detailed accordingly, to be capable of carrying a negative moment of 38 per cent of the center moment and an end shear three-fourths that of a simple span; while if only partial continuity is to be taken into account, as with ordinary detailing, a negative moment only half as great, or 19 per cent, and a shear on the floorbeam rivets of two-thirds the simple-span shear is to be counted. The floorbeam rivets are subjected to a moment which is at least equal to the stringer end shear multiplied by the distance from connection rivets to floorbeam web.

Floorbeam concentrations were found to be considerably reduced by the continuity. For load directly over the floorbeam, the concentration appeared to average about three-fourths of the axle load, about 13 per cent going to each adjacent floorbeam, while slight upward reactions appeared at the next two floorbeams. Other effects, however, increased the floorbeam stress to that corresponding to about 86 per cent of the actual load. The analysis of crossframe action was interpreted as indicating that the resistance of the bottom chord and of the laterals has little effect on the behavior of the frame. The end constraint of the floorbeams, according to the test, was relatively small.

Comparison of the truss stresses with those obtained by three methods of calculation—shear divided equally between tension and compression diagonals, shear divided in proportion to area, and precise calculation according to relative deflections—indicated that all three are fairly applicable, the variations of measurements equaling or exceeding the differences between the several methods. The bottom-chord stresses are uniformly less than the calculated ones, doubtless due to the chord action of the bottom lateral system and the stringers.

Floorbeam bending by the differential movement of stringers and bottom chord is broadly in agreement with what would be expected, but on analysis was found to be so greatly affected by the attachment of the laterals to alternate floorbeams as to make any numerical comparison impossible. The stresses in the laterals caused by vertical loading were found in agreement with the amount computed from the bottom-chord elongation, in that part of the influence lines (Fig. 3) which is of normal form; the increased lateral stresses in the loaded panels appear to be attributable to the spreading effect of the floorbeam bottom flange elongation. The greatest percentage of the chord stress carried by the lateral system amounted to $6\frac{1}{2}$ per cent, but the large percentages occurred in the end panels, where the stresses were small in amount. The percentage of stress that went through the chord itself increased with the amount of the theoretical stress; a maximum of 93.6 per cent.

Under horizontal loading the measured floorbeam moments were found to be 10 to 20 per cent less than the calculated, due to the rigidity of the attached members of the floor system.

A few tests made with combined vertical and horizontal loading (but not with loads at the same panel point, as the horizontal straining device interfered with the vertical-load truck) resulted in showing that the measured stresses correspond to the sum of the separate stresses due to vertical and horizontal loading, with slight excess of the measured values under combined loading. This effect is charged to the reduction of restraints that have a relieving effect when only one form of loading is applied.

# The Railroads—Not Entities But A National System

## Abstract of an Address Given by Joseph B. Eastman Before the National Association of Railway and Utility Commissioners

THAT the railroads of the United States might be grouped some day in a "national transportation system which will be based upon a modification and development of the principle underlying public ownership and operation" is the belief of Joseph B. Eastman, a member of the Interstate Commerce Commission, as expressed recently in an address before the National Association of Railway and Utility Commissioners at Atlanta, Ga. Mr. Eastman said that he believed he could detect symptoms favorable to such a belief in the plan which has already been adopted in the case of the Boston Elevated Railway Co. and in the plan recently devised and now under consideration in the case of the transit companies of the city of New York. Both of these plans is held up as worthy of intensive study.

"I have no interest whatever in public ownership or operation for its own sake and I think I understand its dangers," said Mr. Eastman. "On the other hand, it offers certain advantages which probably cannot be obtained to the same degree in any other way. I have in mind, among others, its advantages in the procurement of capital, in the protection of investors, in the co-ordination of facilities, and in the opportunity which it affords for management less hampered by the time and energy-consuming processes of an exacting system of public regulation. My only suggestion for the present is that these advantages ought not to be passed by because of prejudice, and that they offer, instead, an opportunity for genuinely constructive thought and statesmanship. An inventor having progressed thus far in the creation of a new machine would not rest from his toil until he had found the means of securing the advantages and eliminating the dangers. So long as the Interstate Commerce Commission and the Railroad Labor Board have their present powers, the opportunity for private initiative in railroad operation is circumscribed."

It was the statement of Mr. Eastman that any intelligent discussion of the railroad question should start with the premise that transportation "is an industry affected with a public interest which cannot safely be left to the mercies of unrestrained private initiative." That being the case, the problem is resolved into a critical examination of the present system with a view to remedying its defects.

### Influence of Transportation Act

Mr. Eastman applauded the fact that the Transportation Act of 1920, if it had done nothing else, had given a "clear recognition of the principle that railroad companies are not to be regarded as separate entities, but as parts of a national transportation system which must be maintained, root and branch, in health and full vigor for the good of the country as a whole." He also pleaded for a full measure of co-operation (1) between transportation agencies the country over with the Interstate Commerce Commission; (2) between local transportation systems for the adjustment of local difficulties, and recommendations for the establishment of equable state and interstate rates; (3) between railroad management and railroad labor. Mr. Eastman saw "tremendous possibilities" in the development of the national transportation system which would include reconstruction and the joint use of terminal facilities. Great possibilities he also saw for the railroads in electrification, the economical production and use of power, the development of waterways and motor transport and their relation to and co-ordination with rail systems, and the possibilities which go with the phrase "economy and efficiency in management and concentration upon the details of operation."

### Fundamental Policy

The fundamental policy, if there be any at all, which should govern and make it possible for state railroad commissions and the Interstate Commerce Commission to work harmoniously and efficiently Mr. Eastman asserted to be a realization of the principle that individual railroads cannot, any more than individual social or political groups, pursue an unrestricted course, but must be harmonized by restrictive measures which are national in their application. However, he asserted it was just as vital that smaller units be permitted to do the things for which they were best fitted for "otherwise the central organization becomes a formless and unwieldly thing gradually developing into a 'bureaucracy' dealing in an arbitrary and soulless way with all manner of little matters with which it cannot be in touch, and losing in the process all its larger vision."

"As I have said," continued Mr. Eastman, "the Transportation Act of 1920 has helped us to realize that there is such a thing as a national transportation system, and it follows that it must be guided in many respects by a national policy if friction and interference be avoided. Take the matter of railroad rates. I feel confident that you will all agree that a sound, national policy calls for harmony between state and interstate rates, and I use the word harmony in no rigid sense."

### Chances for Co-operation

The chance for co-operation between state railroad commissions and the Interstate Commerce Commission Mr. Eastman believes lies in the ability of state railroad commissions to adjust their local differences and initiate programs for harmonizing state and interstate rates without waiting until the issue is thrust upon such local organizations. He asserted that he believed if the state commissions of the South would become the active proponents of a plan for bringing about harmony in rates within their territory they would stand on stronger ground than if the issue were brought to the front upon complaint of the carriers or upon the initiative of the Interstate Commerce Commission.

Other opportunities which seem to be afforded for co-operation between the federal commission and the state commissions include, he said, jurisdiction over construction of new lines and the abandonment of old lines. Such cases, he asserted to be difficult of decision from Washington, but the full co-operation of local transportation agencies was necessary in shaping the decisions.

Above all, Mr. Eastman said, there must be co-operation between management and employees for no "railroad can operate efficiently with labor which is either disloyal or disheartened." When wage reductions were considered Mr. Eastman asserted that labor was entitled to a seat at the council table and also to the presumption that it has no less "interest in the country's welfare

and no greater degree of selfishness than shippers or captains of industry." He further suggested that no scale of wages could be fairly or profitably built upon the "pay which men out of work in a period of unemployment are willing to take as an alternative to starvation."

Aside from the foregoing points in his discussion, Mr. Eastman asserted that in any discussion of the railroad problem sincerity, good will, ability to curb prejudices, ability to face facts squarely and follow them wherever they may lead, were essential.

## No Excess of Unusually Heavy Rains During Current Year

Weather Bureau statistics do not show any important excess of unusually heavy rains during 1921 over such occurrences in previous years, according to information received from C. F. Marvin, chief of the Bureau. This is true in spite of the fact that a number of destructive floods have occurred during the year, and that a new high record for 24-hr. rainfall was made at Taylor, Tex., on Sept. 10, in the storm which produced the San Antonio flood, the total reached being 23.00 in. in 24 hr. Mr. Marvin tabulates as below the number of times precipitation in excess of 5 in. and 10 in. respectively in 24 hr. was recorded over the entire United States during the five summer months (April to August) of 1916 to 1921, inclusive. He says:

An examination of these tables shows no important excess of unusually heavy rains during 1921 over such occurrences in previous years; in fact, some of the

NUMBER OF CASES OF EXCESSIVE PRECIPITATION IN U. S.

Precipitation in Excess of 5 Inches in 24 Hours

| | April | May | June | July | August | Total |
|---|---|---|---|---|---|---|
| 1916 | 2 | 21 | 14 | 99 | 13 | 149 |
| 1917 | 3 | 0 | 10 | 4 | 5 | 22 |
| 1918 | 10 | 12 | 5 | 5 | 10 | 40 |
| 1919 | 6 | 7 | 19 | 23 | 32 | 87 |
| 1920 | 17 | 17 | 8 | 12 | 19 | 73 |
| 1921 | 21 | 3 | 23 | 12 | 5 | 64 |

Precipitation in Excess of 10 Inches in 24 Hours

| | April | May | June | July | August | Total |
|---|---|---|---|---|---|---|
| 1916.... | 0 | 0 | 0 | 12 | | 12 |
| 1917 | 0 | 0 | | 0 | 0 | 0 |
| 1918..... | 0 | 0 | | 0 | 0 | 0 |
| 1919 | 0 | 0 | | 2 | 1 | 3 |
| 1920 | 0 | 1 | 0 | 1 | 1 | 2 |
| 1921 | 1 | 2 | 3 | 0 | 0 | 4 |

years, notably 1916, show distinctly larger numbers of these occurrences than the present year. Neither does it appear that heavy local storms are necessarily associated with heavy annual precipitations, further than to augment the total accordingly. In fact, considering the two years 1916 and 1917, the former having the greatest number of heavy storms distributed through all the months and the latter the least of the years considered likewise through all the months, it appears that the former (1916) had really a less total rain during the five months considered than 1917, despite the lack of any larger number of heavy rains during the latter year.

However, in July, 1916, more than 22 in. fell at a point in western North Carolina in a similar period of time, and in June, 1886, more than 21 in. occurred at a point in Louisiana. The flood at Pueblo, Colo., in the early days of June, was not so much the result of unusually heavy rains, as to their occurrence in a region where the topographic conditions favored a quick and enormous run-off. Loss of life in these two floods was due to the fact that they occurred during the night.

## Suggested Remedies to Make Sewage Plants Function

### Weekly Reports, Competent Supervision and Explicit Directions as to Operation Believed Essentials Required

THE human factor involved in the operation of sewage-works in Iowa rather than the design or bacteria upon which the transformation of organic matter depends is responsible for such poor operation that the investment is now a waste of money. John H. Dunlap, professor of hydraulics and sanitary engineering, University of Iowa, made this statement Oct. 27 before the third Conference on the Operation of Iowa Sewage Treatment Plants. The three steps which he believes will do much to remedy the present deplorable state of affairs are as follows: (1) A provision for weekly reports; (2) operation under the charge of a competent sanitary engineer and (3) the preparation of a set of directions. His further statements are as follows:

To ascertain how far the human factor involved in the operation of sewage-works was performing its share of the work, a letter was sent to the sanitary engineer of the state board of health of every state, requesting an outline of the law, or of the rules, followed in the control of the operation of such plants. Judging from the 41 replies, apparently only 18 states are now requiring the submission and approval of plans for sewage-works by the state board of health. Only five states are requiring monthly reports: West Virginia, Michigan, Kansas, New Jersey and Ohio. Only one, New Jersey, is requiring licensed operators. The impression from reading these letters is that the general situation is very unsatisfactory. For instance, in the report of the Illinois department for the year ending June 30, 1920, the following statement occurs:

Experience has shown that there is a strong tendency among municipalities to neglect the operation of sewage-works. It is a common, fallacious idea that these works require little or no attention, and consequently, they are neglected until objectionable conditions prevail because of odors from the plant or because of stream pollution. Some sewage treatment plants have been so neglected that they have become permanently damaged and can be put back into operating condition only at considerable expense.

The situation in Connecticut is apparently much the same, as the following quotation from a letter from J. Frederick Jackson, director of the Bureau of Engineering, indicates:

I am sorry to say that very few of our plants, excepting the old sand filters, are properly operated. We endeavor to regulate them by occasional inspections and advice, but this is not satisfactory.

The writer was recently called in to advise a city council as to what was the matter with its sewage-works. An inspection of the plant was made, which revealed the following facts.

The Imhoff tanks were being operated like septic tanks, with a heavy scum on the sedimentation chambers and with the slots filled with sludge. The attendant in charge of the plant stated that he had been ordered by the city council to let this scum accumulate, since the council thought that this was the proper thing for the tanks and that they could not operate properly without the scum. On taking soundings to determine the depth of sludge, it was found that the sludge was solid from the bottom of the beam forming the slots to the bottom of the tanks. Since no perforated pipes had been placed in the bottom of the tanks at the time of construction, it was impossible to apply water under pressure and agitate the sludge. Accordingly it could not be removed from the sludge pipes. Due to this fact, the sludge was not as well ripened as it ought to be and dried

with difficulty on the sludge bed. Furthermore, trouble was experienced with foaming from the gas vents. It was found later that the sludge capacity of the sludge digestion compartments was altogether too small for the population now connected to the sewers.

Two of the four sand filter beds were badly pooled notwithstanding the fact that 18 in. of sand had been added two months before to one of the filters, and at the same time 12 in. of sand to the other. The remaining two filters of the plant were flooded with sewage 6 to 8 in. in depth, and the sewage was flowing over one of the underdrain vents at the corner of one of the filters. The filters were greatly overloaded, since their combined capacity was intended to serve only 2,200 people, whereas 6,000 people were using the sewers. Furthermore, the past season has been an unusually wet one, and this particular sewer system admits large amounts of ground water and also some storm water run-off.

It will be observed that the trouble with this plant was the human factor, which in this instance was principally

(To be printed on a Postcard)

WEEKLY OPERATION REPORT OF THE SEWAGE TREATMENT PLANT

At _____ Week ending _____ Submitted by _____

| Days | Sewage By-Passed: Hours | Counter: Reading | Counter: Time | Tanks (Cubic feet of Imhoff): Sludge: Depth | Sludge: Temp. | Settling Solids: Inf. | Settling Solids: Eff. | Filters (Sand, Sprinkling or Contact): Condition | Filters: Effluent Stability | Outlet into Creek (Name of River, Etc.): Stability | Hours Spent at Plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| M. | | | | | | | | | | | |
| T. | | | | | | | | | | | |
| W. | | | | | | | | | | | |
| T. | | | | | | | | | | | |
| F. | | | | | | | | | | | |
| S. | | | | | | | | | | | |
| 12 | | | | | | | | | | | |

(Write on postal card and mail to the State Sanitary Engineer at the proper postal card.)

Col. No.
1. Record hours when sewage was bypassed. Under remarks state reason.
2. Reading of counter in siphon chamber.
3. Exact time at which reading is taken.
4. Measure depth of sludge in tanks at several points and record average depth.
5. Cubic foot of sludge run out, computed from dimensions of sludge bed.
6. Find c.c. of settling solids in 1-hr. from influent. See directions for tests.
7. Find c.c. of settling solids in 1-hr. from effluent. See directions for tests.
8. Condition as to surface mat, pooling, evenness of distribution of sewage, etc.
9. Number of days' retention of blue color. See directions for tests.
10. Collect sample about 100 ft. below outlet and record days' retention of blue color.
11. Record the number of hours spent in work at the plant.
12. Under remarks, state any work done not included in columns 1-11, such as repairs, etc., during the week.

the city council of six members—five of whom took office this spring.

The way out of this inefficiency and waste capital consists of three steps, each of which, though perhaps difficult to take, is necessary if a suitable return is to be made upon the large investments now required in sewage-works.

The State Board of Health should require the operator of every sewage-works in the state to render a weekly report of daily operation. The form for such report can be printed upon one side of an ordinary postal card, and when filled out at the end of each week, mailed to the sanitary engineer of the State Board of Health. On the address side of the post card should be printed the address of the sanitary engineer of the State Board of Health, and then upon the left half of the front side can be printed certain directions as to what to record in each column.

It is believed that there are many advantages to be secured by requiring a weekly rather than a monthly report from Iowa plants. For instance, the report card for a week is small enough so that it may be carried in the pocket of the operator, and filled out on the job when the readings and tests are made. Furthermore, the weekly report will aid in securing daily visits to the plants, and prompt knowledge of neglect by the sanitary engineer of the State Board of Health.

While the suggested form does not go much into detail, it does contain sufficient facts to show the state sanitary engineer whether the plants are being operated properly. The facts called for are easily obtained. For instance in Column 1, the number of hours during which sewage is bypassed on any given day, and the reason for it, should be given in order that the state sanitary engineer may know just how much use is being made of the plant. The writer recently visited an expensive plant at which the sewage had been bypassed for a year's time, due to complete neglect on the part of the city authorities. Only after a threatened lawsuit was the plant put back into operation, and then naturally at considerable expense.

The counter contemplated in columns 2 and 3, is one of the simple devices now on the market, sold at a cost of $5.

The depth of sludge in the tanks, columns 4 and 5, is an important matter, especially at this season of the year when it must be ascertained whether or not there is enough room in the sludge compartments for the winter's sludge. The tests for settling solids in the influent and effluent, columns 6 and 7, are simple to make. Imhoff conical settling glasses are used. The average removal of settling solids by Imhoff tanks, as shown by the settling glasses, is about 95 per cent.

The condition of the filters, column 8, is an important part of the report since, on the average, two-thirds of the organic matter in sewage is in solution, and, therefore, must be oxidized by the action of the filters. The test for stability of the effluent, column 9, is easily made. A sample of the effluent may be caught in a 4-oz. bottle, to which is added by an ordinary pipette the proper proportion of methylene blue. The number of days' retention of blue color, when the sample is kept at room temperature, is then noted. If the sample retains its blue color for four days, no nuisance will be caused by discharging it into an ordinary creek or ditch.

The test for stability of the mixed river water and sewage effluent, column 10, is important in case the landowners below the plant should sue the city for damages due to supposed putrescibility of the creek water caused by the addition of sewage. The test is made in a manner similar to that upon the effluent from the filters. Full directions for these tests should be given in a small pamphlet to be issued by the state board of health.

The second step in the process of placing the operation of treatment plants upon a more scientific basis would be the appointment of a competent sanitary engineer in charge of a plant whenever the weekly operation report, or whenever a personal inspection on the part of the state sanitary engineer shows that the plant is not being operated properly. It would not be necessary for the sanitary engineer to devote much time to a given plant. By having copies of the weekly reports sent directly to him as well as to the sanitary engineer of the State Board of Health, and by giving the necessary instructions to the local attendant, proper operation of the plant could be obtained at all seasons of the year.

The third step in securing better operation of Iowa plants would include the preparation of a set of general directions for the operation of the various parts of sewage-works of all types. These directions should contain drawings and photographs of the proper tools to be used in carrying out the directions.

# ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

## Guide for Health and Sanitary Surveys

PUBLIC HEALTH SURVEYS: What They Are, How to Make Them, How to Use Them. By Morris P. Horwood, M. S., Ph.D., Instructor, Department of Biology and Public Health, Massachusetts Institute of Technology. With a Foreword by William T. Sedgwick and an Introduction by George C. Whipple. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible, 4½ x 7 in., pp. 168, illustrated. $4.50.

Surveys are rapidly becoming a popular and practical means of ascertaining the status of almost every kind of activity to learn what changes are needed for the sake of increased efficiency and to present these needs as graphically as possible to those whose interest and support are required. An investigation and report on a water-works made by a consulting engineer or a like report in any other engineering field might appropriately be called a survey, but the term is not often so used. Survey is now coming to have a special meaning confined chiefly to extra-official investigations. That is, the survey is made by or at the instance of some individual, institution or association, not itself responsible for the activity or group or activities surveyed.

In the public health field these surveys have been taking so wide a range as to include not merely health departments but also such other departments as are carrying on work which seems to affect, even though remotely, the public health. Thus, in the volume before us, we find chapters on water supply; drainage, sewerage, and sewage disposal; collection and disposal of refuse; milk supply; inspection of restaurants, lunch rooms, food stores; housing; school sanitation and hygiene, and hospitals. Some of these, as the author himself points out, have relatively little relation to public health.

The suggestive and inspiring Foreword by the late Prof. Sedgwick, the Introduction by Prof. Whipple and the three opening chapters by Mr. Horwood deal with public health surveys in general, as also do chapters toward the end on the survey report, getting results from surveys, and the value of surveys in public health campaigns. There are also chapters taking up in some detail the organization and activities of health departments, tuberculosis surveys, vital statistics, and budgets. A large part of the volume is occupied with material designed to show what constitutes a satisfactory water supply, for instance, and long lists of questions for use in making the surveys in the many fields covered. The book closes with a bibliography and a subject index.

Of the usefulness of Mr. Horwood's guide or manual to those engaged in public health and sanitary surveys there is no doubt. The book will also be useful to any city department in the fields treated which wish to have always in progress what might be termed a perpetual survey of their own department. This, in fact, is the ideal plan—an ideal which should also be extended under the direction of some leading official of the city so as to include and correlate the results of surveys of all city departments and their reactions as well upon the people for whose service city governments exist.

How far American cities are from such an ideal plan as has just been mentioned is well illustrated by the mere fact that public health surveys have become so common of late and that it is deemed necessary to carry them into such minute detail in so many city departments. By this we do not mean to imply that a general health survey at regular intervals, like periodic auditing of municipal accounts, would not be desirable even in an ideally governed city. The point is that such surveys as are detailed in this volume are what we have already termed as extra-official; and, moreover, that when made they often disclose disgracefully shocking and almost criminal lack of municipal efficiency. Otherwise, the mass of detail called for by this volume would be in existence, for one purpose or another, in every city.

Useful as Mr. Horwood's book promises to be, its usefulness might have been quite materially increased by picturing at the outset more clearly than is done anywhere in the book what constitutes thoroughly efficient sanitary and public health work, department by department. There might also well have been a clear indication of the order in which the various city activities involved should be taken up in the public health survey for the sake of (1) getting as quickly as possible a preview of the entire situation and then (2) of accumulating supplementary material as rapidly as may be in just that order which will make each step in the survey easier and tell more than the one before it.

The book contains too little on relative values of sanitary and health protective work as measured in terms of reduced sickness and death rates. Of the hundreds of questions listed under the various elements of the survey, there are many, the answers to which have only the remotest relation to sickness and death rates, if any relation whatever. For instance, of what advantage, in connection with such a survey, is it to know how many miles of sewers of different sizes there are in a city? Many of these questions might be omitted with advantage, or, if not omitted, use might be made of symbols to indicate what best could be ignored where lack of time or of funds make it impossible to carry out the complete survey program. This begets another suggestion, which is that there might well have been presented at the very beginning of the book an outline of a public health survey, with its elements arranged in order of importance: a public health survey score card arranged by percentages from matters of greatest to least importance.

## Another Government War Record

ACTIVITIES OF THE BUREAU OF YARDS AND DOCKS. Navy Department, Wood War, 1917-1919. Washington: The Department, 1921. 8 x 9 in., pp. 252, illustrated.

Civil engineering work of the army during the war was done by two or three different branches. In the Navy, however, it was solely in charge of the long established Bureau of Yards and Docks, expanded far beyond any previous experience to meet the war emergency. This book is the record of what the bureau did, and not only gives an extraordinarily vivid view of what the navy had to do in the way of structures, but also forms a good compendium of harbor structures and shop details such as were necessary to care for the tremendous activity of the navy during the war.

## The Railroads—An Economic Problem

THE AMERICAN RAILROAD PROBLEM. By M. A. Shaughnessy, Ph.D., Professor of Economics, Manhattan College, New York. Published by the Century Co., New York. Cloth; 6 x 9 in.; pp. 312. Illustrated. $2.50.

When an engineer reads an academic discussion of a great economic engineering problem, he is bound to feel that the author has overlooked adequate emphasis and detail development of vital engineering considerations, however able and thorough the discussion. So it is with this work. The book embodies a searching and learned economic analysis of the causes and the experience of Federal Control, the aftermath and the problems that must yet be faced. As such it is well worth the perusal of the thinking railroad engineer. The picture painted is not one of optimism, and renewed government operation—war government ownership—appears to be held out as a distinct possibility in consideration of the subject as a public problem.

From the public viewpoint, the author treats railroad transportation as a natural monopoly and is strong in his indictment of duplication of facilities. The terminal problem is only touched upon in the chapter Unification and Service, and many engineers may be surprised at the statement that shippers' abuse of reconsignment privileges even in normal times probably constituted the greatest single cause of terminal delays. Here, most engineers will feel that a great opportunity was lost, because of the opinion now held by some engineering authorities that complete unification of terminals bids fair to solve the problem without unification of systems. Again, engineers acquainted with recent and highly successful improvements in freight terminal practice and abandonment of antedeluvian methods, will not be quick to accept shippers' abuse of reconsignment privileges as the greatest cause of terminal delays. However, at this point of the discussion, the assumption is made that the Interstate Commerce Commission has no authority to force joint use and operation of terminals. As pointed out in another chapter of the book, the Transportation Act has vested the commission with mandatory powers to effect such joint use of terminals, while its authority to effect consolidations of systems is merely permissive. To engineers, it will therefore appear as a matter of expediency that the question of terminal betterment is worthy of first consideration.

As an economic discussion of the railroad problem, the book on the whole is so thorough that the engineer-reader may have some regret that it does not cover the national transportation problem, considered from the public viewpoint of proper administration and physical co-ordination of railroads, waterways and highways. However, such broader treatment might properly be adjudged outside the realm of purely economic discussion since it would involve features distinctly engineering in character.

A strong case is made for looking to intensive rather than extensive development of railroad plant to provide properly for future traffic demands—a most important aspect of the problem that deeply concerns the engineer. In addition to other elaborate statistical data, there is presented an analysis of the maintenance situation which has decided engineering interest.

The book brings its subject practically up to date and may be said to be a painstaking and learned economic discussion of our greatest after-war problem.

## Fifteen Years of London Water Studies

RESULTS OF CHEMICAL AND BACTERIOLOGICAL EXAMINATIONS OF THE LONDON WATERS: Report for Year Ended March 31, 1921. By Sir Alexander Houston, Director of Water Examination, Metropolitan Water Board, London. P. S. King & Son. Paper; 8 x 13 in.; 12 diagrams. 15s.

Sir Alexander Houston has made his fifteenth annual report the occasion for presenting, in addition to the usual data and comment for the year, a concise summary of his annual and his several special research reports on London water. The summary has all the more value because it is topical rather than chronological.

The main topics covered in the report are chlorination, resistance-to-filtration experiments, the vitality of B. Coli, of the typhoid bacillus, and of the cholera vibrio in river water; tests for distinguishing the vibrio and harmless water microbes, together with comments on various related bacterial searches, including those for streptococci and Morgan (No. 1) bacillus in river water; effects of storage upon the quality of river water; prefiltration studies and experiments with small rapid or mechanical filters; the use of coagulants in relation to purification. The report also contains enteric (typhoid) fever, meteorological, bacterial and chemical statistics.

American chemists, bacteriologists and sanitary engineers in charge of the quality of water supplies would do well to secure and study this report which teems with stimulating suggestions on water research and the interpretation of analytical data.

## The Art of Graphical Representation

GRAPHICAL METHODS FOR SCHOOLS, COLLEGES, STATISTICIANS, ENGINEERS AND EXECUTIVES. By William C. Marshall, M.E., C.E., Consulting Engineer. Formerly Professor of Machine Design, Sheffield Scientific School of Yale University; Consulting Engineer, Federal Sugar Refining Co., etc. Member A.S.M.E. and S.A.E. New York and London: McGraw-Hill Book Co. Cloth, 6 x 9 in., pp. 253, illustrated. $3.

The classes of users for which this book is intended are set forth by its subtitle and are made clearer yet by the Preface, where the author states that he has aimed to make the treatment in part mathematical but yet within the grasp of "anyone with a common school education, or higher." This aim seems to have been well attained.

After an introduction, the author describes various kinds of graphs and the making of diagrams. He then gives numerous applications. There follow chapters on Determination of Laws, Calculations, Nomography, and Mechanical Graphical Records. An extensive Bibliography contains (1) nearly thirty books and pamphlets and (2) many references to illustrative material in technical journals, society proceedings, handbooks, etc., topically presented under such heads as accounting, air, boilers, costs, gears, pipes, and so on through the alphabet.

The book deserves wide attention and close study by all who use or might well use graphical methods.

## Sketch of Moncure Robinson Republished

The rarely available "Professional Biography of Moncure Robinson," by R. B. Osborne, is reprinted in the William and Mary College *Quarterly Historical Magazine* for October (Williamsburg, Va.; $1 a number). Mr. Robinson was born in Richmond, Va., in 1802; graduated from William and Mary College at sixteen years of age; and began his professional career immediately by serving as a voluntary unpaid assistant

on a topographical survey and line of levels from Richmond to the Ohio River, being made by the Board of Public Works of Virginia. Mr. Robinson soon became an advocate of railways rather than canals, although for a time engaged in the construction of both. After a notable career of railroad building, including the Philadelphia & Reading, Mr. Robinson retired from professional work in 1847 to engage "in making investments * * * in productive improvements, considering it would be of more financial advantage to him than a further continuance in his active professional duty for others"—according to his biographer. Mr. Robinson died in 1891. The editors of the *Quarterly* state that the only copy of the privately printed biography by Mr. Osborne (written in 1888 and published in 1889) they have been able to find is in the John Crerar Library, Chicago.

# PUBLICATIONS RECEIVED

ACOUSTIC IMPEDANCE AND ITS MEASUREMENTS—By A. E. Kennelly and K. Kurokawa. Contribution from Electrical Engineering Research Division, Massachusetts Institute of Technology, Boston, Mass. Paper; 6 x 9 in.; pp. 42.

AMERICA AND THE BALANCE SHEET OF EUROPE—By John F. Bass, Author of "The Peace Tangle" and Harold G. Moulton, Author of "The Financial Organization of Society," etc. New York: The Ronald Press Company. Cloth; 5½ x 8 in.; pp. 361. $3.

The purpose of this volume, its preface says, is: "first, to determine the economic and political status of Europe at the present time; second, to appraise the probable effects of the international settlements (including reparations) that have recently been made; and third, to suggest in broad outlines an international policy such as it is believed the situation demands."

ANNUAL REPORT OF THE SOUTH AUSTRALIAN RAILWAYS COMMISSIONER, 1920-21—Adelaide. The Commission. Paper; 8 x 13 in.; pp. 56. Maps and charts.

CALCUL PRATIQUE DES POUTRES CONTINUES EN BETON ARME: En Tenant Compte de la Raideur des Colonnes par G. Magnel Répétiteur á l'Université de Gand Chef des Travaux au Laboratorie de Resistance des Matériaux. Publie avec le concours du Bureau Technique Vercoutre. Gand: Van Ryssel-berghe & Rombaut, Editeurs. Paper; 6 x 10 in.; pp. 60, with charts additional. 30 francs.

CANADA DEPARTMENT OF RAILWAYS AND CANALS: Annual Report, April 1, 1920, to March 31, 1921. Ottawa: The Department. Paper; 6 x 9 in.; pp. 204. 20c.

THE CITY PLAN OF HAMILTON, OHIO—Chamber of Commerce, 1920—By Harland Bartholomew, City Plan Engineer, St. Louis, Mo. Paper; 8 x 11 in.; pp. 66; illustrated.

A COURSE IN MECHANICAL DRAWING: For School Use and for Self-instruction, A Practical Treatise on the Art of Making Working Drawings, Lettering and Tracing—By Louis Rouillion, B. S., A. M., Director Mechanics Institute, New York City; Author of "Drafting of Cams," "Economics of Manual Training," etc. Fifteenth Edition, Revised and Enlarged. New York: The Norman W. Henley Publishing Co. Cloth; 8 x 6 in.; pp. 92; illustrated. $1.50.

DEPRECIATION: Its Treatment in Production—Washington, D. C.: Chamber of Commerce, Fabricated Production Department. Paper; 6 x 9 in.; pp. 23.

DEVELOPMENTS IN THE RAILWAY USES OF CONCRETE—By A. Charles Irwin. Bulletin 23, American Railway Engineering Association, Chicago, Ill. Paper; 6 x 9 in.; pp. 88; illustrated.

DIE KLASSISCHEN PROBLEME DER ANALYSIS DES UNENDLICHEN: Ein Lehr-Und Übungsbuch Für Studierende Zur Einführung in Die Infinitesimalrechnung von Dr. Gerhard Kowalewski, O. Professor der Mathematik an der Deutschen Technischen Hochschule Zu Prag. Zweite Auflage Mit 109 Figuren im Text. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 342. Paper, 70 marks; cloth, 95 marks.

DIE SAUGSTRAHLTURBINE von Dr. Hans Baudisch, Professor an der Staatlichen Hochschule für Technik, Bauwesen, Chemie, Bergbau und Maschinenwesen, Leipzig. Aus der Werft, Frank Dresden. Paper; 7 x 10 in.

EFFECT OF HYDRATED LIME AND OTHER POWDERED ADMIXTURES IN CONCRETE—By Duff A. Abrams, Professor in Charge of Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill. Paper; 6 x 9 in.; pp. 74; illustrated.

THE ELECTRICAL HANDLING OF MATERIALS: A Manual in Four Volumes on the Design, Construction and Application of Cranes, Conveyors, Hoists, Etc. Second Edition. By H. H. Houghton, M. Inst. M. E., M. Inst. E. E. Vol. I. Electrical Equipment. Cloth; 8½ x 10½, pp. 200, 231 figures in text. Vol. II. Structural Work. Cloth; 8½ x 10½, pp. 292; folding plates and 358 figures in text. London: Benn Brothers, Ltd. 25s each volume.

THE ENGINEERING FOUNDATION OF UNITED ENGINEERING SOCIETY. Am. Soc. C. E., A. I. M. & M. E., Am. Soc. M. E., A. I. E. E. Annual Report for Sixth Year, ended Feb. 20, 1921. New York: Engineering Societies Building. Paper; 7 x 10 in.; pp. 32.

FIRE PREVENTION AND FIRE PROTECTION: As applied to Building Construction, A Handbook of Theory and Practice—By Joseph Kendall Freitag, B. S., C. E., author of "Architectural Engineering," "The Fireproofing of Steel Buildings." Assoc. M. Am. Soc. C. E. Second Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Binding; 4½ x 7 in.; pp. 1038; illustrated. $5 postpaid. 30 net.

FIRE RESISTANCE OF CONCRETE AND REINFORCED CONCRETE—Red Books of British Fire Prevention Committee. Paper; 5 x 9 in.; 40 to 50 pp. each; tables and illustrations. London, England. His Majesty's Stationary Office. 2s. 6d. each.

No. 216: Cement Concrete Floors Composed of Concrete Slabs of Various Aggregates and Portland Cement.

No. 228: Cement Concrete Floors Composed of Thames Ballast Sand and Portland Cement.

Nos. 238, 246 and 248: Reinforced Concrete Slabs Composed of granite, various stones, burnt clay and stock brick.

A selected list of titles in continuation of those announced in this section, Aug. 18, 1921, p. 289.

FLOW OF WATER THROUGH 4, 6, 8 AND 10-IN. GALVANIZED SPIRAL RIVETED STEEL PIPE—By F. W. Greve, Associate Professor of Hydraulic Engineering, School of Civil Engineering, Purdue, Ind.: Engineering Experiment Station of Purdue University. Paper; 6 x 9 in.; pp. 32; illustrated. Some of the data in this bulletin were printed in *Engineering News-Record*, July 28, 1921, p. 159, in an article by Prof. Greve.

GOVERNOR OF THE PANAMA CANAL: Report for 1920-21—Balboa Heights, Canal Zone: Jay J. Morrow, Governor. Paper; 6 x 9 in.; pp. 117.

GRAPHICAL ANALYSIS: A Text Book on Graphic Statics—By William S. Wolfe, M. S., Head of Structural Department, Smith, Hinchman & Grylls. Formerly instructor in Architectural Engineering, University of Illinois. First Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 374; illustrated. $4.

GRAPHICAL METHODS FOR SCHOOLS, COLLEGES, STATISTICIANS, ENGINEERS AND EXECUTIVES—By William C. Marshall, M. E., C. E., Consulting Engineer; Formerly Professor of Machine Design, Sheffield Scientific School of Yale; Consulting Engineer, Federal Sugar Refining Co., etc.; Mem. A. S. M. E. and S. A. E. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 253; illustrated. $3.

HANDBUCH FUR EISENBETONBAU—Dritte Neubearbeitete Auflage, in Vierzehn Bänden. Herausgegeben von Dr. Ingenieur F. Emperger, Oberbaurat, Regierungsrat im Patentamt in Wien. Erster Band, Entwicklungsgeschichte, Versuche und Theorie Des Eisenbetons Bearbeitet von M. Foerster, O. Graf, M. Thullie, A. Kleinlogel, E. Richter, A. Berrer, J. Melan. Mit 1076 Textabbilduncen und 1 Tafel. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 800; illustrated. Paper, 186 marks; bound, 207 marks.

Chief among the extensive changes from prior editions of Vol. I. is found in the chapters on test results. Beam, slab and column tests are reviewed, as also special tests on pieces subjected to stress and pedestals. Tests on archs, treated separately, include measurements of temperature effects. The first editions of the four volumes comprising the entire work were reviewed in *Engineering News* as follows: Vol. I., April 16, 1908; Vol. II., March 12, 1908; Vol. III., Part 1, May 9, 1907, and Part 2, Aug. 8, 1907.

THE HUMAN FACTOR IN BUSINESS—By B. Seebohm Rowntree, Author of "Poverty: A Study of Town Life," "How the Labourer Lives," "The Human Needs of Labour," etc. London, New York, Bombay, Calcutta and Madras: Longman, Green & Co. Cloth; 5 x 7½ in.; pp. 173. $2 net.

INDUSTRIAL FATIGUE AND EFFICIENCY—By H. M. Vernon, M. A., M. D., Investigator for the Industrial Fatigue Research Board; Late Fellow of Magdalen College, Oxford. London, George Routledge & Sons, Ltd. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 264. $5.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Report of Annual Conference, 1921. Chicago: A. M. Modelmog, Secretary, 27 West Van Buren St. Paper; 8 x 11 in.; pp. 43; illustrated.

THE J. E. ALDRED LECTURES ON ENGINEERING PRACTICE 1920-1921—The Johns Hopkins University, School of Engineering, Baltimore, Md. Paper; 6 x 9 in., pp. 285, illustrated.

Three lectures each on civil, mechanical and electrical engineering subjects, including "Subway Construction in New York City," by Robert Ridgway, Engineer, Subway Construction, New York City; "Municipal River Front Improvements," by George S. Webster, Chief Engineer, Bureau of Surveys, Philadelphia, Pa.; "Modern Methods of Gas Manufacture," by Col. Frederick H. Wagner, Bartlett-Hayward Co., Baltimore; and "Electricity Supply Systems in Large Cities," by Philip Torchio, Chief Electrical Engineer, New York Edison Co., New York City.

THE LAW OF ZONING: By Herbert S. Swan, Zoning Consultant; A Review of the Constitutionality of Zoning Regulations Which Control Buildings in Accordance with a General Plan of Municipal Development. Supplement to National Municipal Review, Oct., 1921. New York: The National Municipal League. Paper; 6 x 10½ in., pp. 17.

[illegible]

LONDON OF TO-DAY—By The London Society under the Editorship of Sir Aston Webb, K. C. V. O. New York: E. P. [illegible] $12

MAINE STATE HIGHWAY COMMISSION—Report for 1920. [illegible]

MATHEMATICS OF ACCOUNTING AND FINANCE—By Seymour Walton, C. P. A., Dean of the Walton School of Commerce, Chicago, and H. A. Finney, C. P. A., Professor of Accounting, Northwestern University, Chicago. New York: The Ronald [illegible] $4.

MOTOR TRUCK TRANSPORTATION: The Principles Governing the Economical Use of Motor Trucks—By [illegible] Consulting Engineer on Motor Truck Transportation. New York: [illegible] New York: D. Van Nostrand Co. Cloth, 6 x 9 in., pp. 156, illustrated. $2

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Report for 1920. Trenton: The Commission. Cloth; 6 x 9 in., pp. 125.

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION—Report for 1921. Albany, N. Y.: The Commission. Cloth; [illegible] x 11 in., pp. 250, illustrated.

Includes report of C. M. Holland, chief engineer, covering traffic studies, design of tunnels, discussion of alternative construction methods, ventilation problems and experimental investigations. There are appendices on cast-iron tunnel analyses, and tunnel gas investigations.

NOS USINES METALLURGIQUES DEVASTEES—(1914-1918). Monographies De Quelques Grandes Usines Métallurgiques Françaises Detruites Par Les Allemands. Rédigées Par Un Groupe D'Ingénieurs. Introduction par M. Léon Guillet, Professor De Métallurgie Au Conservatoire Des Arts & Métiers et A L'École Centrale Des Arts & Manufactures. Paris: Editions De La Revue De Métallurgie. Paper; 9 x 11 in.; pp. 231; illustrated. 25 francs.

Text and half tones are effectively used to show the destruction of metallurgical works by the German invaders of France. In some cases the views show the works before and after destruction; in others, as destroyed and as since rebuilt.

OPPORTUNITIES FOR STUDY AT AMERICAN GRADUATE SCHOOLS—By George F. Zook, Specialist in Higher Education, Bureau of Education and Samuel P. Capen, Director of the American Council on Education. Washington, D. C.: Department of the Interior. Paper; 6 x 9 in.; pp. 59. 5c. from Superintendent of Documents.

POPULATION OF INCORPORATED PLACES: Prepared under the supervision of William C. Hunt, Chief Statistician for Population. (Reprint of Tables 51 and 52, pages 178-331, Volume I Fourteenth Census Reports.) Table 51—Population of Incorporated Places, 1920, 1910 and 1900, and Population of Wards of Incorporated Places Having 5,000 Inhabitants or More, 1920. Table 52—Population of Cities and Other Incorporated Places Having n 1920, 2,500 Inhabitants or More. Arranged in Groups According to Population: 1920, 1910 and 1900. Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 331. Complete copies of Vol. 1, $1.50 a copy, cloth bound, from Superintendent of Documents.

PRAKTISCHE WINKE ZUM STUDIUM DER STATIK UND ZUR ANWENDUNG IHRER DESETZE—Ein Handbuch für Studierende und praktisch tätige Ingenieure von Robert Otzen, Geheimer Regierungs-Rat und Professor an der Technischen Hochschule zu Hannover. Dritte Auflage Mit 125 Textfiguren. Berlin und Weisbaden: C. W. Kreidel's Verlag. Paper; 6 x 9 in.; pp. 178.

PRELIMINARY NOTE ON THE PURIFICATION OF WATER BY ACTIVATED SILT—By Gilbert J. Fowler and R. R. Deo. *Journal* of the Indian Institute of Science, April, 1921. Paper; [illegible] x 10 in., pp. [illegible] Department of Applied Chemistry, Indian Institute of Science. 6 annas.

An interesting and suggestive account of experiments on the removal of dissolved organic impurities from water by silt activation, suggested by the rapid oxidation of highly polluted heavily silt-laden Chinese and Indian rivers.

THE PREPARATION, TRANSPORTATION AND COMBUSTION [illegible] Department of Mines. Paper; 6 x 9 in.; pp. 131; illustrated.

PUBLIC HEALTH PROBLEMS IN MEXICO AND THEIR SOLUTION DURING THE LAST FIFTY YEARS: Contribution of the Mexican Department of Public Health to the Semi-Centennial Celebration of the American Public Health Association. City of Mexico: The Department. Paper; 6½ x [illegible]

[illegible] Them; How to Use Them—By Murray P. Horwood, M. S., Ph. D., Instructor, Department of Biology and Public Health, Massachusetts Institute of Technology. With a foreword by William [illegible] New York: John Wiley & Sons, Inc. London: Chapman & Hall, [illegible] $4

[illegible] versity Press. Cloth; 5 x 8 in.; pp. 119.

RAILWAY SIGNALING—By Everett Edgar Kink, Member of the American Railway Association, Signal Section, Member of the American Railway Engineering Association, Associate Member of the American Society of Civil Engineers; Professor of Railway Civil Engineering in the University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 371; illustrated. $4.

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA, 1920. Compared with the Official Reports for 1918 and Recent Statistics of Foreign Railways—Prepared by Slason Thompson, Bureau of Railway News and Statistics, Chicago, Ill. Paper; 5 x 8½ in.; pp. 147.

RANGE OF PRICES OF WATER-WORK MATERIALS—Compiled in the Office of Dabney H. Maury, Consulting Engineer, Monadnock Block, Chicago. Reprinted from *Engineering and Contracting*, Oct. 12, 1921. Paper; 8 x 11 in.; pp. 8.

Includes wrought iron and steel pipe, both black and galvanized, cast iron pipe, pig lead, structural shapes, reinforcing bars, portland cement, common brick, vitrified sewer pipe, and copper. The data are presented, in some cases, in both tabular and diagrammatic form. Many of the original figures are credited to *Engineering News* and *Engineering News-Record*.

SPECIAL LIBRARIES DIRECTORY—Edited by Dorsey W. Hyde, Jr., Washington:, Special Libraries Association. Paper; 6 x 9 in.; pp. 123.

Contains annotated list of subjects and a directory by states and cities, the latter with names of librarians. Some 1300 librarians are included.

STATE PARKS—By Harold A. Caparn, Landscape Architect, New York City. An Account of the Widening Movement to Preserve for All the People Choice Bits of Nature with Scenic, Historical, Recreational and Educational Values. Supplement to *National Municipal Review*, November, 1921. New York: The National Municip. l League. Paper; 7 x 10 in.; pp. 17; illustrated.

A SUPERPOWER SYSTEM FOR THE REGION BETWEEN BOSTON AND WASHINGTON—By W. S. Murray and Others. Washington, D. C.: U. S. Geological Survey. Paper; 9 x 11 in.; pp. 261; diagrams and folding maps.

An abstract of this report appeared in *Engineering News-Record*, Nov. 10, p. 738.

TABLES ANNUELLES DE CONSTANTES ET DONNEES NUMERIQUES DE CHIMIE, DE PHYSIQUE ET DE TECHNOLOGIE: Publiées sous le patronage de l'Union de Chimie pure et appliquée par le Comité international nommé par le VII Congrès de Chimie appliquée (Londres, 2 juin 1919)—By Secretaire general Ch. Marie, Dr. es Sciences. Vol. IV. Annees 1913-1914-1915-1916. Première Partie. Paris: Gauthier-Villars et Cie. Cambridge: The Cambridge University Press. Chicago: University of Chicago Press. Cloth; 9 x 11 in.; pp. 626; Postpaid $13.65.

Publication of these Annual Tables of Constants and Numerical Data, compiled by an International Commission, has now been resumed after interruption by the war. Part I (as above) contains constants from "compressibility" to "electricity." It is expected that Part II, covering the remaining constants, will be ready sometime in 1922.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS No. 198. Results of Some Tests of Manila Rope—By Ambrose H. Stang, Associate Physicist and Lory R. Strickenberg, Assistant Mechanical Engineer. Washington, D. C.: Paper; 7 x 10 in.; pp. 11. Free on application or 5c. from Superintendent of Documents.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS: Department of Commerce, Washington D. C. Paper; 7 x 10 in.

No. 201: Friction and Carrying Capacity of Ball and Roller Bearings—By H. L. Whittemore, Mechanical Engineer, and S. N. Petrenko, Assistant Mechanical Engineer. Pp. 34; illustrated. 10c. from Superintendent of Documents.

No. 113: Structure and Related Properties of Metals. Pp. 104; illustrated. 25c. from Superintendent of Documents.

No. 202: Results of a Survey of Elevator Interlocks and an Analysis of Elevator Accident Statistics—By C. E. Oakes, Electrical Engineer, and J. A. Dickinson, Mechanical Engineer. Pp. 30. 5c. from Superintendent of Documents.

TESTS OF PHYSICAL AND ELECTRICAL PROPERTIES OF SLATE—By Merton O. Fuller, Assistant Professor of Civil Engineering Laboratory, Lehigh University, Bethlehem, Pa.: The Author. Paper; 6 x 9 in.; pp. 34; illustrated.

VERANSCHLAGEN VON EISENBETANBAUTEN—Grundlagen fur den Entwerf und fur die Kostenberechnung von Tief—und Hochbauten. Mit mehreren der Praxis entnommenen Beispielen von Prof. Dr.-Ing. A. Kleinlogel, Privatdozent an der Technischen Hochschule in Darmstadt. Mit 23 Abbildungen. Zweite neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 123. 33 marks.

THE VOLUTE IN ARCHITECTURE AND ARCHITECTURAL ENGINEERING—By Rexford Newcomb. Bulletin 121, Engineering Experiment Station, Urbana, Ill.: University of Illinois. Paper; 6 x 9 in.; pp. 85; illustrated. 45c; limited number of copies free.

YEARBOOK OF THE CITY MANAGERS' ASSOCIATION, 1921—Clarksburgh, W. Va., H. G. Otis, Secretary. Paper; 6 x 9 in.; pp. [illegible]

Besides reports from many cities having managers and the general and technical proceedings of the 1920 convention, this [illegible] contains a list of manager cities revised to Aug. 15, 1921. The list gives the population of the city, whether the plan was adopted by ordinance or charter and when in effect, the name of the manager, when appointed, his salaries and the number of cities he has served as city manager.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are therefore, asked to make their letters short.*

## The Significance of Cleveland's Adoption of Proportional Representation

Sir—Your interesting editorial of Nov. 17 regarding the welcome news that Cleveland had adopted the city manager plan did not explain the great significance of proportional representation on which Cleveland is to base its new form of city government. May I add a few words on this point? For it offers much of interest to those who like to see sound principles respected in public affairs as well as in bridge design or railroad location.

Proportional representation ensures that no important group of like-minded voters will be without direct representation in the council, and each group will have representation of its own choice proportional in number to the size of the group. Such is the council which will appoint the city manager and direct the policies of Cleveland—a very different thing from the plan of cities like Dayton, where every member of the council may be unacceptable to nearly fifty per cent of the voters. By the Dayton plan the city is divided, it may be about equally, into the Ins and Outs. In Cleveland 85 to 95 per cent will constantly be the Ins. In this year's election, Cleveland followed the example not of Dayton but of its nearer neighbor, Ashtabula, and of Kalamazoo, Boulder, and Sacramento.

Proportional representation has long been advocated by sincere well-wishers of popular representative government. The fear that in spite of the actual simplicity of the voters' part, it would look too complicated to be acceptable to American voters has stood in its path. Sacramento and Cleveland show that this fear is groundless. It is already in use throughout Ireland, with the warm approval of Sinn Feiner and Unionist alike.

Proportional representation appeals widely (1) because it is so eminently fair; (2) it is so well suited to bring the ablest and most trusted leaders into public life; (3) it gives all minorities the best possible protection and an orderly and wholesome chance of carrying their point when their cause is just and ripe; and (4) all decisions rest finally and firmly with a genuine and informed majority. Incidently it does away with primaries—without retrogression.

And Sacramento and Cleveland have shown that the only important objection to it is fanciful, even in the case of large and varied population.

LEWIS JEROME JOHNSON,
Harvard University, Professor of Civil Engineering
Cambridge, Mass., Nov. 26.

## Highway Efficiency and Weak Bridges

Sir—I have read with considerable interest your article "A Question of Highway Efficiency," p. 759 of your Nov. 10 issue. Having served a number of years in bridge building I have seen highway bridges of the good, bad, and indifferent classes, and the wonder is that more of them have not failed under the present-day traffic.

When we consider a bridge designed for the light and slow-moving loads of the past, carrying the heavy loads of today, which are on the bridge and off again in less time than it takes to write it, creating an enormous impact which has never been considered in the design, then it is evident that something is radically wrong in our present method of design.

We are evidently penalizing the purchasers by excess material, either by playing safe or through our ignorance of the actual coefficients of strength of the various materials used. The accepted theory of stresses in framed structures enables us to determine the stress in any member of a structure when we have a specific loading, but determining the stresses is generally the smallest part of the work, and the design of members to carry the stresses safely is often a tax on the ingenuity and experience of the engineer.

The writer recalls a highway swing span which the county was considering replacing and which he considered absolutely dangerous, yet the county engineer was permitting use of the bridge without restrictions; and when the writer saw a tank wagon drawn by three horses cross the bridge without collapse of the structure the question of unit stresses and factors of safety seemed paramount. This bridge, of Pratt truss design, had one of the main diagonals on the inside of the truss broken, and the county authorities had bent the broken rod through the truss to the outside so that traffic might not become entangled. The trusses had adjusted themselves to the new conditions, shearing rivets through battens and lacing bars of the chords and vertical posts, the chords themselves forgetting the "straight and narrow path" they were designed to hold and each member assuming a position of least work; yet the bridge was carrying traffic in spite of all theory to the contrary.

It would seem that the solution of eliminating all highway bridges which today are too light is replacement. But, as such a financial burden cannot be considered, the next step would be to reinforce all such structures and properly police our roads to control the maximum loads carried over them.

C. H. OSBORNE.

Baltimore, Nov. 14.

## Using the Flow Table in Central Mixing for Concrete Roads

Sir—The article "Central Mixing for Concrete Roads" by C. S. Hill in the Oct. 20 issue of *Engineering News-Record* is especially interesting in view of the experimental work during the past few years in connection with the development of the "flow table."

It is apparent that the success of a central mixing plant is dependent upon the employment of a test which will accurately measure consistency and furnish a definite value for the tendency of segregate.

My experience with the flow table indicates that it furnishes a means of measuring consistency which is even more accurate than needed in the field and in the same operation a definite value can be obtained for the tendency to segregate. The jolting or bumping to which the mass of concrete is subjected on the table is very similar to that which occurs when the concrete is hauled over the road. The tendency to segregate on the table is even more pronounced since the mass is not confined laterally and there is nothing except the adhesion within the mass to prevent the large particles rolling out beyond the mortar line, or the mortar from spreading beyond the zone of the coarse aggregate, depending upon aggregate gradation, cement content and consistency.

From the beginning of the work with the flow table it was apparent that "workability" or tendency to segregate could be as accurately measured as "consistency." The behavior of different concretes is marked, depending upon the above mentioned factors of cement content, aggregate gradation, shape of aggregate, and consistency. Flowability is measured as the spread of the fine material in the mass, or the diameter of the mass within the mortar line. In some concretes, especially the drier or the leaner, large aggregate particles will be found beyond the mortar line. When excess water is present the mortar line will spread beyond the coarse aggregate mass. A definite value can be obtained for either of these conditions, which will serve as a measure of the tendency to segregate. Observation of condition after haulage will permit safe values to be established.

I believe that it is generally recognized by engineers who have had experience with both types of apparatus that the flow table is far more accurate than the slump test as a measure of consistency, but there appears to be the feeling that the flow table is not suited for field use. This feeling is quite similar to that directed toward any change or innovation in field practice which at first thought tends

to upset or modify established procedure. However, the added expense on any work of importance is too small to warrant consideration and no great amount of time or especial skill is required in carrying out the test. The results of the test are definite and conclusive and will result in adherence to established limits for consistency, a most important factor which is at present seldom specified. On road or building construction a few tests at the beginning of the work will furnish to everyone concerned with the production of concrete, from the superintendent down to the laborer who wheels and places, a definite idea of the extreme limits of consistency which will be permitted, and thereafter only occasional tests will be required as a check.

In the laboratory a little experience with the flow table permits the worker to attain any specified consistency at first trial and the flow table test serves merely to confirm his judgment, and we find that it is rarely necessary to adjust the water content and make a second test. It will be found in field work, that after a standard has been established with the table, few tests will be needed and the "consistency" factor can be as accurately controlled as that of proportioning, with little added effort.

I believe that a trial of the flow table in connection with the control of consistency and the measurement of tendency to segregate in the operation of central mixing plants will demonstrate its ability to fully meet the requirements which Mr. Hill has outlined as being necessary.

Saskatoon, Sask., Oct. 29. G. M. WILLIAMS,
Professor of Civil Engineering,
University of Saskatchewan.

## Effect of Motor Truck Tires on Unfinished Road Subgrade

Sir—Relative to road damage caused by contractor's trucks when equipped with pneumatic or with cushion tires, I submit the following, based on recent experiments made in our laboratory.

We have noted a belief on the part of certain high commissioners to the effect that the pneumatic truck tire does not injure incompleted road surfaces so much as does the solid or cushion tire. We manufacture the three types of tire, but in order to determine which was the proper type to recommend as equipment on road contractor's vehicles, we have made exhaustive experiments relative to area of road contact.

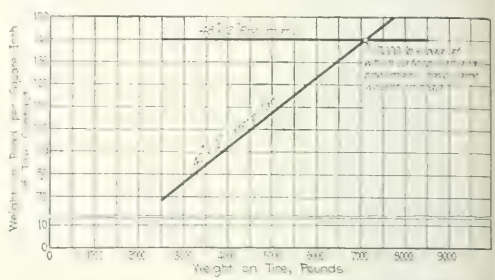
As we understand it, the damage created on the subgrade or incompleted road surface by tires is the "rutting" effect or tendency to make deep tracks in the soft ground. This is in reality a cutting action which is dependent upon the area of contact of the tire carrying the load, or rather upon the pressure of tire contact for each unit of contact area.

If we assume that the larger trucks are more efficient for highway construction work, we can consider the 5, 6, and 7½-ton sizes. The 6-ton truck will have a weight on each rear tire, when traveling empty, approximately 2,500 lb., and owing to the distribution of the load principally over the rear wheels, the weight carried by such rear tires when loaded will approximate 8,000 lb. or more.

If pneumatics are selected such a load would need to be carried on the largest tires yet produced and these have not as yet proved a commercial success. This size is the 48 x 12-in., which the manufacturers state must be kept inflated to a pressure of 140 lb. per sq.in. This is not only the pressure of the air within the tire but also represents the pressure upon the roadway for each square inch of tire area in contact with the surface. The peculiarity of a pneumatic tire is that this pressure per square inch of road contact is always the same whether the truck be loaded or empty and is dependent entirely upon the inflation pressure within that tire.

In the accompanying drawing the horizontal line indicates the pressure per square inch of road contact for the 48 x 12-in. tire under varying loads. This line is horizontal because the pressure does not change; the area of contact increases or decreases in proportion to the added or decreased load applied.

The 40 x 12-in. cushion tire, which will operate with considerably more resiliency than the solid tire and yet will retain practically all of the advantageous characteristics of the latter, will have a capacity of 10,000 lb., somewhat more than the 48 x 12-in. pneumatic. From our tests we have developed the relation between increase in road surface pressure per unit of contact area and increase in load carried by the tire. These results are indicated by the slanting line on the accompanying chart. From this it will be noted that when the truck is traveling empty with an approximate weight of 2,500 lb. on each rear wheel,




the caterpillar tire represents a pressure of but 68 lb. per sq.in. of road surface, whereas a pneumatic, under the same conditions, represents its constant 140 lb. As load is added to the caterpillar tire this pressure per square inch of road contact gradually increases until it equals the 140 lb. of the pneumatic when carrying a load of about 7,200 lb. or within 10% of the capacity of the pneumatic.

It will thus be seen that for all loads below 7,200 lb. the cushion tire-equipped truck represents more of a road-roller effect and less punishment to a soft road surface than does the pneumatic tire. For the final 10% of the maximum load, the pneumatic tire will have the advantage of a lower pressure per inch of road contact.

However, inasmuch as trucks of this size will not always be loaded to full capacity and will travel at least half of their distance with no load whatsoever except body and chassis, the average load will probably be in the neighborhood of 4,500 or 5,000 lb. on each wheel. Here the caterpillar tire represents a pressure of from 40 to 33 lb. less per inch of road contact than does the pneumatic.

We feel certain that this represents conclusive proof of the superiority of a properly designed cushion tire.

HAROLD W. SLAUSON.
New York City Engineering Service Manager,
Sept. 24. The Kelly-Springfield Tire Co.

## Earth Roads Treated with Steam Ashes and Cold Asphaltic Oil

Sir—In *Engineering News-Record* of Sept. 22, p. 477, we described the practice and experience with earth roads treated in the summer of 1920 with steam ashes and cold asphaltic oil. In 1920 about 7,000 tons of cinders were used. So few of the roads required treatment after the winter of 1920-21 and the results were so satisfactory that we have already used this season (1921) 23,000 tons of cinders, corresponding to about 25 miles of roadway. The practice in 1921, as compared with that of 1920, has been simplified and shortened as described below:

The earth road is honed and shaped with a tractor and road machine. The cinders, spread by laborers with coal scoops to an average thickness of 4 to 6 in., are then slightly compacted by a short rolling with a 10-ton roller. Asphaltic oil is next applied from a gravity distributor at the rate of ⅓ to ½ gal. per square yard and the roadway is given a final and thorough rolling with the 10-ton roller. The result is a firm smooth surface approaching the best macadam pavement in appearance and stability.

The total cost in 1920 was $0.27 per square yard and in 1921 $0.258, wages being the same in both years.

Office of President, Borough of Queens, New York, Nov. 12. FRED. H. SHEPHEARD AND E. E. BUTTERFIELD.

# HINTS FOR THE CONTRACTOR

## Cattle Guard Saves Valuable Time on Truck Hauling Job

THE ROAD over which materials were delivered by motor truck to the Kern Canyon hydroelectric rroject in California passed through lands used for pasturing stock. Gates had to be kept closed, thus entailing truck delays which amounted to a serious inconvenience when materials were going in in large quantities. To avoid the necessity for stopping trucks at gates, cattle-guards, similar to those used on railways, were built as shown in the accompanying illustration.

The construction consisted chiefly of a series of transverse timbers or joists, 6 in. apart, with longitudinal

CATTLE GUARD ON A CONSTRUCTION JOB

headers between them on 18-in. centers. Each joist was made up of two 2 x 8-in. pieces, spiked together. By placing these guards beside the ordinary gates there was always the option of using guard or gate, the latter being sometimes preferable as in the case of very heavy truck loads, men on horseback, etc.

The use of cattle guards on this job is credited to R. C. Starr, construction engineer, San Joaquin Light & Power Corporation.

## Cost of Steam Shovel Work in Building Logging Railroads

AS MORE modern methods come into vogue throughout the logging industry, equipment formerly used only in the more extensive operations is being employed by smaller companies to reduce unit costs or to speed up production. Some aspects of this situation were brought out in a paper by Minot Davis, Clemons Logging Co., Tacoma, Wash., read at the recent Pacific Logging Congress, in which there were detailed figures on the saving effected by this company in laying out their railroad construction and other excavation work so it would be economical to use a steam shovel.

Material encountered is largely in one of three classifications, namely, clay, loose rock or solid rock. The "loose rock" is a soft red or brown shale which is handled very rapidly after it has been loosened up with a few blasts. It stands on a very steep slope and is highly satisfactory material for handling with a steam shovel. The "hard rock" is a comparatively soft, blue sandstone which, nevertheless, requires fairly heavy shooting and has a tendency to break in large chunks. The average of these classifications has been 40 per cent clay, 40 per cent loose rock and 20 per cent solid rock. In the following discussion of comparative costs this average is assumed.

At the time the first shovel was bought the company was confronted with the necessity of building as quickly as possible 1½ miles of railway which involved moving 60,000 cu.yd. of material. The contractors' bids were not less than $1 per yard, lumping all classes of material. However, by selecting the easier parts of the work contracts were finally awarded on an average of 72 cents per yard, the contracts being made directly with station men.

The greater part of the work was then done with a steam shovel. In six months the shovel had moved about 40,000 cu.yd. of material, at a cost after charging off all overhead, including depreciation, of $6,400 less than it would have totaled on the 72-cent station-man basis. The comparison is based on the theoretical amount of yardage as cross-sectioned and staked by the engineers. The steam shovel actually removed 10 to 15 per cent more material than the stakes called for, while the station men worked very close to theoretical quantities.

The company now operates two shovels, one having a ¾ and the other a ⅜-cu.yd. dipper. Both are of the revolving type mounted on caterpillar treads which is believed to be the only practical type for all-around construction such as is required in a logging operation. Both are equipped with a boom-hoist which is regarded as a necessity. The larger shovel weighs 30 tons and its rear end projects 11 ft. from the center bearing. The smaller shovel weighs 26 tons and has a rear projection of 9 ft.

While the larger shovel is more useful in handling solid rock which breaks in large chunks, it has to move more material in order to clear itself than does the light shovel, and this disadvantage is not believed to be offset by the larger capacity. Where the cuts will not be more than 15 ft. in depth and the road bed not more than 16 ft. wide, it is concluded that a light shovel is superior.

A good grade of mine-run steam coal is used for fuel. When the shovels are away from the railroad, the coal is delivered in sacks on a horse-drawn sled. Each shovel burns an average of one ton of coal per day.

Both shovels are kept in almost constant use. When not engaged in building railroad extensions they are employed in grading camp sites, landings and donkey settings and are frequently used in grubbing or "chunking-out" which they can do on steep and broken ground where it would be almost impossible to do this with a donkey engine. In order to handle this work to good advantage, one of the shovels has an auxiliary drum whence a cable passes through a small block hung on one side of the boom. With this it is possible to "chunk-out" as much as 200 or 300 ft. from the shovel.

From Jan. 1 to Aug. 10 this year the two shovels graded 2.99 miles of railway, moving 67,000 cu.yd. of material. The total cost of this work was as follows:

| | |
|---|---|
| [illegible] | $1,200 |
| [illegible] | [illegible] |
| [illegible] | 300 |
| [illegible] | 1,700 |
| [illegible] | 1,100 |
| [illegible] | 1,100 |
| [illegible] | 1,800 |
| [illegible] | [illegible] |

This averages 47 cents per cubic yard. If this could have been contracted for 30, 60 and 100 cents per cubic yard for the three classes of materials, which is doubtful, the average cost per yard would have been 56 cents, or a balance of 9 cents per yard in favor of the shovels.

# NEWS OF THE WEEK

New York, December 15, 1921

## Highway Officials Want Continuity in Federal Aid

### Interlocking State and Federal Problems Discussed at Omaha Meeting—Committee Work Extensive—Manual Projected

Nearly every phase of highway development, finance, design, construction and operation was touched upon Dec. 5, 6, 7, and 8 at the annual meeting in Omaha of the American Association of Highway Officials. Only ten assigned subjects were scheduled, but practically every topic was handled by at least two men and sufficient time was therefore available for discussion, which was entered into freely. Location economics was probably the feature subject. Research co-ordination, future traffic, safety, aesthetics in design and maintenance administration were treated exhaustively. Projected federal-aid policies and graphic descriptions of the daily curling or warping of concrete under temperature and moisture changes elicited spirited discussion.

Reports of committees indicated that the organization is approaching one of its most valuable services, that of close comparison and broad standardization. Not much progress has been made yet beyond the first step, that of the collection of data as to standards in the various states. The aim of the bridge committee is eventually to produce a manual of recommended practice. The committee on tests has divided the country into nine districts where similar conditions will make similar specification limits possible, but it hopes to make methods of determining those limits universal.

#### Administrative Problems

*Location Economics* — C. J. Bennett, state highway commissioner of Connecticut, in his treatment of location economics, held that practically every case was special and that few rules were generally applicable. One of the fundamentals, he said, is to spend only an amount from which the public can get an adequate return. Final locations may not be possible for years.

F. F. Rogers, commissioner, Michigan, in discussion, referred to tests in Iowa by Prof. T. R. Agg, which indicated that for motor vehicles a rolling grade is more economical of gas than unbroken grades because of wind retardation at the higher speeds attained in descending the longer grades.

Frank T. Sheets, superintendent of highways, Illinois, stated that officials should hold vigorously to the proper location. On 85 per cent of 3,000 miles of interurban roads in Illinois there was no justification for running around all section corners. In a relocation of portions of the Chicago—Springfield line a saving of 40 miles is affected by an air line paralleling a railroad. With an estimated 3,000 vehicles daily, at 10c. per mile, the savings are enormous. R. J. Windrow, state highway engineer, Texas, said he considered proper location the greatest problem, since locations made now are probably final. He mentioned moving 142 hours in 136 miles. In 6 miles between Ft. Worth and Dallas a relocated road eliminated 7 grade crossings.

*(Continued on p. 1000)*

### Name Bridge for Engineer

**The Minneapolis City Council has named the concrete bridge over the Mississippi River at Franklin Avenue, now under construction, the "Cappelen Memorial Bridge" in tribute to F. W. Cappelen, former city engineer, who died recently. The structure will cost in excess of $1,000,000.**

### Alabama to Vote Again on $25,000,000 Road Bonds

Gov. Thomas E. Kilby of Alabama has issued a proclamation calling for a special election on Jan. 30, 1922 to vote on a $25,000,000 highway bond issue. If this bond issue passes, roads will be built by the State Highway Department connecting every county seat in the state. Not less than $250,000 plus federal aid will be spent in each county on state trunk roads and bridges.

Little doubt is expressed as to the passage of this bill. The original bill which was declared unconstitutional passed the people by approximately a 7 to 1 vote. Since its annulment about 10 counties have voted for bond issues, the money to be turned over to the state highway department. All of these elections went in favor of the bond issues by votes ranging for 2 to 1 to 10 to 1.

### Chicago Opens Large Double-Deck Bascule Bridge

The 268-ft. double-deck double-leaf bascule bridge over the Chicago River at Wells St. was put in service for the elevated railway on Dec. 4, railway traffic having been continued over the old swing bridge until the evening of Dec. 2. Under the original program, outlined in *Engineering News-Record* of Sept. 13, p. 606, this traffic was to be stopped from Saturday morning to Monday morning, but in view of the heavy Monday morning traffic it was decided to advance the time and have the bridge ready on Sunday evening. With the old bridge swung to the open position and blocked up on the rest pier, it was cut apart by torches and the members of the middle portion removed by cranes, leaving a gap into which the leaves of the bascule were lowered. Owing to the grade of the bridge being above that of the old structure, necessitating street alterations at the south end, the lower or roadway deck is not open to traffic. It is expected the bridge and approaches will be completed by the end of the year.

## Passenger Terminal for Cleveland Authorized

### Interstate Commerce Commission Reverses Decision Made Public August 12

Reversing its decision made public Aug. 12, the Interstate Commerce Commission on Dec. 7 authorized the New York Central, the New York, Chicago and St. Louis and the Cleveland, Cincinnati, Chicago and St. Louis Railroads to acquire control of the Cleveland Union Terminals Co. and to construct and operate a terminal station for passenger trains in the Cleveland Public Square.

Issuance of a certificate of public convenience to the carrier applicants was denied in August by the Commission on the ground that it was not persuaded by the evidence presented that the plan was compatible with public interest or that sanction should be given it owing to the enormous expenditure involved. At the time the application was dismissed, however, the majority opinion held that "possible the presentation of further evidence or the modification of the plan in various particulars might make possible a different conclusion." No changes in the physical aspects of the plan have been made in the meantime, though some fiscal changes have been made.

In its opinion made public Dec. 7 the commission found that "It is conceded by all parties that the existing passenger terminal facilities are antiquated and entirely inadequate. The opinion further finds that "evidence as to congestion during times of normal as well as heavy traffic movement is persuasive that additional facilities are imperatively needed."

#### Advantage of New Project

The plan proposes an additional route through Cleveland for the through business of the applicant railroads and a separate and independent passenger route from Collinwood on the east to Berea on the west, with the complete segregation of passenger movement through the city, thus leaving the full capacity of the lake-front tracks and of the Cleveland Short Line available for freight movement only.

It was pointed out in the opinion that the original estimates of the cost of the project were made on the basis of 1920 prices and that these estimates as now shown by the applicants may be reduced by an average of about 20 per cent on account of the present lower cost of labor and materials.

In a dissenting opinion Commissioner Eastman finds that it is difficult "to reach the conclusion that the new passenger route of the Public Square plan will be any more effectual in the relief of railroad congestion than the eight main tracks through Cleveland and the elimination of present obstacles to the free movement of traffic which would result at much smaller expenditure of capital from the adoption of the Mall plan." (See *Engineering News-Record* Aug. 18, 1921, p. 297.)

*Want Federal Aid Extended*

*According to the Secretary of War the agriculture bloc in the U. S. Senate has on its program legislation looking to the further extension of federal aid to so-called farm-to-market roads. Secretary Weeks sounds a note of warning against extending federal aid to highways entirely local in character.*

## Marshal Foch Honored by Engineering Societies

**Membership in Civil, Mechanical, Electrical and Mining Bodies Conferred in New York**

In the presence of an audience which filled to capacity the auditorium of the Engineering Societies' Building in New York City, honorary membership in the four national societies of civil, mechanical, electrical, and mining engineering was conferred upon Ferdinand Foch, Marshal of France, at a ceremony held Dec. 13, on the eve of his departure from the United States. This is the first time that any one man has held honorary membership in the four founder societies.

J. Vipond Davies, consulting engineer of New York City and president of the United Engineering Society, presided and introduced as the first speaker Col. William Barclay Parsons, who served during the war as commanding officer of the 11th Engineers in France. After a brief address in French, Col. Parsons introduced George S. Webster, president of the American Society of Civil Engineers, who conferred upon Marshal Foch certificates of honorary membership on behalf of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers.

Mr. Webster, in making the presentation, said:

"Ferdinand Foch, Marshal of France, Commander in Chief of the victorious armies of the Allies, master of military strategy, foremost military engineer, the hope of the civilized world during the dark days of the War, idol of the exponents of liberty and justice, military genius whose effective coordination of the armies of the Allies and whose indomitable will inspired them with the hope and the renewed vigor which brought the World War to a successful close!

"In recognition of these achievements and of your unparalleled service to mankind, I have the honor on behalf of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, to present to you this certificate of honorary membership, signed by the president and secretary of each society, and also these emblems of membership in the societies."

In accepting honorary membership in the four national engineering societies, Marshall Foch said:

"It was due largely to the engineers and the engineering industries that the war was brought to a successful conclusion. The armies could not have accomplished much without the effort of the engineer. Success was made possible to a great extent by the industry of the people at home, but when decisive moments arrived the engineer stood out as an essential factor in attaining success.

"What would have become of the armies without the engineering industries and without the professional knowledge which you exercised and which enabled us to lead our armies in the field, to feed them, to protect them and to facilitate their forward moment?

"It is for these reasons that I am pleased to be here today, to receive so splendid a welcome, to express my gratitude and that of France and of all my countrymen for the splendid sacrifices made by the men of your calling. I am grateful to you for including me in your ranks as one of the members of your four national engineering societies. This honor I deeply appreciate, and I shall always cherish this event with the happiest memories."

## Would Prevent Turning Schoharie Into Catskill Aqueduct

A suit to enjoin the diversion of Schoharie Creek from the Mohawk River southward into the Ashokan reservoir of the Catskill aqueduct water supply of New York City, or for $1,000,000 damages if the diversion is not enjoined, has been brought by the Cohoes Power & Light Co. The company claims perpetual rights to the Mohawk flow in excess of what is needed for Erie Canal navigation.

## Hearings on Polluting Navigable Waters by Oil and Acid

The House Committee on Rivers and Harbors was to begin hearings Dec. 7 on two bills (H.R. 7369 and 7430) designed to prohibit the discharge into navigable waters of any oil or oil wastes and on a third bill (H.R. 8783) covering acids and acid wastes in a like manner. One of the oil bills is new legislation, a simple prohibition, while the other amends Sec. 13 of the River and Harbor Act of March 3, 1889, with substantially the same intent as the first bill, but with more explicitness. The acid bill is also an amendment to the River and Harbor Act of 1889.

# Criticism of Joint Committee Report Heard in Two-Day Meeting

**Main Objection to Concrete Specifications Against Strength Guarantee Clause—Some Design Provisions Attacked**

On Dec. 7 and 8, in New York City, the American Society of Civil Engineers held a six-session meeting to discuss the Tentative Specifications for Concrete and Reinforced Concrete issued last June by the Joint Committee on Concrete and Reinforced Concrete. This is the first open meeting at which these specifications have been considered in pursuance of the program whereby each of the constituent societies could criticise and discuss the report for from six months to a year before referring it back to the committee for consideration in preparing a final specification. From 50 to 300 men were in attendance at the various sessions.

The scheme followed was to receive discussions of specific sections of the specifications at certain sessions, and to confine the discussions quite closely to the announced sections. It was made plain that the committee was present mainly to hear comment and not to defend the specifications. After some controversy early in the meeting, the chairman, Richard L. Humphrey, who is also chairman of the Joint Committee, stated that members of the committee present would be glad to explain anything in the specifications, but it proved that this meant in the main that they would clear up any obscure clauses and not that the reasons governing the writing of the clauses would be gone into. In the matter of column and flat slab design the basis for the specifications was freely stated; in some other instances, notably in the rail-steel bar discussion, the committee chose to stand on the report as printed without explanation.

### Discuss Scope of Report

As a necessary piece of information in the conduct of its work, the committee sought light from those present as to the scope of the present report, whether it were better to confine it entirely to building or whether to include in complete form or by high spot references the other types of construction, such as bridges, dams, chimneys, reservoirs, etc., and whether it would be most useful in the form of a specification or as recommended practice. Those who discussed this inquiry were neither in accord nor apparently quite clear individually as to what this scope should be. It was admitted that it would be impossible to prepare specifications for all types of reinforced-concrete construction, but no one was able to lay down a strict line of demarcation by which only the basic principles would be treated, nor to offer constructive criticism of the present form except to point out, for instance, that in the table of stresses there was no provision made for a unit stress in a reinforced-concrete arch rib and to suggest that the specifications as written lean somewhat too heavily to buildings.

It was also contended that inasmuch as such failures, mainly in surface disintegration, as are occurring in concrete today are found in outdoor structures that there might well be a distinction between units in buildings as specified in the current specifications and the identical units in an outdoor structure subject to the vicissitudes of weather. Furthermore, there were certain of the speakers, governed apparently by their antagonism to certain specific clauses in the tentative specifications, who held that it is not proper rigidly to specify such things as are in this document, but they had better be put forward as recommended practice. It was admitted that this would allow much greater flexibility in the treatment of the subject, but that at the same time would make it difficult to delimit the extent of the report.

The major part of two of the sessions was given over to discussions led by commercial interests who felt that they had been militated against in the report. The first of these discussions was led

by the advocates of so-called integral waterproofing who opposed the clause "No integral waterproofing shall be used." Their contentions were mainly statements of theoretical action of such waterproofers and experience statements as to the use of the integral compounds with great success. It should be said, however, that those having such compounds to sell were backed up by several independent engineers who seemed to feel that they had been successful with integral waterproofing in the past and that it was unwise to forbid its use. No actual facts for or against integral waterproofing were advanced.

### Commercial Interests Heard

The second commercial discussion waged around the reduction of the unit stress in rail-steel bars, which are credited in the specifications with 16,000 lb. as against 18,000 lb. for intermediate and hard grade billet steel bars. Here, too, the discussion was entirely ex parte.

The most serious opposition to the specifications was that voiced against the first two alternate clauses in Section 28, which specifies the proportions of the concrete. The second of these clauses certainly and the first in the opinion of some put full responsibility for the proportioning and mixing of the concrete on the contractor, the engineer merely specifying the strength to be reached in cylinder tests at the end of 28 days. Opinion from the floor was unanimous against this clause. It was contended to be unethical in that it relieved the engineer of his necessary and desired responsibility and unworkable in that it provided for the rejection of material which at the time its rejection was decided upon would be in most cases an integral part of a structure, irremovable without wrecking the structure or at least seriously damaging it. The inconsistency and unreliability of 28-day cylinder tests were pointed out and the possibility of manipulation of tests so as to still further increase such disparity prophesied. Generally it was contended that while the art of concrete had greatly progressed and that while specifying quality and strength was something which could possibly be hoped for, the present state of the art was not such that a strength could be absolutely guaranteed and that it was plainly the duty of the engineer to take the chances involved in attempting to produce a given strength.

It was suggested by a number of speakers that the clause could well be rewritten so that the engineer should specify a tentative proportion which he hoped would produce the greatest strength and on which the contractor would bid, at the same time bidding on additional units of cement and possibly of aggregate, so that the engineer could readily shift his proportions during construction provided the tests he himself made seemed to show that his assumed proportions were not up to his required strength. In defense of the clause, Prof. D. A. Abrams, of the committee stated that there was much misapprehension as to the clause, that it was not intended to harm the contractor as many of them seemed to think, but to give him the advantage of being able to produce an acceptable concrete at a lower cost. He said it would not necessarily require wrecking, because there are many ways of improving concrete after it has set by more curing, heating, etc. However, he thought if removal is necessary would it not be better to remove the structure than to have it fall down? He said that a great deal of current concrete is not satisfactory and that some way must be devised for producing better concrete. The committee felt that this might be one way in which this could be done.

### Minor Details Criticized

There were a number of specific criticisms of minor details of design, some of which, it was admitted by members of the committee, were still a subject of discussion in the committee; others of which, it was pointed out, were in error or typographically incorrect. The main criticism of the design came from New York contractors who had made an analysis of a typical reinforced-concrete building designed under the provisions of the present New York code and of the proposed tentative specification. It was found that a flat-slab building of the assumed size and loading would cost about 11 per cent more under current prices by the specification than it would by the New York code and that a beam-and-girder building would cost for the lighter load around 5 per cent and about the same for extremely heavy loads (600 lb. per square foot). They asked the Joint Committee approximately the following question: How can we tell our clients who are successfully using buildings which we have built under the New York code or codes stricter than the New York code that the buildings which we will build them under the new specifications are worth from 10 to 15 per cent more than the ones which they now occupy? In other words, they asked for specific statement of the superiority of service to be gained by the stricter regulations of the tentative specifications. In reply members of the committee stated that in the first place the tentative specifications give higher unit stresses than the New York code in everything except columns, in which it is contended that the New York code is extraordinarily bold. Furthermore, they said that the added cost in the analysis submitted is due mainly to the extra expense of producing what the tentative specification calls a 2,000-lb. concrete, and in the opinion of the members who spoke the probabilities are that the so-called 2,000-lb. concrete that is being produced under the New York code is not 2,000-lb. concrete. In other words, the buildings required under the tentative specification would be stronger than the ones now being built in New York City.

### Source of Column Formula

F. R. MacMillan, of the committee, explained the source of the column formula which is radically different from any other formula yet suggested for concrete columns. It is based on data published in the 1921 *Proceedings* of the American Concrete Institute, and takes into account the shrinkage of concrete during setting, the initial tension in steel introduced by this shrinkage, and the flow of concrete under load. The rational formula to meet these conditions was set forth in the A.C.I. paper noted. The formula in the specification is a simpler algebraic form practically duplicating the curve of the other formula, which explains its apparent lack of rationality. No contention was made by any of the speakers that the formula was wrong or that the other formulas were right. The entire contention was that this gave a more expensive column than the formulas which have apparently produced satisfactory columns.

Some opposition to the design provisions was expressed by Edward Godfrey, who contended that decreasing the mid-beam moment coefficient from $\frac{1}{20}$ to $\frac{1}{16}$ and at the same time increasing the unit stress from 650 lb. to 800 lb. was in effect increasing on a ratio of 39 to 64, which, in his opinion, was "an enormous degradation of design standards." Mr. Godfrey contended, furthermore, that we must not get away from the average concrete produced on the job and not attempt to specify fancy concrete according to laboratory method which could not be reached in the field. He was also not yet satisfied with the shear provisions of the specification which have been a point of attack by him for years.

### Prof. Talbot's Views

Prof. A. N. Talbot stated that while he was not altogether prepared to accept the 800-lb. per square inch flexural stress noted, the use of that certainly deserved consideration and that the factor of safety was probably greater than the ratio of 2,000 to 800 lb. In the first place, he said, the stress-strain relation was not a straight line, but rather a parabola which increases the load carrying capacity of the beam and changes the factor of safety from about $2\frac{1}{2}$ to about 3 or more. Also, when concrete is under compression in flexure the actual strain before failure is more than in direct compression, which adds to the factor of safety another 20 per cent, raising the total ratio up to about $3\frac{1}{2}$ to 4. On the other hand, he said, when concrete is repeatedly stressed the actual point of failure may be lower than for a single application which reduces the ratio to about 3, or at least as great as the ratio between the 16,000 lb. of the steel and its 40,000 lb. elastic limit. He repeated, however, that it should be given earnest consideration whether this was enough. He felt, on the contrary, that the 900 lb. and the negative moment might be too high. In further discussion of this factor of safety the familiar fact was pointed out that in reality the factor of safety is much greater than the ratio between the unit stress and the compressive limit of the concrete, because the unit stress is arrived at by the action of both dead and live-load and the added load which can cause failure can only be a live-load, so that the ratio of the design live-load to the live-load which would cause failure is greater than the direct ratio of the safe compression and the breaking load of the concrete.

Very little discussion was devoted to the flat-slab specifications, about the only comment being that they appeared to require a more expensive structure than would be required under most of the current codes. Objection was registered to the footing design and it was admitted by members of the committee that they were by no means satisfied with these provisions.

Taken all in all, the criticisms seem to divide into two classes—those by engineers who opposed or were concerned about certain more or less minor details of design practice, and those by contractors who seemed to feel that the specifications tended greatly to add to the cost of concrete work without compensating improvements. The latter were greatly in the majority.

## Paving Brick Manufacturers Take Important Action

**Endorse Simplification of Varieties—To Promote Brick for Sewers and Bridges**

Endorsement of the simplification of paving brick varieties recommended at the recent Department of Commerce Conference in Washington, D. C., the determination to promote the use of vitrified brick for sewer and bridge construction, and the approval of asphalt filler as the preferred type were the outstanding features of the annual conference of the National Paving Brick Manufacturers' Association which was held in Pittsburgh, Dec. 6 and 7. The reports of the board of directors, the secretary and the treasurer showed that the association was vigorously functioning and that the financial condition was sound. O. W. Renkert, president, presided at the meetings.

Much interest was shown in the variety elimination accomplished at Washington. The recommendations as to the elimination were unanimously approved and the new standard sizes will be included in the association's specifications. The creation of the standing committee on further elimination was approved, the association going on record as believing that further eliminations were desirable.

The determination to promote vitrified brick for sewer and bridge work as well as for pavements followed a report by Will P. Blair, vice-president, presenting the results of study of the successful use of brick in such structures.

### Asphalt Filler Endorsed

The resolution endorsing asphalt filler as the preferred type set forth that the associations' studies had shown for some time a decided trend toward the use of asphalt filler, that 60 per cent of the brick pavements laid this year were so filled, and that it was clear that the majority of engineers and public officials were convinced that such filler insured the construction of durable and economical pavements. The association, however, in expressing its confidence in and preference for asphalt-filled brick pavements properly designed and built, did so with the qualification that its expression of preference was without prejudice to any other type which might possess peculiar adaption to special local conditions. The resolution covering this matter was recommended by an engineering committee composed of J. R. Marker, W. C. Perkins, R. H. MacKinley, Will P. Blair and M. B. Greenough.

Among the forward-looking activities provided for in the budget were appropriations for research and for devising a uniform cost-finding system. A promotional plan of much larger proportions than in former years was provided for, the whole budget being based on an estimate of the laying of 7,000,000 sq.yd. of brick pavement next year.

Addresses were made during the conference by A. V. Bleininger, chairman of the Joint Clay Products Research Committee, on "Research in Relation to Paving Brick Manufacture"; by E. J. Mehren, editor of *Engineering News-Record* on "The Engineering Viewpoint Toward the Trade Association"; by E. W. McCullough, of the U. S. Chamber of Commerce on "What Trade Associations are Doing for Their Members"; and by Prof. Arthur H. Blanchard, of the University of Michigan, on "Trade Associations and Their Relation to Educational Institutions." Special interest was shown in the progress of the clay products research to date and very evident approval of the work was registered not only by the subsequent vote of a continuance of appropriations but by the spirit shown and the questions following Prof. Bleininger's paper.

## Mechanical Engineers Hold Annual Meeting

**Professional Engineering Education and Waste Elimination Chief Discussions**

Professional engineering education and the elimination of waste in industry were the chief topics for discussion at the forty-second annual meeting of the American Society of Mechanical Engineers held in New York City, Dec. 5-9. General topics of engineering interest were also discussed, among them being plans for the establishment of a world union of engineers, announced by Ambrose Swasey, of Cleveland. He pointed out that engineers and scientists are the determining factors in modern warfare and are constantly assuming an increasing importance in this field. A world association of such men would work, he thought, for a deeper mutual understanding in times of peace, and their association would tend to obviate international discord.

### Engineering Education

In the discussion of professional engineering education the four speakers—F. C. Pratt, A. G. Christie, J. E. Otterson, and Prof. Dexter S. Kimball—brought out forcibly the need for (1) a well defined national system of engineering education; (2) avoidance of narrow, specialized training; (3) an opportunity for the technical mind to progress in a measure commensurate with its ability and not be checked by a curriculum attuned to the average student; (4) the establishment of graduate schools in a few strong institutions that would receive adequate financial backing; (5) industry to select and pay graduates in accordance with their education and abilities; and (6) the student to secure practical ideas concerning the administration of business along with his technical development.

### Waste Elimination Discussed

Of particular interest in the discussion upon the elimination of waste was that concerned with prevention of waste through proper choice and installation of mechanical-handling equipment. This was discussed under the auspices of the Materials-Handling Division of the Society and the chief paper was read by H. V. Coes, manager of Ford, Bacon & Davis, Philadelphia. Mr. Coes proposed a formula which would solve within certain limits the economy of the application of this or that type of materials-handling machinery. Such a formula took into consideration the following variables: Interest charges on investments, interest to provide for upkeep of apparatus installed, interest to provide for (1) depreciation due to age, (2) progress in the art of the particular device proposed, (3) extensions to service, additional superintendence and overhead expenses due to changes in method, and interest to provide for taxes, cost of power supplied and other variable items.

In the discussion that followed Mr. Coes' paper it was brought out that the best service to which the Material-Handling Division of the American Society of Mechanical Engineers could subscribe would be to put in the hands of the public exact information upon the peculiar uses of all kinds of mechanical equipment. It was also asserted that necessity was present for manufacturers of equipment to realize the limitations of their specific devices and that each had a field, but that each was not all sufficient.

One of the proceedings of the meeting was the bestowal upon Hjalmar G. Carlson, a mechanic of Worcester, Mass., of the society's gold medal as a prize for his invention, making possible the production of 30,000,000 drawn steel booster casings to use principally as a component of 75-mm. shells.

The following officers were elected: President, Dean Dexter S. Kimball, Cornell College of Engineering, president; vice-presidents, Col. Edward A. Deeds, Dayton, Ohio; Robert Sibley, San Francisco; Louis Strothman, Milwaukee; managers, Sherwood F. Jeter, Hartford, Conn.; Horace P. Liversidge, Philadelphia; Hollis P. Porter, Tulsa, Okla., and Walter S. Finlay, New York. William H. Wiley of New York was chosen treasurer, and Calvin W. Rice, also of New York, secretary.

## Proposed Federal Works Total $73,000,000

**President Submits Budget to Congress —$48,000,000 for War Department**

Despite the reduction in the federal budget, the appropriations requested for the next fiscal year are practically as great as those appropriated for during the current fiscal year. The budget which just has been submitted to Congress by the President, provides for $73,438,946.67 for public works. This is only $88,463 less than the amount appropriated for the current fiscal year. In fact, there is an increase in the amount requested for public works in each of the departments, except Interior. The reduction is confined entirely to the amount requested for construction work in connection with that department and the Panama Canal.

## N. Y. Section Am. Soc. C. E. to Meet Dec. 21 to Discuss Zoning

The meeting of the New York Section, Am. Soc. C. E. to consider the Zoning Law will be held Dec. 21 and not on Dec. 9 as erroneously stated in our Dec. 8 issue.

## Tennessee License Board Meets

The Tennessee State Board of Architectural and Engineering Examiners held its regular meeting in Nashville, Dec. 3. Plans for examinations were decided upon and application blanks were approved. Every architect and engineer practising in the state after April 9, 1922, in "responsible charge", will be required to have a license. The board suggests that as many as possible apply early, to avoid a rush of applications when time is limited.

Application blanks and copies of the License Law may be had from any Board member. The chairman of the board is A. L. Dabney, Randolph Bldg., Memphis.

## Highway Officials Meeting

(Concluded from p. 996)

Commissioner Crawford of Indiana, pointed out the weakness of spending too much for expensive relocation before certain districts had any roads, because it penalized the man on a mud road.

Fred R. White, chief engineer, Iowa, spoke of the numerous relocations in Iowa now being built to obtain unobstructed views at grade crossings. Mr. Rogers said more accidents occurred on "safe" roads in Michigan than on curves and at crossings.

A. R. Hirst, state highway engineer, Wisconsin, indorsed Mr. Sheets' views. In his opinion departments could not go too far in getting proper location.

Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, in answer to a question regarding federal aid for railroad underpasses said that the new law prohibited participation on the theory that the structure was a bridge for the railroad, but that 50 per cent of the cost of overhead structures could be so borne, which would average up on total allowances, since the railroads usually paid for half of such structures. The bureau, he said, was gathering data on cost of operations so as to enable the states to base designs of alternate routes in relocations on actual costs of transportation service rendered.

### Road Slab Observations

*Warping of Concrete* — The striking results of observations on the warping of concrete slabs under temperature and moisture changes were brought out by A. T. Goldbeck, chief, division of tests, Bureau of Public Roads, and Clifford Older, chief engineer, state highway department, Illinois. Mr. Goldbeck analyzed the problem mathematically and showed that the stress at the center line of an 18-ft. slab under ordinary daily fluctuations of temperature, 36 deg. F., approached the modulus of rupture. Mr. Older detailed observations on the Bates 2-mile test road where the daily movement lifted the edges from the subgrade. On this showing he has hinged his pavements at the center, making the slabs 9 ft. wide, doweling them together and running a continuous rod along the edge to support corners at transverse cracks.

A. R. Hirst started a lively discussion by his paper on "Safety and Beauty as Factors in the Layout and Design of Highways." He held that the future of a road is practically decided by the original layout, by its design and by its structures. Some beauty can be secured by preserving natural growthes during construction and also in preparing the plans for a highway. With reasonable precautions vision can be provided and vision is the keyword to safety. A department that is not being severely criticized because of its drastic relocations and treatment of curves and widths is not living up to its responsibilities of leadership in American highway development, Mr. Hirst believes.

Mr. Sheets endorsed center strip markings as a measure of safety. Mr. Rogers favored 500 ft., as against the usual 200 ft., as the distance for placing railroad warning signs. Mr. Bennett said the law providing for mirrors on [illegible] drivers turn to one side to permit a [illegible]

F. W. Saar, deputy commissioner, New York, spoke of the safety value of the double-track roads recently constructed with a 6-ft. macadam center strip. (See *Engineering News-Record*, Nov. 17, p. 804.)

### Research

In the report of the committee on tests, H. S. Mattimore, engineer of tests, Pennsylvania, chairman, the country is divided into nine districts in which similar limits in specifications may be applied. These districts are: (1) New England States, including New York and Pennsylvania; (2) Ohio, Kentucky, Virginia, Maryland, Delaware and New Jersey; (3) Tennessee, North Carolina, Alabama, Georgia and Florida; (4) The states in the Mississippi Valley Association, Indiana, Illinois, Michigan, Wisconsin, Minnesota and Nebraska; (5) North and South Dakota, Wyoming and Colorado; (6) Kansas, Missouri, Arkansas, Louisiana and Mississippi; (7) Texas, New Mexico and Oklahoma; (8) California, Nevada, Utah and Arizona; (9) Oregon, Idaho, Montana and Washington.

Permission was granted the committee by the convention to prepare standard methods of tests and for each of the nine districts to define limits used in specifications in those districts. Contractors in these districts will not be under the necessity of preparing material under more than one set of specifications. On stone tests a subcommittee has been at work for two years comparing the standard Deval cylinder with a slotted cylinder, the latter being recommended especially in determining the qualities between a medium soft and a very soft rock. The question was ordered sent to letter ballot.

Dean Anson Marston, commissioner, Iowa, spoke of the actual loads on pipes in culverts showing that the stress depends upon the bed and whether the pipe is laid on or below the natural or compacted surface. Specifications and formula recommended were referred to the committee.

Shale particles in aggregate can be removed by jigs, according to a subcommittee progress report, but as yet a commercial plant as projected in Minnesota has not been constructed.

Prof. W. K. Hatt, director, advisory board, highway research, National Research Council, in his paper on "The Co-ordination of Research Work as Carried on by State Highway Departments" urged the recognition of research departments. He made it plain that the function of the board was not to do any work but to act as a clearing house for work under way, proposed or suggested. He called attention to the fact that the highway industry was of 20-billion dollar magnitude, equal to that of the railroads. The frozen assets of research should be liquidated through mediums of a census and publicity.

In discussion, Mr. Mattimore indicated that research was not a cure-all and theory must go hand in hand with practice where the details of construction may be worked out to provide a finished product. He made a strong plea for the continuity of research investigations, regardless of changing personnel.

*Future Traffic* — J. H. Mullen, chief engineer, Minnesota, analyzed present traffic and predicted a few of the problems of the future. Horse traffic [illegible] number, though not in per cent, in the agricultural district and must be cared for. Formerly th travel limit was 10 miles. Now it i unlimited; 10 per cent of the vehicle passing the 137 census stations i Minnesota carried out-of-state license As to future regulations, he predicte maximum speed limits of 40 miles pe hour and minimum limits of 25 mile at certain periods of the days, thu forcing slow-moving vehicles into nigh and off-peak periods.

### Federal-Aid Policies

In his paper on "A Resumé of th Work of the Bureau of Public Road and Its Projected Policies in Handlin Federal Aid" Mr. MacDonald exhibite a striking chart showing the straight line percentage increases since 1910 o motor vehicles as compared with th very flat increases in road constructio and maintenance during the war perio Expenditures both for maintenance an construction have lagged much behin funds available. There is no more im portant item, in his estimation, tha the immediate selection of the federa highway system, in which local traffi is not to be minimized. Other point to be considered are provisions fo parallel roads through larger cities routing trunk lines off heavy local-traf fic streets, reconstruction of trunk lines widening and connections with adjoin ing states.

The provision for maintenance b federal authorities, Mr. MacDonal hoped, would not have to be invoked He said, however, that this provisio would be enforced to the letter. T make such maintenance satisfactory t the government the states must hav some form of patrol constatnly an automatically operative. With this i view he suggested the desirability o the states immediately taking over th designated systems for maintenance. I construction, 18-ft. paved widths are th minimum for two-way traffic. One-hal may be built at a time in sparsely set tled districts. Old roads should b salvaged to preserve present invest ments and eventually every grade cross ing on the federal system must b eliminated.

### New Developments

Of the new developments during th year Charles M. Upham, state highwa engineer, North Carolina, indicated tha they were confined mostly to details Reinforcing is becoming heavier; 10 lb. per 100 sq.ft. not being unusual Concrete materials are generally kep off the subgrade. Richer bases ar being used and cured like one-course work. Curing receives much more at tention now than formerly. Forms hav been too light; heavier ones with double web are recommended to insur good riding qualities in the complete pavement. Fiber conduits are being placed transversely in some small town for water and gas mains and electric wires. One new road has been developed, the "subgrade" highway, a sandclay road with all provisions fo a future surface. To keep a bituminous oil mat from peeling a thin layer of 1½ to 2 in. stone is rolled into the sur face after loosening with a scarifier.

B. H. Piepmeier, engineer of construction, Illinois, in discussion said that during the year 95 contractors oper ated 102 mixers. On 20 plants industrial haulage was used; 34 had central proportioning plants served generally by trucks; 17 had central mixing

plants; 8 had roadside storage piles 600 ft. to 1½ miles apart. The tendency was toward central proportioning rather than central mixing. Storage over tunnels is losing in favor. Heavier equipment is required. Present equipment design is far behind the requirements of the average road contractor, not in conception but in stability. This, with the attendant breakdowns, is the chief reason why only 300 or 400 ft. is the average day's run. For curing success has attended the use of straw, sawdust, an asphalt cover and calcium chloride. The latter, 4 lb. per yard, is sprinkled on in a rich 1:1 solution. Laboratory tests show an accelerated set as well as increased strength folowing its use.

*Maintenance.*— W. A. Van Duzer, assistant maintenance engineer, Pennsylvania, described the maintenance organization and how it functions in his state. Finances should be made available in the winter so that budgets may be made up five months ahead of construction. Fixed revenues should be provided in county units with smaller amounts for contingencies. The department handles every complaint, realizing that the road by each man's house is to him the most important in the state. Success is largely dependent on maintaining equipment in good condition.

In discussion, H. G. Hotchkiss, second deputy commissioner, New York, spoke of the development of a heavy surface-treatment binder applied after old macadam had been cleaned thoroughly by hand. W. H. Root, maintenance engineer, Iowa, described the Iowa system which is exactly the opposite of that in Pennsylvania and New York in that it is entirely decentralized, everything being handled by the counties from the district engineers' offices.

RESOLUTIONS

The suspension of the U. S. Bureau of Public Roads' magazine *Public Roads* was deplored. Advertising signs on highways were condemned and the organization pledged itself to support any proper movement to eliminate them. Grade crossing elimination on main roads as rapidly as funds were available was endorsed and the attitude of certain railroads and state utility commissions against such expenditures was condemned. The Federal-Aid Highway Act was endorsed and the organization pledged its aid in carrying out its provisions. House bill 8978 calling for $100,000,000 annually for a 5-year period was endorsed. The Interstate Commerce Commission and the utility commissions were urged to remove the inequalities in freight rates which discriminated against road materials. Assurance was given Congress of the proper use of surplus war material and a request made for the release of 5 and 10-ton caterpillar tractors. States were urged to collect a more equitable proportion of taxes from the vehicle users for construction as well as maintenance. An elimination of partisan politics from highway administration was urged.

*Officers.*—The officers elected for the coming year are as follows: President, Charles M. Babcock, Minnesota; vice-president, Charles J. Bennett, Connecticut; secretary, Charles M. Upham, Raleigh, North Carolina; treasurer, Frank T. Sheets, Illinois; directors W. D. Uhler, Pennsylvania, and D. P. Olson, Idaho.

## Allegheny County Bond Issues Heavily Defeated

The official count, announced Dec. 7, of the popular vote at the November election on a $27,000,000 bond issue by Allegheny County, Pa., showed a 2 to 1 defeat or worse for each item, the adverse majorities increasing in the following order; roads, new bridges, raising Allegheny River bridges, remodelling courthouse. It was at first proposed to make the bond issue $41,000,000.

## B. Welchii a Feature at New Jersey Sanitary Association

A feature of the annual meeting of the New Jersey Sanitary Association, held at Lakewood Dec. 9 and 10, was a discussion on "B. Welchii and the Montclair Water Supply." The opening paper was by M. N. Baker, of the editorial staff of *Engineering News-Record*, who for twenty years was a member of the Montclair Board of Health. The paper was in part a brief of the symposium on B. Welchii in *Engineering News-Record* June 2 and 9 and the article on the same general subject by Sir Alexander Houston in the same journal for Sept. 22, 1921. Mr. Baker concluded that in view of the remarkable general health record of Montclair and the almost complete freedom of the town from typhoid fever, and in view also of the little use of the B. Welchii test throughout the country and the lack of proof that it is a cause of the spread of water-borne intestinal troubles, the ban on the Montclair water supply that has now existed for some nine months is unwarranted.

H. B. Larner, health officer of Montclair, urged that freedom from typhoid does not prove the safety of the Montclair water supply and cited the large outbreak of diarrhea in the town some three years ago as proof, together with the opinions of some of those who contributed to the symposium already mentioned to the effect that a safe water should show no gas-forming bacteria. Mr. Larner also stated that a considerable percentage of the water samples examined almost daily for about a year showed the presence of B. Welchii and a lesser but still significant percentage of B. Coli as well. F. W. Green, superintendent of filtration and pumping, Montclair Water Co., said that the bacterial findings of the company at the filtration plant did not agree with the Montclair laboratory records, but that before reaching the Montclair taps the water passes to and through an open storage reservoir. Dr. R. B. FitzRandolph, chief of the New Jersey State Board of Health Laboratory, stated that a limited number of examinations of 32 different surface water supplies in New Jersey showed B. Welchii sometimes present in all but nine. Cultures from milk supplied Montclair showed B. Welchii in three of seven samples. George W. Fuller, consulting engineer, New York City, gave general support to the engineering conclusions of the paper.

In his presidential address, Dr. R. B. FitzRandolph outlined a health district scheme of public health administration for New Jersey, with special reference to giving the proper service to the smaller incorporated places and the rural townships of the state. A discussion on "Garbage Disposal as it Affects the Municipalities in the Metropolitan District" was opened by James E. Brooks of Glen Ridge.

## Discuss Colorado River Power Development

### Controversies by Adherents of Public and Private Operation Block Results

At the meeting of the League of the Southwest at Riverside, Cal., Dec. 8 and 9, over 1,000 delegates and visitors listened to papers and addresses on the proposed development for irrigation, power and flood protection of the Colorado River. Controversies between the adherents of public and private water-power operation prevented any definite results.

The purpose of the meeting was to gather the opinion of the states of the Southwest in regard to the mode of procedure for the development of the entire Colorado River and to present this information to the Secretary of the Interior who was present at the meeting and who later conducted the hearing at San Diego on the same subject. A program of over two dozen addresses was presented, covering every phase of the development of the Colorado River basin. Each state in the basin was represented by one or more speakers.

PRINCIPAL ADDRESSES

O. C. Merrill presented a paper on the attitude of the Federal Power Commission. He stressed the point that the development should not be made by an agency that was restricted by state lines, and, while this did not mean government operation, it did mean that the development should be by a single interconnected system which could take advantage of the improved load factor of such a large territory. The attitude of the Southern California Edison Co., which has made filing for power on the Colorado aggregating over 2,000,000 hp. was given in a statement to the effect that the company was ready immediately upon the issuance of permits by the Federal Power Commission vigorously to proceed with this work and that it was in a position to spend from $30,000,000 to $40,000,000 per year in the construction of works which would remove the flood menace and provide power in units sufficient for demands.

Director A. P. Davis, of the U. S. Reclamation Service, stated that no plan of development should be undertaken until the Colorado River Commission, which has been constituted by the several states concerned and one federal representative, has completed its work and allocated the water and benefits to the several states. It is reported that President Harding has appointed Herbert Hoover to be the federal representative on this commission. Secretary Fall said that the government was the only agency that could properly protect the interests of all and that in his opinion the government alone should undertake this work.

SAN DIEGO GOVERNMENT HEARING

At the hearing on the Colorado River held by Secretary Fall at San Diego on Dec. 12 an almost unanimous agreement by the delegates present was given to the policy of government construction and control of a dam on the Colorado River at Boulder Canyon as expressed by Secretary Fall and Director Davis of the Reclamation Service. The hearing was for the purpose of hearing any objections to the plans of Director Davis as reported by him to Secretary Fall on July 8, 1921, under the provisions of the Kincaid Act. It was extended in scope

## Indiana Plans Large Highway Contracts

With 80 miles of paved roads contracted in 1921 the Indiana Highway Commission contemplates letting contracts some time after Jan. 1 for from 100 to 125 miles of hard surfaced road. About 66 miles of the new construction will fill gaps in the National Road and complete this highway across the state from Terre Haute to Richmond. Construction on grade and structures is now in progress and is expected to be ready for paving in the spring.

(Continued from preceding page)

to cover any general phases of the development of the Colorado River basin but no general discussion resulted.

The only objections were entered by the states in the upper part of the basin, who were firm in their desire that their rights to the use of water would not be jeopardized by any prior appropriations made in the lower basin or because of a dam or dams constructed below the Utah state line. Former Governor Sloan of Arizona emphatically stated that his state counted on a prior right to power generated therein as such was their greatest natural resource. A statement that the work could well be done by private interests was made by H. H. Craig of the Southern Sierras Power Co. and R. H. Ballard of the Southern California Edison Co. The latter said in part: "In the applications filed by the Southern California Edison Co. for the development of the power possibilities of the Colorado River that the company recognizes that these can be made under such conditions only as will first provide for flood control and irrigation, and that the company will submit to such modification of its plans and to such regulations of its operations as may be imposed by the Federal Power Commission, or other federal authority in the interests of flood control and irrigation."

In presenting an abstract of his final report under the Kincaid Act, Director Davis stated that a strong argument in favor of dams on the upper reaches of the river lay in the freedom from silt of the water in that place but that this was overbalanced by the urgent necessity of having the dam near the Imperial Valley. He claimed that a great waste of water would follow if the dam was near the Utah line as a surplus of water would need to be released in order to assure sufficient for the varying needs for irrigation in Imperial Valley. He stated that the power to be obtained from Boulder Canyon dam was in accordance with the table shown herewith:

Based on 2,020,000 Acres Irrigated in Lower Basin

| Storage in Million Acre Feet | Hundred Thousand Horsepower |
|---|---|
| 21 | 1.6 |
| 22 | 2.7 |
| 28 | 5.2 |
| [illegible] | [illegible] |
| [illegible] | [illegible] |
| 13 | 1.0 |
| 20 | 4.4 |
| [illegible] | [illegible] |
| 37 | 8.2 |

Mr. Davis recommended a board of three not resident or interested in states affected, one an irrigation engineer, one a [illegible] and one [illegible] of the Reclamation Service.

## Civil Service Examinations

UNITED STATES

*For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.*

Vacancies in the Bureau of Standards, Department of Commerce.

Junior Technologist, $1,200 to $1,500 a year. Examinations to be held Jan. 11, March 8 and May 17.

Junior Engineer, $1,200 to $1,500 a year. Examinations to be held Jan. 11, March 8 and May 17.

Technologist, $2,800 to $4,000 a year. Associate Technologist, $2,000 to $2,800 a year. Assistant Technologist, $1,500 to $2,000 a year. Applications rated as received until further notice.

Engineer, $2,800 to $4,000 a year. Associate Engineer, $2,000 to $2,800 a year. Assistant Engineer, $1,500 to $1,800 a year. Applications rated as received until further notice.

## Engineering Societies

### Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich., Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C., Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C., Mid-Year Meeting, Washington, D. C., Jan. 5 and 6.

**The American Water Works Association, New York Section,** at its meeting Dec. 9, at the Hotel McAlpin, New York, was addressed by Walter E. Spear who will describe the waterworks of Greece and the project of a new supply for Athens, on which he served as consultant.

**The Dallas (Tex.) Technical Club,** at its regular weekly luncheon, Nov. 7, heard the reports of its employment bureau showing that the bureau had placed 130 applicants and that men were being placed at the rate of six a week. Three city engineers secured positions in one week.

**The Engineers' Club of the Lehigh Valley,** Bethlehem, Pa., has elected W. O. Hearsey, division superintendent of the Bethlehem Steel Co., as president and W. M. Kelsey, general superintendent of the New Jersey Zinc Co., Palmerton, Pa., as manager.

**The Iowa Engineering Society's** advisory council Oct. 19 nominated the following candidates for office to be voted upon at the January meeting of the society: President, T. E. Rust, J. G. Thorne, R. W. Crum and C. H. Streeter; vice president H. P. Streeter, K. C. Kastberg, J. B. Davidson and F. C. Chambers. The council has recommended an increase in dues from $6 to $10 and a provision for sustaining members so that funds may be available for a secretary, paid at least for a part of his time. Co-operation with the architects in obtaining a registration law was recommended.

**The Texas Section, Am. Soc. C. E.,** at a recent meeting, was addressed by E. A. Wood, engineer to the Chamber of Commerce Development Association of Dallas. His subject was "City Planning."

**The Engineering Society of Western Massachusetts,** at its meeting in Greenfield, Nov. 22, was addressed by C. C. Chesney who read a report on the new million-volt transformer at the General Electric Co.'s works in Pittsfield, Mass., and by O. P. Perin on "Industrial Developments in India."

**The Youngstown (Ohio) Engineers' Club,** at its meeting Nov. 11, was addressed by James A. Campbell on "The Present Railroad Situation and Its Relation to Business."

**The Illinois Society of Engineers** will hold its 37th annual meeting, Jan. 24 to 26, at Decatur, Ill. Aerial surveys and land and engineering surveying will be considered at the first session Jan. 24, and sewerage and sewage disposal matters at the second session. On Jan. 25 the papers will be on water supply resources and treatment. There will be an excursion to the new waterworks dam and sewage disposal plant, the evening being assigned to committee reports and a business session. On Jan. 25 one session will be devoted to roads and street paving, and the other to waterways and the legal and engineering aspects of land drainage. The annual dinner will close the meeting.

## Personal Notes

JOSEPH WRIGHT, until recently chief of construction, Division 1, at the Wilson Dam, Florence, Ala., has accepted a position with Dwight P. Robinson & Co., Inc., and has sailed for Brazil.

BERTRAM D. DEAN, formerly deputy engineer in the county engineer's office, King County, Wash., has been appointed resident engineer on the inter-county bridge over the Columbia River, between Pasco and Kennewick, Wash.

ROBERT D. SNODGRASS has been made vice-president in charge of engineering of Hamilton & Chambers Co., Inc., New York.

R. M. CONNER, formerly project manager, Fort Peck project, U. S. Reclamation Service, with headquarters at Poplar, Mont., has been appointed construction engineer of the Riverton project, on diversion dam and canals to irrigate 100,000 acres in Fremont County, with headquarters at Pilot, Wyo.

PROF. LOUIS C. MONIN, dean of cultural studies, Armour Institute of Technology, has been granted a leave of absence until Sept. 1922. He sailed from Montreal, Nov. 1 on a trip to Europe.

R. C. E. WEBER, since 1907 with the U. S. Reclamation Service, has been

promoted from assistant engineer to project manager of the Orland project.

WILLIAM B. BAMFORD, consulting engineer, Trenton, N. J., has been elected mayor of Belmar, N. J.

TEVOR J. POWELL of Summit, N. J., has been appointed assistant county engineer of Union County, New Jersey.

H. S. CLARKE, for the past two years division engineer of the Delaware & Hudson R.R., with headquarters at Carbondale, Pa., has been appointed general manager, maintenance of way department, with headquarters at Albany, N. Y.

J. B. AKERS, for 12 years engineer, maintenance of way, for the middle district of the Southern Ry., with headquarters in Knoxville, has been appointed chief engineer, Lines East, Southern Ry., with headquarters in Charlotte, N. C.

E. R. THOMAS has been appointed city engineer of Port Arthur, Tex.

WILLIAM L. REEVES has been appointed city manager of Glendale, Cal.

C. GRAY, who has been acting chief engineer, Indiana State Highway Commission since Sept. 1920, has been appointed chief engineer of the commission.

BENJAMIN BEAN, with the Missouri State Highway Department on highway construction, is now with the Merkle Machinery Co. on installation of water-works and power plant for Duncan, Okla. Benham & Mullergren are the consulting engineers on this work.

WILLIAM N. ELSBERG, assistant city engineer, has been chosen by the City Council as city engineer of Minneapolis. He graduated from the University of Minnesota in 1910, and since 1911 has been in the Minneapolis city engineering department on sewer and bridge work except while serving in the civil engineer corps of the navy in 1918-19. Recently he has been in charge of construction of the Third Ave. bridge, Minneapolis.

GEORGE B. HILLS has just established the George B. Hills Co., engineers, Jacksonville, Fla., successor in the South to Isham Randolph & Co., specializing in drainage, docks and terminals and structural design. W. O. Sparklin, structural engineer and architect, lately of Washington, D. C. is now associated with this office.

H. G. SOURS, deputy county engineer, Summit County, Ohio, has been appointed resident state highway engineer for Summit County.

O. J. BROOKSHIRE has been appointed city engineer of Lebanon, Ind.

S. UCHIYAMA, chief engineer, city planning commission of Osaka, Japan is in this country to make a four months' study of the parks and public grounds in Chicago, Cleveland, St. Louis, Kansas City, Washington and Boston.

R. F. HEILLAND, for two years city engineer of Waxahachie, Tex., has entered into partnership with his father, Hans Helland, city engineer of San Antonio, Tex., forming the engineering firm of Helland & Helland, with office in San Antonio.

G. W. COURTER of Marshall, Tex., has been appointed engineer for Palo Pinto County to supervise the construction and maintenance of the Palo Pinto County's portion of the Bankhead Highway and 40 mile of lateral county roads.

W. W. KELLEY, formerly division engineer, Atchison, Topeka & Santa Fe Ry., with headquarters at San Bernardino, Cal., has been appointed engineer of the Grand Division, with headquarters at Los Angeles, Cal.

T. MARTIN has transferred from the position of division engineer Revelstoke division, Canadian Pacific Ry., to division engineer of the Nelson Division, at Nelson, B. C.

D. W. MURPHY, consulting engineer, Los Angeles, has been appointed consulting engineer on drainage for the Imperial Valley Irrigation District. Mr. Murphy was for many years connected with the U. S. Reclamation Service, where his work dealt largely with studies of relief from troublesome ground water in irrigated lands. In his work in the Imperial Valley he is to handle problems of a similar character.

DR. K. G. MATHEWSON has resigned the presidency, Georgia School of Technology to accept the presidency of Drexel Institute, Philadelphia, effective April 1, 1922.

## OBITUARY

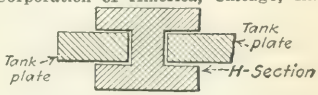
SEBASTIAN WIMMER, engineer, died recently at St. Vincent, Pa. He was born in Bavaria in 1831 and came to America in 1851. His experience in railroad construction work dates back to 1854 when he became connected with the Allegheny Valley R.R. as assistant engineer. Entering the service of the Pennsylvania R.R. in 1861, he was appointed in 1865 to take charge of a portion of the construction of the Imperial Mexican Ry., and for three years he was engaged in this work with headquarters at Maltrata. In 1874 he was elected to the Pennsylvania legislature, serving two years. Later he was chief engineer on the construction of the Pittsburgh & Lake Erie R.R., constructed the New York City & Northern R.R., now a part of the New York Central system, and the Yonkers Rapid Transit railway from Van Cortland Park Park to Gettys Square, Yonkers, N. Y.

LORD MOUNT STEPHEN, railroad constructor and first president of the Canadian Pacific Ry., died Nov. 30 at his country residence, Brocket Hall, Hatfield, Hertfordshire, England. He was born at Forres in Banffshire, Scotland, in 1829, went to Canada in 1850 and entered the store of his uncle in Montreal, a cloth merchant. He later came into business relations with Donald Smith, afterward Lord Strathcona, who interested him in the construction of a railway to the Canadian West. They joined forces with the late J. J. Hill and acquired the St. Paul & Pacific R.R. and the line was built through from St. Paul to Winnipeg, which made possible the subsequent building of the Canadian Pacific Ry.

## EQUIPMENT AND MATERIALS

### Cast-Iron Tanks for Dry Materials

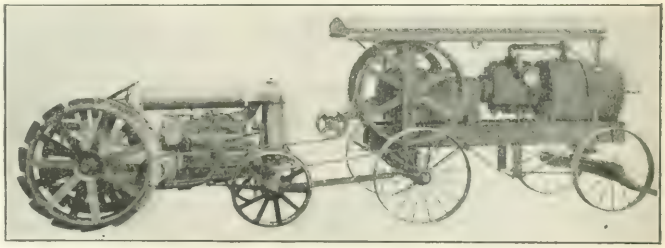
Cast-iron tanks for storing dry materials of any sort ordinarily stored in bins are being made by the Conveyors Corporation of America, Chicago, Ill.,




for installations where resistance to abrasion and rust and low maintenance costs are especially important. The tank is made of ½ in. x 2 x 2 ft. radius plates held between cast iron verticals of H-section. It is set on a concrete slab floor and can be elevated and provided with bottom discharge openings in any manner desired.

### Tractor-Driven Portable Compressor

For light rock excavation in trenching and road grading, a portable air compressor outfit has been devised by the Sullivan Machinery Co., Chicago. It consists of two units: a steel truck



carrying a compressor and receiver and a small tractor which drives the compressor by a belt and also hauls the outfit from place to place. This outfit will operate one rotator or hammer drill, using ⅞-in. hollow drill steel, and capable of drilling holes as deep as 16 ft.

The compressor is of the horizontal single-stage type, but with a hopper or open jacket instead of the usual closed jacket for the cooling water, thus dispensing with a circulating pump. The jacket is filled by means of buckets or a hose. With a speed of 260 r.p.m. the compressor has a displacement of 121 cu.ft. of free air per minute and gives a 90-lb. pressure, requiring 18 hp. to operate it for this pressure. In line with the air cylinder is a receiver 26 x 33 in. The weight of the compressor unit, with cooling jacket empty, is a little over 4,000 lb.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Engineering News-Record's Cost Index 1917 to Date

*Engineering News-Record's* Construction Cost Index Number is here tabulated monthly from January, 1917, to December, 1921, inclusive. The chart on this page includes this Number from 1918 to date. The Index Number for the months of 1916 will be presented here next week.

ENGINEERING NEWS-RECORD
CONSTRUCTION COST INDEX
NUMBER
(100 in 1913)

| | 1917 | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|---|
| January | 167 75 | 184 51 | 198 05 | 206 55 | 230 87 |
| February | 167 75 | 184 51 | 201 50 | 225 10 | 230 67 |
| March | 175.66 | 184.51 | 198.05 | 240.85 | 224.27 |
| April | 183 41 | 186.01 | 191.25 | 265 20 | 213 07 |
| May | 187.61 | 186.01 | 191.25 | 268.90 | 210.82 |
| June | 199.26 | 186.31 | 191.85 | 273.80 | 209.82 |
| July | 204.01 | 188.65 | 193.65 | 265.65 | 203.82 |
| August | 198.41 | 193.85 | 196.65 | 252.00 | 193 07 |
| September | 190.31 | 193.85 | 202.85 | 255.20 | 188.27 |
| October | 167.11 | 193.85 | 202.25 | 255.20 | 182.57 |
| November | 166.51 | 193.55 | 206.85 | 255.32 | 166.32 |
| December | 167.11 | 194.75 | 206.85 | 251.62 | 167.82 |

## E. N.-R. Cost Index Converts Permits into Volume

One of the chief applications of *Engineering News-Record's* Construction Cost Index Number is to place current construction on a 1913 purchasing basis, so that the actual volume may be compared with the volume in a similar period in 1913. This, by the way, is the computation of the *E. N.-R.* Construction Volume Index Number. By the same process current valuations of building permits issued may be converted into 1913 terms, and the current construction volume promised by the permits compared with the promised volume of some other period—with one year ago, for example.

In November, 1921, Los Angeles issued 4,242 permits valued at $8,685,775, against 2,640 in November, 1920, at $6,267,660. To place these two valuations in terms of comparable volumes it is only necessary to divide each by the Cost Index Number for that period. The result is, $5,170,000 for November, 1921, and only $2,490,000 for November, 1920, showing that the November, 1921, permits promise 107 per cent more actual construction volume than those issued in November, 1920.

## Large Building Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 259@268, are the following large building projects: A 15-story apartment hotel in New York, to J. G. Siegel, New York, $1,400,000; an 8-story apartment hotel in Rocky River, Ohio, to Crowell & Little Construction Co., Cleveland, $1,500,000. There are three $2,000,000 building contracts: a hotel and theatre project in Akron, to W. [illegible] Co., Cleveland; a [illegible] office building in Philadelphia, to Metzger, Fisher & White; a 14-story hotel for Cincinnati, to Wells Brothers Construction Co. Plant for the Globe Portland Cement Co., Dubuque, Iowa, will be built by H. C. Strucher, St. Paul, $2,000,000.

## Status of Criminal Cases Against Building Material Men

Trial of seven corporations and eleven individuals, members of the Eastern association of terra cotta manufacturers, indicted for violating the anti-trust provision of the Sherman act in the Federal court for the Southern district of New York, has been set.

Four of the defendants in the federal case against the tile manufacturers in the New York district, found guilty of violating the Sherman law, have begun their terms in jail. Three of these defendants received terms of four months and fines of $4,000 and the fourth a two months' jail sentence and a fine of $4,000. There were 62 defendant companies in the indictment against the tile men, 53 of the defendants entering pleas of guilty. Total fines against them were $126,000.

No date has as yet been set for pleading the cases against the hand-blown window glass manufacturers, 104 corporations and individuals engaged in that trade having been recently indicted for violation of the Sherman anti-trust law.

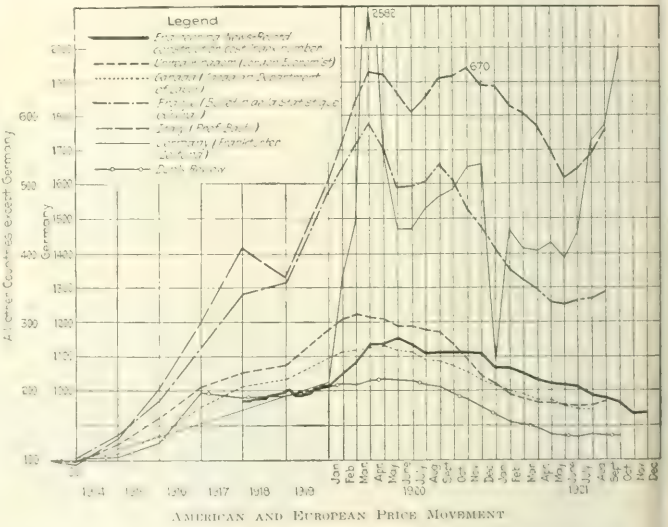
In the New York State Court, the prison terms given four defendant marble men, who formed a small part of number indicted for a violation of the state's anti-trust laws, have been suspended and the defendants put on parole for a period of three years, during which time it may be possible to commit them to jail for an indefinite period should they again engage upon the practices for which they were indicted.

All these cases have grown out of evidence adduced at the investigation of housing conditions in New York by the Lockwood joint legislative committee on housing.

## Index Numbers of America and Europe Compared

### Showing Increased General Costs—The Price of War—Construction Costs in United States

The accompanying chart shows the economic result of the war in Europe and the United States. Words are hardly needed. In addition to the European, Canadian and American index numbers, the *Engineering News-Record* Construction Cost Index Number is plotted. Economic conditions are based in the following order: Germany, Italy, France, England, Canada, United States. Dun's Review shows all commodities, in the United States, to be 3 per cent above the 1913 figure; Bradstreet's increase is 21 per cent. *Engineering News-Record* shows general construction cost to be 66 per cent above the 1913 level.




AMERICAN AND EUROPEAN PRICE MOVEMENT

## Bids Wanted on Big Jobs

Among the projects on which bids are either being asked or will soon be called for in Construction News, pp. 259@269, are the following:

Sewerage system for Springwells, Mich., $1,250,000.

Buildings for Johns Hopkins Hospital, Baltimore, $1,100,000.

Three buildings for Western University of London, Ont., $2,000,000.

Warehouse project at San Francisco, $2,500,000.

Additions to State capitol, Sacramento, $3,000,000.

Extension of Temiskaming & Northern Ontario Ry., from Cochrane to New Post, Ont., $3,000,000.

*Next Week—Six Salient Points of the New Tax Bill.*

## Lumber Freight Reductions

Freight rates on fir lumber from Washington, Oregon and California to New York and New England, which were 80 cents per 100 lb. before the freight rate increases of August, 1920, and $1.06½ after those increases went into effect, will now be 90 cents, according to the National Lumber Manufacturers Association.

Under the $1.06½ rate, on the basis of 4,500 lb. as the average weight per M. ft. b.m., $26.62½ was the approximate average cost of transporting by rail a thousand feet of lumber from the west coast points to the New York and New England territory. The cost of transportation will now average about $22.50 per M. ft. The freight cost to the Cincinnati-Detroit district will be 85 cents per 100 lb. or about $21.25 per M. ft. from west coast points, and 88½ cents, or about $22.12½ to the Pittsburgh-Buffalo territory. The new schedules for Spokane, Montana, Eastern Oregon, etc., give 3c. per 100 lbs. less than the past rates to the various eastern districts.

## Freight Rates on Scrap Higher than on Pig Iron

In comparing Pig Iron and Scrap Iron rates between producing and consuming points, it is noticeable that in most cases scrap pays the higher rate. The scrap rates are not only higher, but much higher. For instance, from Birmingham to Cincinnati the pig iron rate is $4.50 per gross ton, and that of scrap $5.745, or a difference of 28 per cent. From Chicago to Moline, the pig iron rate is $1.96, scrap $2.66, or a difference of 35 per cent. From Cleveland to Toledo, the rate on pig iron is $2.52, scrap $2.94, a difference of 17 per cent. Handlers of the material claim that inasmuch as scrap always sells at a lower figure than pig iron—in the case of some grades as much as 75 per cent lower—the market value of scrap should be taken into account in establishing the freight rate basis.

Steel plants consume much of the pig iron at producing points, but scrap usually requires shipment by rail. At present it is impossible to move scrap any considerable distance, as the transportation charges are too close to the selling price to permit long hauls; rates in many instances range from $6 to $12 per ton.

## Steel Works Planned for India

According to information received from U. S. Department of Commerce, there has recently been registered in India the United Steel Corporation of India, Ltd., with a capital of approximately $60,000,000 to $100,000,000, depending upon the exchange calculated. The registration is in the name of the firms of Messrs. Bird & Co. of Calcutta and Messrs. Cammell, Laird & Co. The latter firm is acting as technical adviser to the corporation and is responsible for the design, erection, and staffing of the works. The plans of the new works are already well advanced. The plant is designed to produce 600,000 to 700,000 tons of pig iron, and the steel works and rolling mills will be capable of producing 450,000 tons of finished steel per year. As a first step, however, it is proposed to erect a unit capable of dealing with half these quantities, and the subsequent development will only be undertaken as occasion demands.

## Industrial Machinery Division Embraces Wide Field

The industrial machinery division of the Department of Commerce, recently organized to promote good business methods and to increase exportation in the machinery trade, is more or less directly connected with 4,000 factories in the United States producing industrial machinery, says a recent news dispatch from the Department of Commerce. The value of the products of these factories exceeds $2,200,000,000 per year, of which about 17 per cent is exported. The Department of Commerce believes it is easily possible to increase to a much larger total the export trade because the Bureau of Foreign and Domestic Commerce can do more than has been done to assist the individual manufacturer in developing his foreign business. The foreign business now amounts to approximately $1,000 per employee.

## Trend of Business

**Bonds**—Principal strength in municipals, with general trading declining probably due to tightening money market.

**Stock Market**—Reaction due to profit-taking on the part of those who won in the rise in the previous week. Conditions do not warrant expectation of a sound forward movement before Jan. 1.

**Money**—Call loan rates stiffer, ranging from 4½ to 6 per cent. Sufficient time money available.

**Foreign Exchange**—Dec. 10 Sterling reached $4.105, which was the highest since Nov. 15, 1919. All exchanges rose.

**Iron and Steel**—Pig iron production for November was 1,415,481 tons, against 1,246,676 in October. Steel ingot production was 1,660,001 tons; 1,616,810 in October, for the thirty companies reporting to the American Iron and Steel Institute. Total steel production averaged 45 per cent, against 44 in October, 32 in September, 30 in August, 21 in July. Consumption is fair except in the construction and machinery industries.

## Fabricated Steel Freight Cost

The Bridge Builders and Structural Society, New York City, has found that at the present selling price of fabricated structural steel freight amounts to about 40 per cent. Fabricated steel today is selling at not more than 50 per cent over the average price of 1914, runs the report, while freight alone is more than 100 per cent over the 1914 cost. The fabricator has reduced his labor and other cost items and is now "sacrificing a part of his overhead charges in his efforts to meet the demand for lower prices. The item of freight alone is unchanged."

Recognizing the need for readjustment of freight costs the society adopted a resolution which it has sent to various railway associations and officers of the government having to do with railway and labor matters, embodying the thought that only through a correct relationship between freight and other cost items can there be proper improvement in business conditions.

## Economic Paragraphs

Wholesale prices in Canada, the United Kingdom and France also declined during October but continued inflation increased the price level in Germany and Italy.

Increased buying is reflected by greater sales in October by mail-order houses, and chain stores, greater advertising in magazines and larger postal receipts.

The surplus of idle freight cars was cut in half during October, largely due to the threatened railroad strike, and car shortages increased, especially for coal cars. Bad order cars were reduced and total car loadings increased, especially coal and merchandise.

"Personnel Research Agencies" is the title of a bulletin just issued by the United States Department of Labor, through its Bureau of Labor Statistics (No. 299). It is intended to serve as a guide to organized research in employment management, industrial relations, training, and working conditions.

Calculations made by the "Survey" of the Department of Commerce show that the monthly export trade of the United States for the past six months is greater than in 1913, even making an allowance for an increase of 50 per cent in prices. On that basis, exports are 10 per cent greater than the 1913 average but imports are 10 per cent less.

Foreign Commerce of the United States in the first ten months of 1921 totaled $2,060,790,841 for imports and $3,895,791,358 for exports, as against $4,691,214,922 imports and $6,831,201,222 exports in the corresponding period of 1920, according to the Department of Commerce.

Increased employment is shown by the United States Employment Services report covering November in the following industries: paper and printing; lumber and its manufacture; vehicles for land transportation; iron and steel and their products; tobacco manufactures; chemical and allied products; stone clay and glass products; textiles and their products; metals and metal products. Decreased employment was shown in the liquor and beverage industry, in railroad repair shops and in the food and leather industries. While there were employment increases in 40 of the 65 cities, the total unemployment throughout the country increased largely due to seasonal and climatic conditions.

As compared with the average in the year 1913, the retail cost of food on Nov. 15, 1921, showed an increase of 59 per cent in New York and Washington; 57 per cent in Manchester; 54 per cent in Baltimore; 52 per cent in Philadelphia; 46 per cent in Atlanta; 42 per cent in Little Rock; 41 per cent in Denver; and 40 per cent in Louisville. For the year period, Nov. 15, 1920, to Nov. 15, 1921, there was a decrease or 24 per cent in Louisville, Norfolk, Peoria, and Springfield; 23 per cent in Atlanta, Baltimore, Denver, and Little Rock; 21 per cent in Manchester, Philadelphia, Rochester and Washington; and 19 per cent in New York, according to Labor Statistics.

## New Railroad Shop-Craft Rules Become Effective

The new shop-craft rules, promulgated by the United States Railroad Labor Board, and affecting approximately 450,000 railroad employees, became effective December 1. Estimates of the Board's statisticians are that the new regulations will effect a saving of about $50,000,000 a year.

Of the new rules, 99 were lifted from the existing national agreement almost word for word, while only 37 have any marked changes in them. The rules which supplant the national agreement are to be applied where the carriers and their employees have failed to agree on new rules. The Labor Board figures that about 60 per cent already have been agreed to between management and men.

Among the typical changes are that the machinists working on repairs may disconnect any wiring, coupling or pipe connections necessary to make repairs, this work having previously been assigned to electricians and sheet metal workers. Under the new rules, too, engineers, firemen and cranemen are not prohibited from making repairs to equipment on the line, if they are qualified to do this. The new agreement also recognizes the open shop principle. Though the railroads have never been strictly closed shop in theory, both union and non-union employees have made their demands through union organization leaders.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1, the next, on January 5.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.78 | $4.00 | $4.00 | $2.88 | $3.06 | $3.75 | $3.45 | $3.75 | $4.00 |
| Structural rivets, 100 lb | 3.50 | 5.25 | 5.50 | 3.43 | 4.15 | 4.25 | 5.50 | 4.25 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb | 2.68 | 3.20 | 3.50 | 2.68 | 3.08½ | 3.57½ | +3.00 | 3.75 | 2.75 |
| Steel pipe, black, 3½ to 6 in. lap, discount | 54% | 57.65% | 45% | 57% | 58.9.5% | 38% | 51.8% | 50% | 35.10 |
| Cast-iron pipe, 6in. and over, ton | 47.30@48.30 | 45.00 | 54.30 | 44.10 | 47.80 | 52.00 | 50.00 | 55.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl | 2.30 | 2.69 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.16 |
| Gravel, ¾ in., cu.yd | 1.75 | 1.85 | 2.25 | +2.00 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.00 | 1.25 | 2.25 | +2.00 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.00 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 40.00 | 38.00 | −34.00 | 48.00 | 35.00 | 50.00 | +30.00 | +22.50 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | 27.00 | 21.00 |
| Lime common, lump, per bbl | 3.39@3.69 | 1.50 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 3.25 | 11.00 |
| Common brick, delivered, 1,000 | 17.40@18.40 | 9.00 | 12.72 | 11.00 | 17.00 | 14.00 | −15.50 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .0675 | +.15 | .0821 | .0792 | .09 | .12½ | .10 | .08@.2 |
| Hollow partition tile 4x12x12, block | .11120 | .0675 | +.15 | .0657 | .... | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal | .72 | +.80 | +.88 | .74 | .80 | .90 | .83 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | .35 | ..... | .72½ | .50 | .50@.55 | .75 | .50@.60 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@.45 | .35@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or −. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent, 45-10% means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforcing steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 350-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand, gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags, common lump lime per 180-lb net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars, $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on trucks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5¼ x 5 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Barrel change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

## Changes Since Last Week

The most conspicuous price advances of the week are in lumber, reinforcing bars, sand, gravel, hollow tile and linseed oil in six of the important centers listed above.

San Francisco reports an advance of 10c. per 100 lb. in reinforcing bars and a rise of $1 per M ft. in pine lumber, but quotes a reduction in common brick to $14 per M as compared with $16 per 1,000, one week ago. Both sand and gravel are quoted in Chicago at $2 as against $1.75 per cu.yd. Dallas quotes a rise of 3c. per gal. in linseed oil and a slight advance in hollow wall tile. Atlanta also reports an increase in the price of linseed oil to 80c. as compared with 79c. per gal. last week.

Long leaf yellow pine, base sizes, is quoted in the New York market at $49 per M ft., b.m., delivered. Douglas fir has advanced 50c. per M ft. all along the line in Seattle, with import and export demand increasing.

One hundred and two mills reporting to the West Coast Lumbermen's Association for the week ending Dec. 3, show 60,218,037 ft. of lumber manufactured; 46,172,192 ft. sold and 55,396,960 ft. shipped. Production at mills was only 18 per cent below normal.

Thirteen cement manufacturers in the eastern states, reporting under date of Nov. 30, show that 2,422,000 bbl. of cement were produced during November, 1921, as against 3,032,000 bbl. for November, 1920. Shipments during November, 1921, amounted to 1,537,000 bbl. as compared with 2,602,000 bbl in November, 1920. Reports of stocks on hand show 2,730,000 bbl. on Nov. 30, 1921; 1,846,000 bbl. on Oct. 31, 1921, and 1,180,000 bbl. as of Nov. 30, 1920.

Winter reserve stocks of Hudson River brick, in the New York district, are also unusually large for the season, even considering the most favorable weather conditions; wholesale quotations reaching the lowest point since the 1920 peak.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, DECEMBER 22, 1921 — Number 25

## *Christmas*

YEAR AFTER YEAR we have been interrupting the staid path of technical discussion by hanging up a verbal holly wreath or sprig of mistletoe and calling to you through these pages a message of hearty good-will. We do it again this year—and we make no apology.

Merry Christmas to you, and may the good New Year bring you every happiness—more prosperity, better friends, more joy in the bosom of your family.

The times warrant special rejoicing. We have seen great things done in the last few weeks, things that are truly in the spirit of Him whose birth we celebrate. Peace He sought to bring to us—peace to men of good-will.

In a mighty way we have been striving at Washington to achieve peace—a peace based on the good-will of men. Navies are to be shrunk in size; conference is to replace belligerence in settling Pacific Ocean difficulties.

Happiest of all, from our viewpoint, is that in this mighty endeavor our own America has taken the lead. How the nations are praising us for it. "Peace on earth is here now," says a great London daily. "No nobler contribution has ever been made by any civilized power to any period of the world's history," adds the Lord High Chancellor of England.

Truly a fine preparation for this Christmas of 1921—this Christmas that we of the staff of *Engineering News-Record* hope may be your happiest and your merriest, filled with peace and the ring of children's voices—a happy forerunner, let us hope, of a less troubled, a more satisfying New Year.

### lore Variety Elimination

THE influence of the paving brick manufacturers in recently making a big cut in the variety of their roduct to eliminate waste and reduce costs gives prom-e of extending to other fields. The Associated Penn-lvania Highway Contractors, at their annual meeting st week, passed resolutions favoring a greater degree standardization in construction plant. A committee contractors and equipment manufacturers will en-eavor to bring about action along this line.

### Form of Bribery

OFFERING a commission to an engineer for goods or materials which enter into construction at his ini-ative is a form of bribery and an insult against which gineers are constantly protesting. Single protests, wever, are likely to be held by those offering these ibes and insults as exhibits of individual whims. otest from engineering organizations, formally pre-nted, are more effective. Such a protest has recently en addressed to an offender by direction of the Council the American Institute of Engineers, in the form of expression of regret that the "well known code of hics of the profession in matters of this kind is not own to the offender," and with a citation of Clause 2 the Institute's Code, which declares "unprofessional" e acceptance of "trade commissions, discounts, allow-ces, or any indirect profit or consideration in connec-on with any" engagement of a member of the Institute. every engineer who is improperly approached in the way indicated would bring the matter before some engineering society and the society, on consideration, would officially protest, the engineering profession and business generally would be raised to a higher plane.

### Cleveland Union Passenger Terminal

FOR years the question of better railway passenger facilities at Cleveland has been one of controversy, and during the past three years the Public Square station project has been the subject of much criticism. A brief historical review of the subject and a description of the station as now planned appear elsewhere in this issue, in an article largely setting forth the viewpoint of the three railroads going into the project. These plans show clearly that the engineers—with the site for the station fixed—recognize the necessity of segregating and distributing passenger traffic, in so far as possible, to afford the maximum relief from congestion at this point. In carrying out this purpose great ingenuity has been shown, and a distinct advance in the art of passenger station planning has been made. Nevertheless, this journal still believes that a station on the Public Square is wrong and that the location promises to continue as a point of centralized congestion. The question is a public one, concerning not only the local interests of Cleveland but also the interests of the whole public, which will be required to pay the bill ultimately. From this standpoint the project is large enough to warrant more than the usual interest among engineers As a private business enterprise the building of this

great passenger terminal on the Public Square site may be justified, among other things by resulting benefits of increased realty values and "air-rights" rentals. Otherwise it is hardly conceivable that the managements of the three railroads would so strongly favor the undertaking. The expenditure involved is large; the possibilities of relieving the freight situation are great. But the possibilities are equally as great of serious city congestion. Whether the project is a profitable one or not, viewed as a whole, we believe the latter possibilities to preponderate, that the increased congestion will develop at a point where it needs to be decreased, and that in solving the Cleveland terminal problem for both freight and passenger traffic a better plan could be found by following the principle of decentralization rather than that of centralization.

### Construction Is Not Contracting

CONFUSION of construction engineering and contracting is common in discussions of engineering construction. It is frequently remarked of an engineer, who has performed a piece of construction with success, that he would make a good contractor. The prophecy may be true, but it is quite as likely to be false. Construction engineering is essentially the technique of fabrication. It embraces, besides fabrication proper, the selection, maintenance and operation of plant, the purchasing of materials and the management of labor. It does not, generally, embrace the task of seeking work to do, the financing of that work or contractual responsibility for its quality, cost and time of completion, all of which are vital functions of contracting. Demarcation between construction engineering and contracting is represented by an area and not by a line, but it is actual. The distinction should be kept constantly in mind because clear thinking is both good contracting and good engineering.

### Supreme Court on "Open Competition"

THOUGH the text is not yet available it appears, from the press reports at hand, that the United States Supreme Court decision in the famous "hardwood case" is very broad and definitely forbids those practices of trade organizations involving exchange of information, sales and prices. Until the full decision is available it is not possible to moralize on the extent or influence of the decision. It sufficeth to say that for the present, then, that the decision will warrant the most careful study. It may not be amiss to express, at the minute, surprise that Justice Brandeis should be found supporting a dissenting opinion. He is commonly expected to be severe in his construction of the legitimacy of business practice.

### Uniform Contracts

UNIFORM construction contracts appear more nearly possible than ever before following the conference of engineers and contractors held last week in Washington. One reason for optimism is that now contracting is organized to act with organized engineers and architects and comes forward for the first time with a definite plan. A secondary reason is that uniform contracts are urged by the Department of Commerce and Secretary Hoover is putting his force and the influence of the department into their development. Incidentally the committee membership includes the men who have had most experience in developing the standard contracts of the American Institute of Architects, of the Americ Railway Engineering Association and of the Bureau Public Roads. There will, therefore, be none of t floundering about of inexperience in seeking ways proceed. And back of everything is the stimulus the growing sentiment that waste and false motion h to be reduced so that industry may revive. Altogeth there is good promise that something material and ta gible will result from the work of the committee uniform contracts, and engineers and contractors shou gather to its support.

### Abolishing the Eight-Hour Crime

AT LAST there is a break in the most serious barri to honest work that has ever been erected in th country. The crime of 1916—whereby the railro workers were given 10 hours pay for 8 hours work, wi all the consequent overtime evils—has been struck blow by the Railroad Labor Board. It is true that t relief applies only to a small part of the railroad fie and does not affect the brotherhoods favored by the famous Adamson law. That law, however, was t precedent which was followed in giving the 8-hour ri to the maintenance-of-way forces. Under a decision the Railroad Labor Board rendered last week, the 8-ho day is not abolished but the provision by which time a one-half had to be paid for overtime in excess of 8 hou is abolished. The normal rate is now to apply up 10 hours of continuous service, after which the tir and one-half rate will be enforced. Time and one-half also abolished for Sunday and holiday work. The d cision is a substantial step forward.

### The Four-Power Treaty

WITH the discouraging results of the Versaill peace conference fresh in mind there were ma who expected the Disarmament and Far Eastern Co ference to end in talk. However, the greatest expect tions have been realized. There seems no doubt th heavy naval reductions will result and that a satisfa tory procedure with reference to China will be work out. Already there is an outstanding tangible result the Four-Power Treaty for disposing by negotiation a conference of the difficulties that may arise regardi the islands of the Pacific. Such is the effect of th agreement that the praise for it has been almost extra agant. It certainly raises new hope to a world discou aged with international conferences and will go far restore international confidence.

## City Engineers in Name Only

INQUIRY would doubtless show that many Americ cities of considerable size have no city enginee except possibly in name. That is, there is no we organized engineering department in many of our citi that are large enough to feel their importance. If th office and title of city engineer exists the chances a that the powers and duties of this official are so limite that he is very little more than a surveyor of limite scope, often engaged on a per diem basis, doing litt or no designing work for the city and with little or n real authority over construction, his services here bein confined to giving lines and grades.

Such a condition seems to have existed at Ne London, Conn., until recently, where successive adminis trations appointed a city surveyor, on small pay Fortunately, the Sewer and Water Board has had a

engineering organization for a long time and has kept records for these two branches of the municipal service. Almost immediately after the new city manager form of government took effect at New London, J. E. Barlow, city manager, decided not to have the work of the city surveyor continued, but instead to have it taken over by the engineering force of the Sewer and Water Board.

Like consolidations, in many cases with considerable enlargement of scope, of engineering activities might well be made in many of our cities. This would result in economy by eliminating duplicate organizations. It really is a most anomalous condition that many of our city engineers today have nothing whatever to do, or if anything very little indeed, with the sewerage or waterworks systems of their cities and oftentimes not with paving either. The time has certainly come for reform in this respect. A realization of this need and action accordingly are more likely to come under the commission-manager form of government than under the old haphazard system of mayor and council with much of the administrative work in the city not really under these officers but carried on by more or less independent boards or still less efficiently by committees of the legislative body.

This is a subject that might well be given immediate and close attention by local engineering societies and individual engineers in the various cities throughout the country. Probably not very much investigation would be needed to show that reforms along the line indicated are quite as necessary in many of our large cities as in the smaller ones. In fact, it would perhaps be easier to name off-hand more large cities without than with efficient, centralized engineering departments.

## Supreme Court on Picketing

COMMENT was made in these columns in the issue of Nov. 17 on the reasonable decisions of North Carolina and New York courts regarding picketing during labor disputes. In brief, the courts held that picketing which resulted in annoyance to workers or mental distress was illegal. The same view is held in a U. S. Supreme Court decision handed down Dec. 5, on an appeal of a case involving a strike at the plant of the American Steel Foundries Co., at Granite City, Ill. It settles finally the status of forms of picketing heretofore considered "peaceful," but which place a heavy restraint upon those against whom the picketing is directed.

The court is very explicit. It declares against methods which "inevitably lead to intimidation and obstruction," and further holds that in the case in question "the numbers of the pickets in the groups constituted intimidation." Continuing the argument the court says:

"The name 'picket' indicated a militant purpose, inconsistent with peaceful persuasion. The employees were made to run the gauntlet. When one or more assaults or disturbances ensued, they characterized the whole campaign, which became effective because of its intimidating character, in spite of the admonitions given by the leaders to their followers as to lawful methods to be pursued, however sincere.

"Our conclusion is that picketing thus instituted is unlawful and cannot be peaceable, and may be properly enjoined by the specific term of 'picketing' because its meaning is clearly understood in the sphere of the controversy by those who are parties to it. . . . A restraining order against picketing by that name will advise earnest advocates of labor's cause that the law does not look with favor on an enforced discussion of the merits of the issue between individuals who wish to work and groups of those who do not, under conditions which subject the individuals who wish to work to a severe test of their nerves and physical strength and courage."

The specific limits of peaceful picketing are not set down by the court, it being held that each case must turn on the circumstances and that the measures of restraint are for the "flexible remedial power of the court" to determine. In the Granite City case the stationing of one watcher at each point of ingress or egress of the plant is held legitimate.

All in all the decision commends itself as a reasonable exposition of the general principles upon which the exercise of persuasion in labor disputes should be permissible.

## Second Picketing Decision

HARD upon the decision of the United States Supreme Court in the American Steel Foundries case commented upon above comes a second decision of the court, this time involving a case of a restaurant business in Bisbee, Ariz., in appeal from a decision of the Supreme Court of that state.

The decision is an involved one legally for it touches upon property rights in that by the denial of the Arizona court of an injunction preventing the picketing of the restaurant it is held that property is unlawfully taken. In its main aspects, however, the decision follows logically along the lines of the Steel Foundries judgment. As in that case the pickets were guilty of libelous attacks upon the restaurant keepers, their business, their employees and their customers and applied to them abusive epithets. The situation is summed up by the United States Supreme Court as follows: "The patrolling of defendants immediately in front of the restaurant on the main street and within five feet of plaintiff's premises continuously during business hours, with the banners announcing plaintiffs' unfairness; the attendance by the picketers at the entrance to the restaurant and their insistent and loud appeals all day long; the constant circulation by them of the libels and epithets applied to employees, plaintiffs and customers, and the threats of injurious consequences to future customers, all linked together in a campaign were an unlawful annoyance and a hurtful nuisance in respect of the free access to the plaintiffs' place of business."

Four of the nine justices dissented from the majority opinion, entirely on technical grounds, and three of the minority held that it was within the power of the Arizona legislature to declare these means of picketing legal even though they might be violation of the common law. It was because of this feature of the case that the Supreme Court evidently found it necessary to proceed beyond the question of legality of the particular method of picketing and to examine the effects in the light of the Fourteenth Amendment to the federal Constitution which guarantees to every person equal protection of the laws and prevents the taking of property without due process.

Apparently, therefore, the methods that may be followed in bringing pressure to bear on employers in the case of labor disputes have, within a relatively brief space of time, been brought within narrow limits.

# Structural Design of U. S. Mail Terminal at Chicago

## Steel 150-Ft. Truss in Wall—Girders for Offset Columns—Provisions for Future Changes—Ring Frames at Mail Chutes—Foundation Cantilevers

THE LARGEST STEEL TRUSS used in building construction, 150 ft. in span and 28½ ft. deep, with a weight of 365 tons, is a bold and conspicuous feature of the structural frame of the U. S. Mail Terminal at Chicago. The truss carries six stories over a wall opening for a railway track entrance. This mail terminal is being built by the Chicago Union Station Co. as part of the improvements in connection with the new union passenger station. The building, of steel frame construction, is about 796 x 75½ ft., flanked on both sides by railway tracks and having its ends fronting on Van Buren and Harrison Sts. It will constitute one of a group of notable railway structures in this vicinity. The great truss is shown in Fig. 1 and its location is indicated on the plan Fig. 2. Cantilever concrete foundation girders and steel floor girders supporting offset columns are other special but less unusual features.

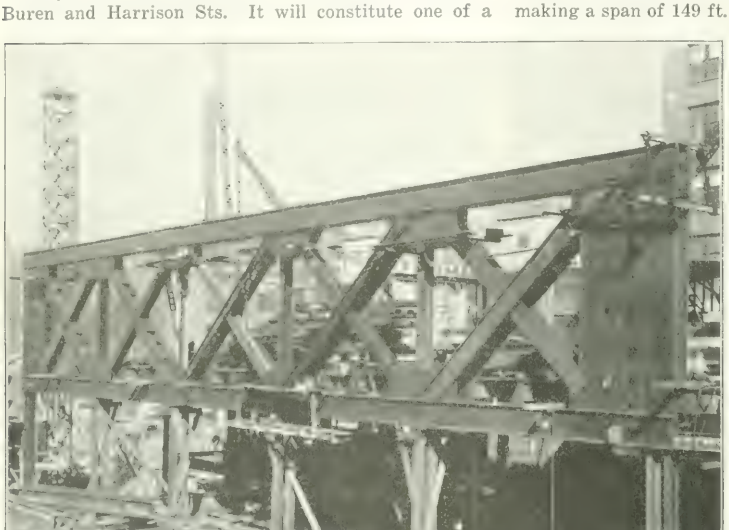


FIG. 1. LARGEST BUILDING TRUSS IN U. S. MAIL TERMINAL, CHICAGO

The building will have a basement over its entire area, a track floor at the level of the track system of the new union station, a first floor at the street level and five upper floors. For railway mail handling the basement and track floor will be operated by the Chicago Union Station Co., the other floors being used by the U. S. Post Office. Along the east side, at the street level, will be a 30-ft. driveway, above two tracks of the station approach. At its south (Harrison St.) end the outer ends of the driveway girders will be framed against columns carrying a parallel driveway along the adjacent freight station of the Chicago & Alton R.R. (see *Engineering News-Record*, Oct. 14, 1920, p. 732). At its north (Van Buren St.) end the driveway will connect with a similar driveway built by that railway.

The great width of wall opening spanned by the truss is necessitated by the track layout (see Fig. 2). Along the west side of the building there will be two parallel loading tracks, one inside and the other outside of the west row of columns. These tracks will be spaced 23 ft. c. to c. and separated by a 13-ft. loading platform, in which the wall columns are located. The inside track will be connected with the outside track by a crossover near the south end of the building, this crossover having No. 7 frogs and a total length of 220 ft. over switch points. Four columns are omitted at the crossover and two are displaced 4 ft. 2 in. from normal position, thus making a span of 149 ft. 4½ in. c. to c. of columns, which is spanned by the heavy truss referred to.

No walls are provided for the track story, except on the east side. Street viaducts protect the north and south ends and the west side is protected by a canopy roof attached to the wall columns and covering the loading platform.

The 150-ft. truss, Fig. 3, is divided into panels of 28 ft. 2½ in. to conform to the column spacing above it. As the columns which carry the truss do not extend above its top chord and are offset 50 in. from the upper wall columns supported by the truss, a heavy end construction is required for shear stresses. Thus a truss post is placed 50 in. from the supporting column and heavy web plates are riveted over the flanges of the column and post for the entire depth of the truss. A total load of about 4,050 tons will be carried to the upper chord of the truss.

In depth the truss will be 28 ft. 8 in. over the chord cover plates, while the height between floors is 21 ft. The bottom chord is considerably below the first floor level, giving a clear headroom of 17 ft. above the rails at the track entrance. To it are attached brackets for a concrete canopy over the loading platform. The upper chord is above the second floor level, coming just below the window openings. Beams and girders of the first floor are framed against the truss posts, while those of the second floor are carried by hangers attached to the web of the top chord. A trough section about 36 x 36-in., giving a gross sectional area of 304 sq.in., is used for the chords, which are of identical design but reversed in position. The posts are of I-section and the diagonals of I- or double-channel section. Distributing girders for the upper columns are seated on the top chord as shown in Fig. 4, their webs registering with those of the truss chord.

Drilled holes ⅞-in. in diameter were reamed to 1⅛-in. for 1-in. rivets, and the specifications provided that the

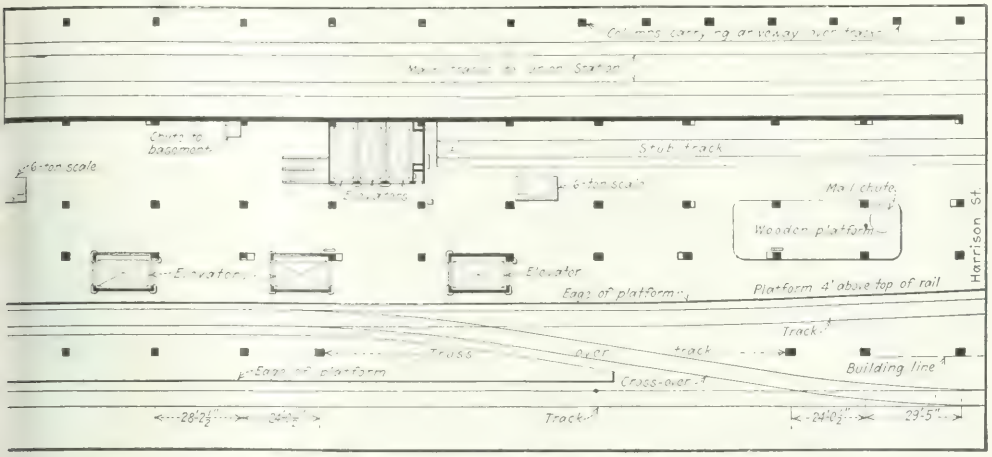



FIG. 2 PART PLAN OF TRACK FLOOR OF MAIL TERMINAL

·uss should be assembled and reamed at the shops. he weight of the completed truss is 365 tons, 11 tons f which are field rivets. As erected, the truss has a ımber of 2⅞ in. All members will be encased and ıvered by concrete protection and the bottom chord ill be further protected by a blast plate over the ack.

### Foundation Piers and Cantilevers

Concrete foundation piers 4 to 6 ft. in diameter are ınk through the Chicago clay to hardpan at an average :pth of 50 ft. below datum. The bottoms of the piers 'e belled out in the usual way in order to increase the :aring area and thus limit the load on the hardpan to )out 6 tons per square foot.

Foundation conditions were complicated by the pres- ıce of a freight tunnel, about 7 x 6½ ft., in the clay at depth of about 45 ft. and passing close to the location a line of piers, as shown in Fig. 5. The site of the w building includes an old freight terminal which was nnected by elevators with an underground freight rd of the Illinois Tunnel Co. and although the merous branch tunnels and connections at the yard ve been abandoned, the main line is still in service.

Alternative methods of overcoming this difficulty were to rebuild the tunnel on a new location or to relocate seventeen piers so as to avoid the tunnel. The latter course was adopted as being the more economical. This displacement of the pier centers from the column centers varies from 2 to 5 ft. The columns are carried on concrete cantilever girders or on girders supported by two piers. These girders are placed below the basement floor, except that at one of the driveway columns there is a cantilever girder a few feet below the track floor, since the basement does not extend under the driveway.

Column shoes or bases are seated usually on I-beam grillage on the heads of the piers. For the two heavy columns which carry the long truss, a more elaborate system is used. Each of these columns has a rolled steel slab base, supported by a pair of 4-ft. distributing girders 8 ft. 3 in. long, these girders in turn resting on a row of five 24-in. plate girders and four 24-in. I-beams 8½ ft. long. This lower course is seated on the top of a concrete pier 9 ft. 2 in. in diameter.

In the typical structural arrangement below the first floor there are five longitudinal rows of columns forming two outer bays about 31 ft. wide and two inner bays

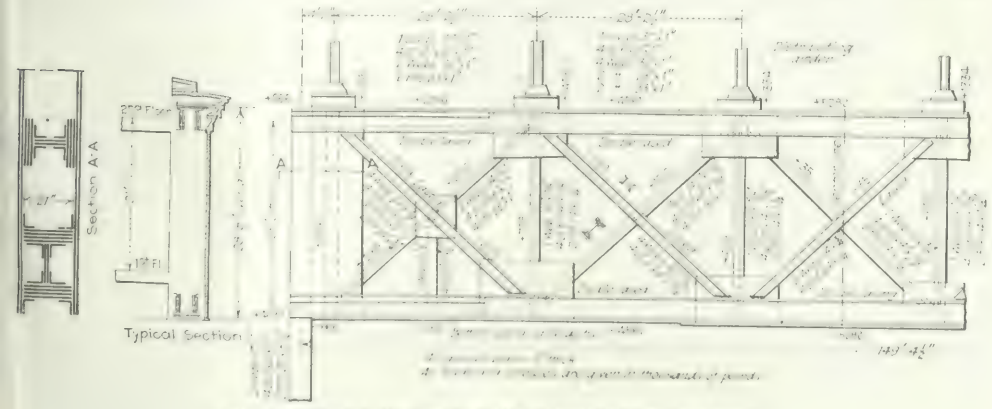
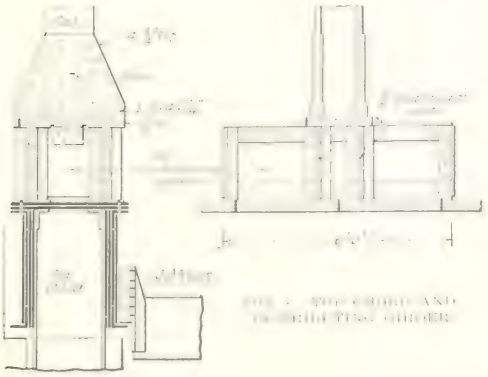



FIG. [illegible] DETAILS OF [illegible]-FT. TRUSS CARRYING SIX STORIES



of 16 and 26½ ft., as shown in Fig. 2. Above the first floor, one of the outer rows is omitted as it carries only the girders for the longitudinal driveway. From the part plan of the first floor framing, Fig. 6, it will be seen that longitudinal beams between the columns carry transverse I-beams of 7- to 9-ft. spacing. This type of construction was adopted as being more flexible in providing for possible alterations due to mail handling equipment than any long-span concrete floor construction, although the cost of the adopted type was about 10 per cent greater.

An offset in the column spacing occurs, however, at the first floor, where the middle row of columns is offset 4 ft. from the columns below. For this reason the columns of the 16-ft. bay carry pairs of transverse girders in the first floor framing, upon which are seated the columns of the second and upper floors. This unsymmetrical arrangement of columns, due to the trucking space required at the track floor, is shown in Figs. 6 and 7.

Transverse plate girders are used also at some panel points in the 31½-ft. bay for the driveway, these girders carrying longitudinal I-beam joists of 29 ft. 2½ in. length. The introduction of this reversal of the arrangement of longitudinal girders and transverse I-beams is due to a former plan, later abandoned, for an express building on this site. Connections for this building were provided also on the columns of the adjacent new freight station of the Chicago & Alton R.R.

Numerous circular openings in the floors are required for mail chutes and are formed by rings of 10-in. channels with flanges outward, as indicated in Fig. 6. Lugs on the floor beams and diagonals across the corners of the rectangular floor framing form eight points of attachment for each ring. Concrete slab floors and roof are provided, the concrete encasing all steel work.

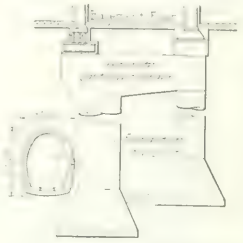
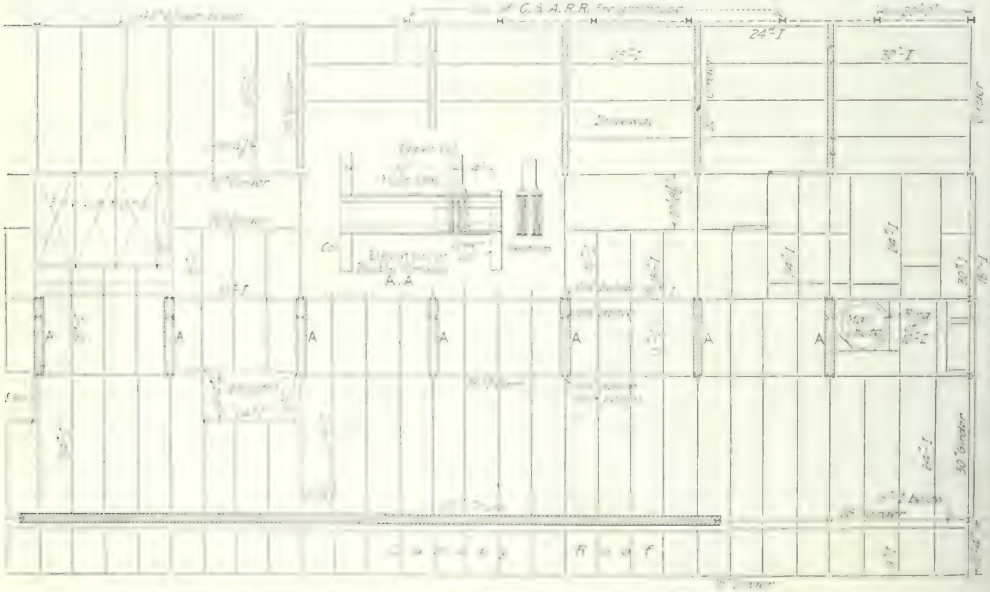


FIG. 5. CANTILEVER GIRDERS CARRY WALL COLUMNS ABOVE TUNNEL

Creosoted wood block paving on concrete floor slabs will be used mainly for floors and driveways, with 2-in. blocks for the former and 4-in. for the latter. These blocks will be laid on an asphalt paint coat and with asphalt filler. Cement flooring will be used in toilet and machinery rooms. For the track spaces, the concrete slab will be left with a rough surface as a base for the finished concrete floor, which will have recesses for short wood blocks carrying the rails. The exterior walls will be of gray brick with terra cotta trimmings and steel sash. Steel rolling shutters are provided for the openings along the driveway at the backing-in space for wagons, which is inside of the building line, on a




EIGHT-STORY PART OF FIRST-FLOOR PLAN OF CHICAGO MAIL TERMINAL BUILDING

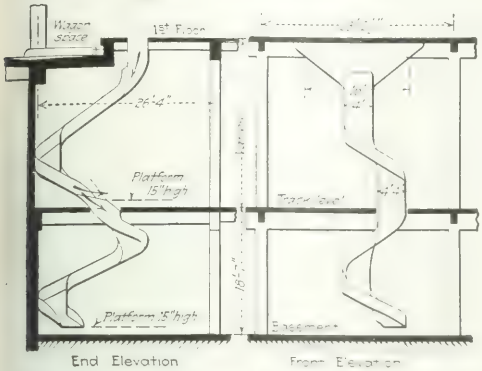



FIG. 7 SPIRAL CHUTES FOR HANDLING MAIL

level with the driveway and 2 ft. 6 in. below the first floor. Floors are designed for live loads of 150 and 200 lb. per square foot, with 250 lb. for the driveway outside of the building and for the backing-in space for wagons.

### Mail Handling Equipment

Details of the extensive mechanical equipment for handling and conveying mail matter have not been developed fully by the Post Office authorities. In addition to fifteen large freight elevators there will be a number of spiral and inclined chutes for the rapid lowering of sacks and packages from floor to floor, these chutes delivering to tables, platforms or horizontal belt conveyors. One of the spiral chutes, serving three floors, is shown in Fig. 7. A special feature of this mechanical equipment will be a 5-ft. escalator or inclined traveling platform, 144 ft. long, to carry trucks loaded with mail sacks from the basement up to the track floor. In addition there will be inclined belt conveyors between the several upper stories and horizontal conveyors in these stories.

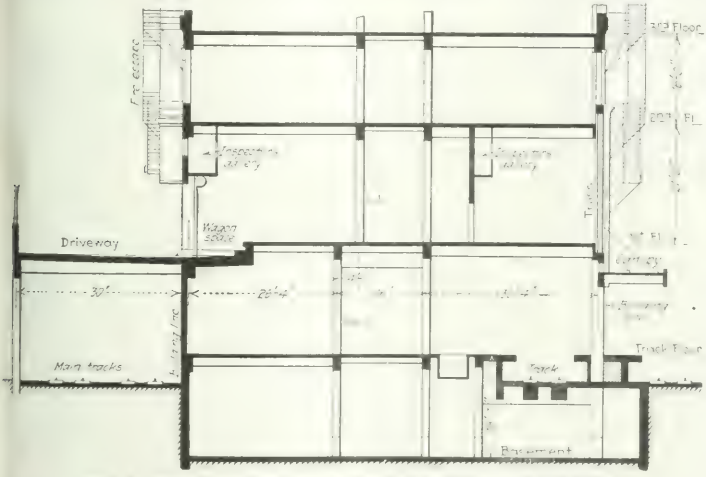



FIG. 8. CROSS-SECTION SHOWS TRUSS AND OFFSET COLUMNS

The general and structural designs for this mail terminal building were prepared by Graham, Anderson, Probst & White, architects. Both design and construction are under the direction of J. D'Esposito, chief engineer, and A. J. Hammond, assistant chief engineer, of the Chicago Union Station Co. The R. C. Wieboldt Co. has the general contract. The steelwork, including the 150-ft. truss, was fabricated by the McClintic Marshall Co. and was erected by the Kelly-Atkinson Construction Co.

## Lowell Goes Back to Mayor-and-Council Plan

At a popular election held in October the electorate of Lowell, Mass., decided by a vote of 8,534 to 7,903 to change from the commission plan of city government to the mayor-and-council plan. Nearly all the administrative officers of the city will be appointed by the mayor, subject to confirmation by the council. Both the mayor and members of the council will be elected for terms of two years. The mayor will be paid $5,000 a year and councilmen only $300. The council will consist of fifteen members, one each elected by the nine wards of the city and six elected at large. The mayor will appoint the city solicitor without confirmation by the council, and the council will choose a city clerk, treasurer, and auditor independently of the mayor. All the other administrative officers will be appointed by the mayor and confirmed by the council. A board of public service of three members will appoint a city engineer, superintendent of streets, and superintendent of waterworks. There will be a board of health, a park commission, a budget and auditing commission, besides several other boards. Among the individual administrative officers appointed by the mayor and confirmed by the council will be a purchasing agent, a city physician, a superintendent of wires, a city bacteriologist, an inspector of public buildings, and an inspector of milk and vinegar—the latter not until a vacancy occurs since this office as well as those of sealer of weights and measures and of moth superintendent are under civil service rule. The entire city government will be swept out of office when the new charter goes into effect on Jan. 1, 1922. Between now and then a new mayor and council will be elected and the various administrative officers appointed as already outlined.

## Volume of Cargo Passing Through Panama Canal

According to a report recently issued by the transportation division of the Department of Commerce, the volume of tonnage passing through the Panama Canal for the first nine months of 1921 was greater than the total tonnage for any other twelve months except during the calendar year 1920. For the nine months ended Sept. 30, the total tonnage handled was 7,912,737 long tons. This figure compares with 11,236,119 long tons for 1920 and 7,468,167 long tons for 1919, that being the highest year except 1920.

# Concrete and Gunite Flumes on the King Hill Project—II

## Five Types Compared as to Cost, Maintenance, Construction and Serviceability—Semi-Precast and Monolithic Flumes Have Slight Advantage

By Walter Ward
Project Manager, Reclamation Service,
King Hill, Idaho

*This concluding article describes two combination types of flumes, the combination concrete-and-gunite and the semi-precast concrete. The bell-and-spigot type, no-joint and gunite flumes were described in the issue of Dec. 8, 1921, p. 926.*—Editor.

### Combination Concrete-and-Gunite Flume

The combination concrete-and-gunite flume has a floor with a uniform thickness of 5 in. while the side walls vary in thickness from 2½ in. at the top to 4 in. at the bottom. The inside dimensions of this flume are 8 ft. 7 in. by 5 ft. and it has a capacity of 268 sec.-ft. with a freeboard of 1 ft. The concrete was a 1:2½:5 mix. The gunite was mixed in the proportion of 1 part cement to 5 parts sand but as 20 per cent of the sand was lost in the rebound, the gunite in

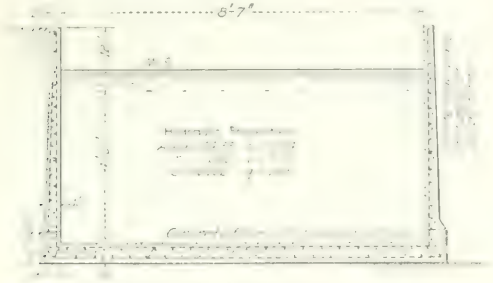



FIG. 8. DETAILS OF COMBINATION CONCRETE-AND-GUNITE FLUME

place is in the proportion of 1 to 4, there being very little cement lost in the rebound.

A double row of longitudinal or temperature reinforcing steel was placed in the floor to permit of a wider spacing of the bars; otherwise they would be so close together it would be difficult properly to place and tamp the concrete. The transverse bars in the floor bend at right angles and extend through the side walls which are reinforced as vertical cantilevers. Additional reinforcing steel was used in the bank wall to make it safe against external pressure caused by blow-sand accumulating behind the flume. The higher compressive strength of gunite over ordinary concrete permits of the reduction in section of the side walls at the base from 5 to 4 in. This reduced thickness of side wall has the advantage of reducing the amount of longitudinal or temperature steel required as the amount of this steel is based on a per cent of the total area of gunite.

This flume is designed with sufficient temperature steel to force it to crack at 6-ft. intervals. In arriving at the percentage of temperature steel required, it was assumed that as this flume would be built in the late fall it would be subjected to a range of temperature of 70 deg. From [illegible] it was estimated that ½ to 1 per cent would be required when ½-in. bars were used with an elastic limit of 55,000 lb. per sq. in. It was observed after this flume had been built for some time that fine hair cracks appeared at more frequent intervals than 6 ft., usually at 18 in. intervals and at the point where the gunite area was reduced and weakened by the vertical transverse bars.

The lower 3 in. of the side walls was built of concrete and poured in conjunction with the floor, forming a curbing against which the forms for the gunite side walls could be placed and held in exact line and grade. By using a concrete floor, with a steel troweled surface in place of a rough gunite, the value of $n$ in Kutters' coefficient was reduced from 0.018 to 0.014 for the floor. This reduction permits the building of a flume 8 ft. 7 in. wide which will have the same carrying capacity as one 9 ft. 6 in. wide where the floor is untroweled gunite.

A 4-in. tile drainage system was provided similar to the one described in connection with the bell-and-spigot flume.

#### Compressor Location

The compressors, instead of being spaced at intervals along the flume bench and moved as the work progressed, were set up permanently on the bluff above the flume at a central point and the air was conducted through pipe lines leading to the cement guns. When the guns were operating at the maximum distance from the compressors these air conduits were 2,200 ft. long. The transmission loss through this length of pipe was high and should be avoided if possible, but in this case it was not practicable, due to the narrow flume bench, to set up the compressors and move them along as the work progressed. Neither was it feasible to move the compressor along the bluff above the flume. On account of the narrow flume bench, a construction road along the flume over which materials and equipment could be hauled with teams was not practicable, and as the bench, due to its location on the steep hillside, was accessible only from each end, a 36-in. gage industrial railroad was laid along the bench paralleling the flume over which all materials and equipment were transported.

The railroad extended to a central mixing plant which was located at the upper end of the work where a pit with an unlimited amount of sand and gravel was uncovered with a small amount of stripping. At the mixing plant two mixers were installed, one to mix concrete and the second to mix dry sand and cement ready for use in the cement guns.

The forms needed for the walls as may be noted in Fig. 9 were inside panels built of shiplap with a system of cross-bracing to hold them in alignment. As only one side of the walls was formed and no pressure exerted by the gunite, these forms were comparatively simple and were easily and rapidly set up and removed. A top templet only was needed to force these panels to conform to the alignment, the bottom being held tight against the concrete curbing by

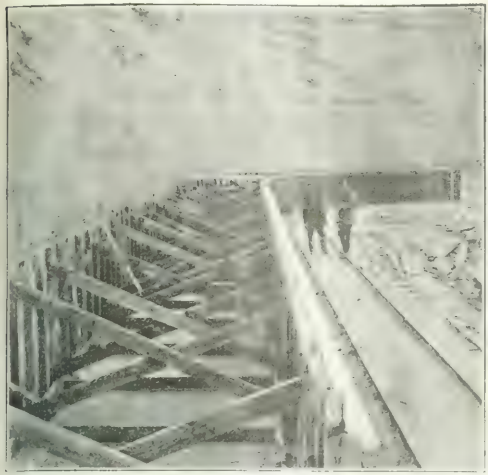


FIG. 9. FORMS FOR CONCRETE AND GUNITE FLUME PLACED AFTER FLOOR DEPOSITED

means of spreaders between the panels. After the forms were placed and securely braced a 1-in. board, which was straight for the tangent and cut to the proper radius for the curves, was at first nailed along the top to act as a form for the top of the wall, but this was later omitted as it was found that pockets of rebound would collect against this board and, when the forms were removed, would brush off and leave a bad looking top. Instead of shooting the gunite against this top board it was shot directly against the vertical wall and struck off level with a steel trowel which left the top of the wall sound and smooth.

### Method of Construction

Following the preparation of the subgrade and the installation of the drainage system, the reinforcing steel, which had previously been cut and bent in a central yard, was placed. Fig. 10 shows the reinforcing steel assembled and suspended from a framework used to hold it to line and grade, and the curbing forms set ready to receive the concrete. The concrete from the central plant was hauled over the track to its location in the flume in 1-cu.yd. side-dump cars and discharged from the cars onto the floor by gravity. The bottom of the inside curb forms served as a gage for the top of the floor.

After the concrete floor had been allowed to set sufficiently to permit workmen to walk on it without injuring its surface, the framework shown in Fig. 10 was moved ahead and the gunite forms shown in Fig. 9 were erected. The gunite aggregate mixed dry in a concrete mixer at the central plant was sacked in batch quantities and hauled on flat cars to the cement guns. The guns were mounted on a flat car and were moved along the industrial track, at all times keeping them within 50 ft. of the work. The guns were kept together, a nozzleman working on each side of the flume and one crew feeding both machines; thus the entire operation was under the supervision of one foreman and fewer laborers were required.

In building the side walls application of the gunite began at the bottom and was carried upward. This allowed the rebound to escape with less danger of any of it being buried in the wall. Gunite, having a tendency to build up upon whatever it strikes, could not be shot at right angles against the wall until the space between the steel and the forms had first been filled by shooting at an angle. Square bars proved decidedly objectionable in this connection as it is almost impossible to completely fill in the space between the bars and the forms and insure that the bars are entirely imbedded. Round bars of small diameter should be used when gunite is applied from only one side. If too much water was mixed with the gunite or too great a thickness applied at one time on a vertical wall, the gunite had a tendency to sag and slough off, leaving cracks along the horizontal bars. Experience demonstrated that the walls should be built in layers of about 1½ to 2 in. with a moderate moisture content and each coat allowed to set some-

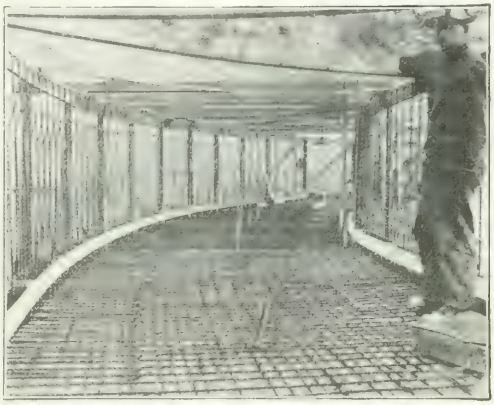


FIG. 10. FRAMEWORK TO SUPPORT STEEL FOR CONCRETE AND GUNITE FLUME

what before the next is applied. To insure a proper thickness of wall a gage marking the finish lines of the wall was hung from the top of the forms and was kept close up to the nozzleman as the finish coat was applied.

As most of this flume was built during the winter months it was necesary to heat the steel and forms ahead of the nozzleman and protect the green gunite from the frost. The former was accomplished by attaching the water hose to a steam line and playing live steam on the steel and forms, and the latter by covering the entire flume with a burlap or other covering and keeping stoves in the flume for from two to five days. During extreme cold weather sacks filled with hay were piled against the outside walls of the flume. Gunite will set up sufficiently to resist frost action in about half the time required by concrete.

### Tests of Sand for Gunite

A well-graded concrete sand obtained at the central mixing plant was first used in this gunite work. The rebound was unusually high, amounting to at least 30 per cent of the total aggregate and consisting mostly of the coarser particles. With this in mind experiments were conducted to determine which of the sands available would be most economical and what effect would be produced by the addition of hydrated

lime to the sand and cement mix. Although these experiments were not by any means exhaustive, they did bring out some interesting and valuable information, as follows:

1. The rebound can be decreased by the addition of hydrated lime and the decrease is proportional to the amount

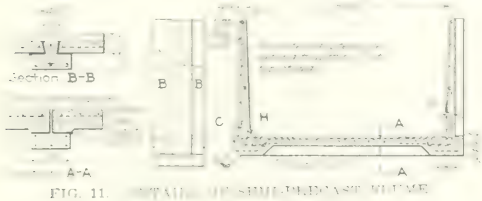



FIG. 11. DETAILS OF SEMI-PRECAST FLUME

of lime used, up to a proportion of 1 part of lime by weight to 10 parts of cement.

2. The rebound decreases in proportion to the decrease in sand particles rejected on a ¼-in. screen. Especially is this true where the reinforcing steel is closely spaced and of large diameter.

3. These experiments showed, with the grades of sand used, that the smaller the sand particles the less the rebound. As an example, using a sand 100 per cent of which passed a ½-in. screen, 92 per cent a No. 10, 90 per cent a No. 20, 80 per cent a No. 30, 68 per cent a No. 40 and 50 per cent a No. 50, the rebound was 20 per cent as compared to 30 per cent rebound for sand of which 100 per cent passed a ¼-in. screen, 95 per cent a ½-in. screen; 82 per cent a No. 10; 75 per cent a No. 20; 56 per cent a No. 30; 30 per cent a No. 40; and 19 per cent a No. 50 screen.

4. The density of the gunite in which the fine sand was used was 8 to 10 per cent greater than the gunite made of the coarser sand.

A total of 3,300 lin. ft. of this combination type of flume was built. It has all the advantages of the all-gunite flume, with the disadvantages eliminated.

The flume was built on a foundation that was extremely treacherous but after being in operation one year, at the time of writing, no settlement or disturbance of the foundation has occurred, and as the flume is watertight, no settlement or erosion of the foundation is expected. This flume has fulfilled all expectations and is a type well adapted to an insecure foundation. No maintenance or repair work has been done on it nor is any now needed. It should last its expected useful life with a very low maintenance charge.

### Semi-Precast Concrete Flume

The construction program for the fall of 1919 and spring of 1920 contemplated the building of more than two miles of concrete flume. The construction season was limited to the non-irrigation season, and to accomplish this amount of work in the allowable time, it was either necessary to purchase additional equipment and increase the organization sufficiently to push the work through in the short construction season, or to provide some means of doing a portion of the work during the summer months. Considerable doubt existed as to whether or not it would be possible to secure the required number of men to hurry the work. At that time there was an extreme shortage of labor, and further, it was not considered economical to purchase the required amount of additional equipment since it would not be needed for subsequent work. Therefore, the idea of doing all of the work during the non-irrigation season was abandoned. Included in the contemplated work was a stretch of 4,500 lin. ft. where the foundation was mainly lava rock and advantage could be taken of this conditions to design a flume from which a small amount of leakage would not be serious.

To meet all of the above conditions a semi-precast concrete flume was designed and built. The side walls of the flume were cast during the summer months, were set up during the winter months and the floor and joints were poured in the spring, completing the flume.

Except on the inside curves the precast side walls were built in 12 ft. 2-in. lengths, 3 in. wide on top, and 5 in. wide at the base. A short section of the floor was poured in conjunction with the side walls giving the slab an L-shape with one leg 5 ft. 6 in. long and the short leg 8 in. in length. The wall

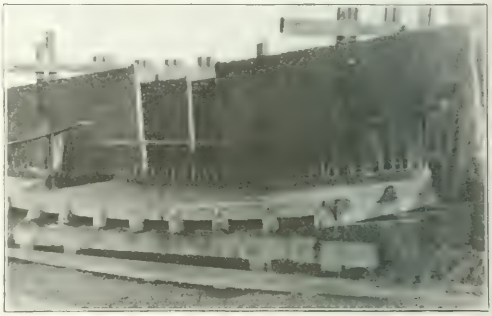


FIG. 12. CURVED SLABS OF SEMI-PRECAST FLUME

slabs were designed to act as vertical cantilevers when placed in the flume section. The lower 6 in. of the slab, properly a part of the floor, was imbedded in concrete when the floor was poured. The transverse bars from the wall slab extended through the short leg of the slab and 21 in. into the concrete floor poured in place, lapping the floor transverse bars 15 in. Some question arose as to whether there would be sufficient bond developed between the old and new concrete to resist shear and to overcome any weakness from this source, the corner bars marked C in the drawing (Fig. 11) were added. The hook bars in the fillet, marked H, were also added as an additional factor of safety against overturning. The concrete floor which was poured in place extends under and 6 in. up the outside of the wall. This is to prevent any possible leakage following around the joint between the old and new concrete, and also to furnish a solid footing for the side walls. Additional steel was placed in the slabs on the bank side wherever it was anticipated that there would be any external pressure caused by the accumulation of blow-sand. A nominal amount only of temperature or longitudinal steel was required as each 12-ft. section was free to move at either end. Concrete sills 4 in. thick and 10 in. wide with a 6-in. vertical leg at each end were placed across the subgrade at the required intervals to support the wall slabs. These sills were built to exact line and grade and the inside of the vertical legs marked the exact position of slabs while the top of the sill established the grade.

The joints between the precast slabs were closed with a pilaster poured in place connecting with the

sills and filling the wedge-shaped space between two adjacent slabs. These pilasters with the sills formed a collar around the flume at the joint and provided a slip joint for the wall slabs.

Expansion and contraction joints were provided by painting each end of the precast slabs and both ends of alternate floor sections with a 1:3 mixture of asbestos cement and asphalt. This same mixture was used to paint the top of the sill and outside of the walls, between the wall and pilaster, to form the slip joint.

As most of this flume was built on a lava rock foundation the only drainage necessary was an occasional cross-drain built to take care of storm water. However, at the short stretches built on a clay foundation, a 4-in. open joint tile drain was placed with relief drains every 100 ft.

### Formwork Made Simple

As is the case with all concrete work where the structure consists entirely of thin walls, the formwork is one of the principal items of cost and it is therefore necessary that the forms be as simple as possible and admit of easy and rapid erection. For the present slabs the forms consisted of flat panels made up of shiplap nailed to 2 x 4-in. studding similar to the panels used in the other types of flume construction. These panels were laid flat on a frame consisting of three longitudinal timbers rigidly cross braced, forming a stiff supporting and tilting frame. A board cut to the dimensions of the cross-section of the slab was nailed across each end of the panel to form the ends. In building straight slabs the form panels were wired down to the horizontal frame but for curved sections the panels were lashed to curved templets which were bolted to the framework. Fig. 12 shows one of these curved forms in place filled with concrete. The slabs were 12 ft. 2 in. long on tangents and the outside of the curves. The slabs on the inside of the curve were reduced in length the necessary amount to keep the joints on radial lines. These shorter slabs were molded in the same forms by simply inserting the end pieces in the form at the proper location.

Extraordinary care was taken in the field location of this flume and numerous points were referenced in order that the location might be accurately re-established at any point. After the location had been completed and checked, the entire length of the flume was divided into 12-ft. 2-in. sections and each slab assigned a number. With this information a chart was prepared showing the exact dimensions and shape of each slab and its location in the completed flume. A map was then made of the casting yard showing the number of each slab and its location. The yard layout was such that the slabs could be most readily loaded and hauled to the point of erection in the flume with a minimum amount of moving of the loading equipment.

After the slab forms had been set in position the reinforcing steel was placed in them in the form of a mat. The 1:2½:5 concrete, mixed at a central plant, was hauled from the mixer to the casting yard in ¾-yd. hoppers mounted on wagons. The concrete was discharged from these hoppers into the forms by gravity where it was tamped and rodded into place. The exposed surface of the concrete which was the inside face of the flume wall was rodded off to exact thickness and section by a straight edge guided on the ends of the panel forms. In the case of the curve sections the straight edge or screed board was cut to the required curvature.

As these slabs must be allowed to set for two days in summer weather before it is safe to up-end them and recover the forms, an average day's run with a total of 60 forms was 20 slabs. However, when forms were available it was easily possible to fill 40 in 8 hours. There were 706 slabs manufactured. The slabs were up-ended (see Fig. 13) by a home-made

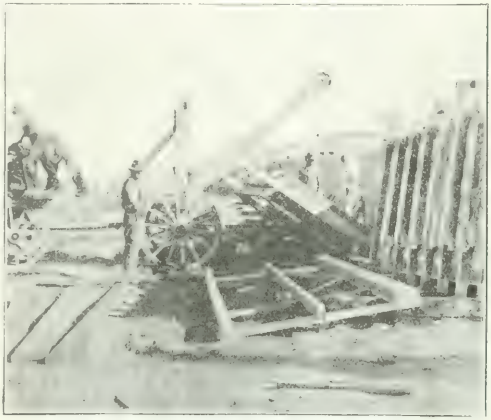


FIG. 13. HOMEMADE PORTABLE DERRICK FOR UP-ENDING SLABS

portable derrick and held in a vertical position by a simple system of framework.

After the flume bench was graded a 36-in. gage industrial track was laid parallel to and 8 ft. from the center line of the flume. This railroad was used to transport the slabs and all other materials and equipment used in the building of the flume. A tramway laid up the face of the bluff was used to connect the railway with the casting yard, which was located on the top of the bluff 1,000 ft. from the nearest end, and 200 ft. above the flume bench. Using the portable derrick shown in Fig. 13 the slabs were loaded two on a car and lowered down the incline by the use of a steam hoist. At the foot of the incline the slab cars were coupled to a 3-ton locomotive and run out on the track opposite their position in the flume where they were unloaded and set in position by a stiff-leg derrick. The mast and one leg of the derrick were mounted on two flat cars placed on the track with the second leg resting on a dolly which rolled on a portable track made up of short-length 6 x 12-in. timbers. It was necessary to start setting these slabs at the end nearest the slab yard and work away from the yard in order to operate the derrick on the track and not have it in the way of the incoming slabs. When the slabs had been set in their exact position on the fills they were held in place by a cleat joining them to a slab previously placed and by an occasional cross frame as is shown in Fig. 14.

When the slabs had been set in position the concrete floor was poured in sections of the same length as the slabs and as it was necessary to place an elastic filler

between two adjacent sections, the floor was poured in alternate sections.

Concrete for the floor was mixed at the central mixing plant located at the junction of the railroad and the tramway. For the purpose of conveying concrete to the flume and spouting it over the side of the wall, two specially constructed hopper cars were used. The hoppers on these cars could be raised and lowered in 6 x 6-in. timber guides by means of a hand crab. The hoppers were kept in a lowered position when moving. Following the pouring of the floor the pilasters were poured, completing the flume.

This flume, 4,500 ft. in length, has been in operation one year and although it was expected that this flume might leak somewhat at the joints, it has proved to be, for all practicable purposes, watertight, there being very much less leakage through these joints than through the bell-and-spigot flume. The precast

FIG. 11. CLEATS JOINED ADJACENT SLABS OF SEMI-PRECAST FLUME BEFORE CONCRETING

concrete was of an extra good quality, as it was possible thoroughly to tamp and spade it into the forms, making it unusually dense.

The costs of the above described flumes taken from actual cost reports are not comparable as the flumes were of different sizes and the construction work was spread over a period of three years with fluctuating labor and material costs. The difference in the length of haul of materials, local conditions and the season of year in which the construction work was done had a decided effect on the costs.

There is given below a cost per lineal foot for each type of flume with conditions adjusted so as to make the costs comparable. These costs are based on a flume with a carrying capacity of 270 sec.-ft. on a slope of 2 ft. per 1,000 ft. This capacity requires the inside dimensions to be 8 ft. 7 in. x 5 ft., including a 12-in. freeboard for all types of flumes except the all gunite, which had to be increased 11 in. in width to provide for the same capacity.

[illegible] COST OF FLUME PER LINEAL FOOT

| | |
|---|---|
| [illegible] | $[illegible] |
| [illegible] | [illegible] |
| [illegible] | [illegible] |
| [illegible] | [illegible] |
| [illegible] | [illegible] |

The above are field costs exclusive of excavation and are based on winter construction, 10-mile haul for materials from railroad to job, 2-mile haul for sand and gravel, common labor costing 50c. per hour and skilled labor in proportion, cement $4 per barrel at job, steel 5c. per pound and lumber $70 per thousand. These costs are abnormally high due to the fact that labor was scarce, inefficient and the cost of both labor and materials high on account of war conditions.

The fact that most of the flumes were built during the winter months was a factor greatly increasing the costs. Records show that a reduction of 25 per cent would have been made if the work had been done during favorable construction weather.

The above described construction work was all done by government forces and was carried on under the supervision of A. P. Davis, director, U. S. Reclamation Service, F. E. Weymouth, chief engineer; J. L. Savage, designing engineer; Walter Ward, project manager; A. M. Rawn and E. C. Panton, engineers.

## Two Small Dams Good Examples of Amateur Engineering

### Correspondents Report on Structures in Different Parts of Country, Both of Which Disregard Good Practice

ON THE same day last month two engineers in different parts of the country, obviously unknown each to the other, sent this journal drawings and a brief description of small dams about to be built. The two cases were alike in that each was an example of amateur, or, at least, unintelligent engineering applied to what might seem to be a small and unimportant structure, but one whose failure might entail serious consequences. Details of the two dams as reported by the two engineers are given herewith.

The first dam is to be built in Ohio and is reported on by Gale Dixon, chief engineer of the Bureau of Water Works Improvement of Akron, Ohio. It is shown in Fig. 1, p. 1019. It is being built immediately above an unsafe mill dam and right near the site of a half dozen other small dams which have washed out at intervals in the past fifty years. Mr. Dixon's comment on the dam is as follows:

"The feature of the new dam which most interests me is the design of the spillway, described in the specifications as 'constructed of reinforced-concrete.' As illustrated in the accompanying sketch, it would be better termed an 'earth embankment with concrete paving containing some reinforcing steel.' The paving slab as reinforced is unsafe for the support of its own weight between the walls after the embankment beneath it has settled.

"The type is such an obvious development of the timber spillway of the forest country that there must have been many such built; yet I have never before happened to observe one, nor do I recollect ever having seen this type illustrated or described in technical literature.

"In the present instance I believe the designer's inspiration came from the spillway of the old mill dam just below, but in that case the word sluiceway would perhaps fit better as the aperture is 8 ft. square and the concrete trough is founded entirely upon the embankment, with no walls running down to original ground.

"The general design of the new dam will bear a word of description. It is being thrown across a creek of 9 sq.mi. drainage area, and will make a pond about 25 acres in extent with 20-ft. depth just above the

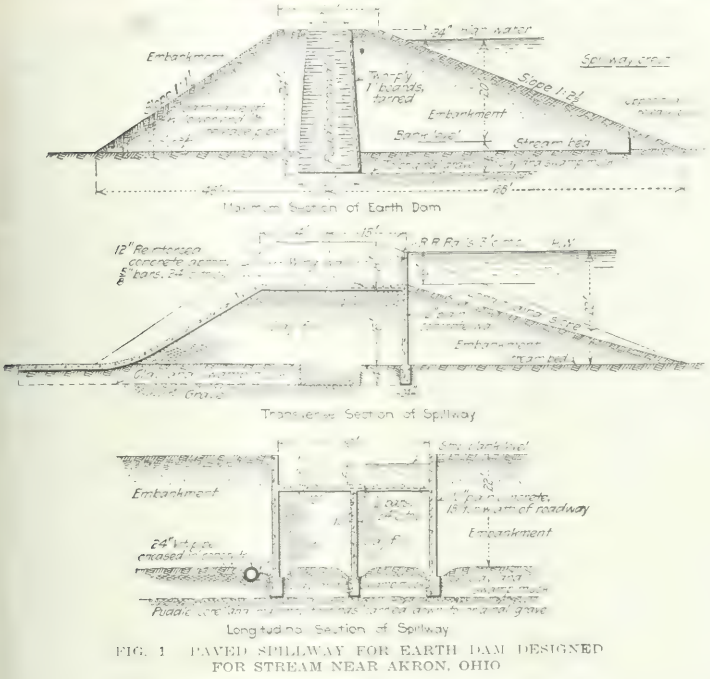



FIG. 1 PAVED SPILLWAY FOR EARTH DAM DESIGNED FOR STREAM NEAR AKRON, OHIO

dam, to be used for fishing. The valley floor at the dam site is about 175 ft. wide and has a surface layer of some 14 ft. of soft muck and silt overlying gravel and sand. No cutoff piling is provided and except for the 'puddle core wall' the embankment is placed on the original swamp surface. The specifications do not prescribe the method of forming the embankment, nor do they define 'puddle.' The results in construction may be imagined.

"The release pipe is of vitrified clay incased in concrete with gate valve at the downstream end. The core-wall trench was not carried under the release pipe, and the plans made no provision for the prevention of percolation along the exterior of the relief pipe or the backs of the spillway abutments. No surface protection of any kind is provided for either the upstream or the downstream slope."

The other dam, given in the sketch in Fig. 2, is reported on by Ernest H. Lee, civil engineer and surveyor, Gadsden, Ala. Mr. Lee's letter is about as follows:

"I am enclosing herewith sections of a small dam to be constructed near this place. The person having the dam constructed furnished the engineer the general design and gave instructions that the plans be drawn to conform with the dimensions furnished. The question has arisen, Would the dam not give way to heavy pressure upon its completion?

"The engineer recommended on face of plans that the project be condemned or else the dam be fastened securely in the solid rock by means of boring holes in the rock and sinking steel pins of sufficient caliber to anchor the dam, and further that the following specifications accompany the design: All concrete to be of a 2:3:5 mix and to be reinforced where necessary to meet the approval of the engineer; all walls to be firmly cemented to the rock bottom and finished in workmanlike manner; no wall to be more than 8 in. thick except at the south end of the dam, which is to be 6 in. thick, and on north end next to water house, which is to be 12 in. thick; no concrete to be poured in moving water; rock and gravel to be used in walls must be clean or free from dirt, not to exceed 3 in. in dimension. When the contractor learned what the reinforcement requirements would be he threw up the job."

"Note that the borings say that at the bottom of the dam there is solid rock. The stream is sliding along over this rock at the present time, and only has a few angling shoulders which run almost up and down stream. My contention is that the dam will slide, even though the cross-section walls are close enough, which I think is not a fact. I also feel that the loose rock inside the dam will place much strain on the bottom of the walls, and will do more harm than good."

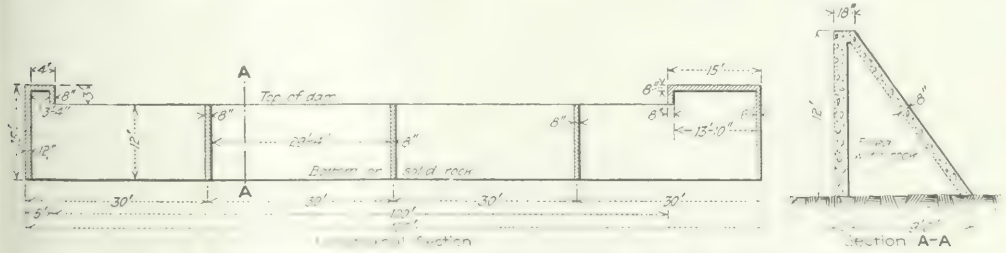



FIG. 2 LONGITUDINAL AND CROSS-SECTIONS OF A PROPOSED DAM IN ALABAMA

### Paducah Elects Two Engineers to Commission

Two of the four members of the City Commission of Paducah, Ky., elected Nov. 8, were engineers, Henry A. Pulliam, and L. A. Washington, a former city engineer.

# Cleveland Public Square Passenger Terminal Authorized

**Commerce Commission Issues Certificate of Public Convenience—Railroads Reply to Criticism—Plans Aim to Distribute and Segregate Traffic—Steam and Interurban Traffic on Same Level**

AUTHORITY was granted by the Interstate Commerce Commission, Dec. 7, 1921, to the New York Central, the Big Four and the Nickel Plate railroads, as applicants, to purchase the corporate stock of The Cleveland Union Terminals Co., and to enter into an agreement with the terminal company for the use of the passenger station and its approaches to be constructed by it at the southwest corner of the Public Square at Cleveland, as shown in Figs. 1 and 2. This action reverses the opinion of the commission made public Aug. 12, in which an application was denied. (*Engineering News-Record*, Aug. 18, p. 297.). The commission also issued a certificate of public convenience and necessity with respect to constructing the station. It is believed that this action will now permit the Public Square station project to go forward, following the many years of discussion as to the location of a new station, during which the Public Square plan has been criticised in comparison with a union passenger terminal on the Lake Front. Plans and sections of the station as developed to date are here published for the first time. It is the intention of the railroads and the terminals company to proceed with the financing so that construction may follow as quickly as practicable.

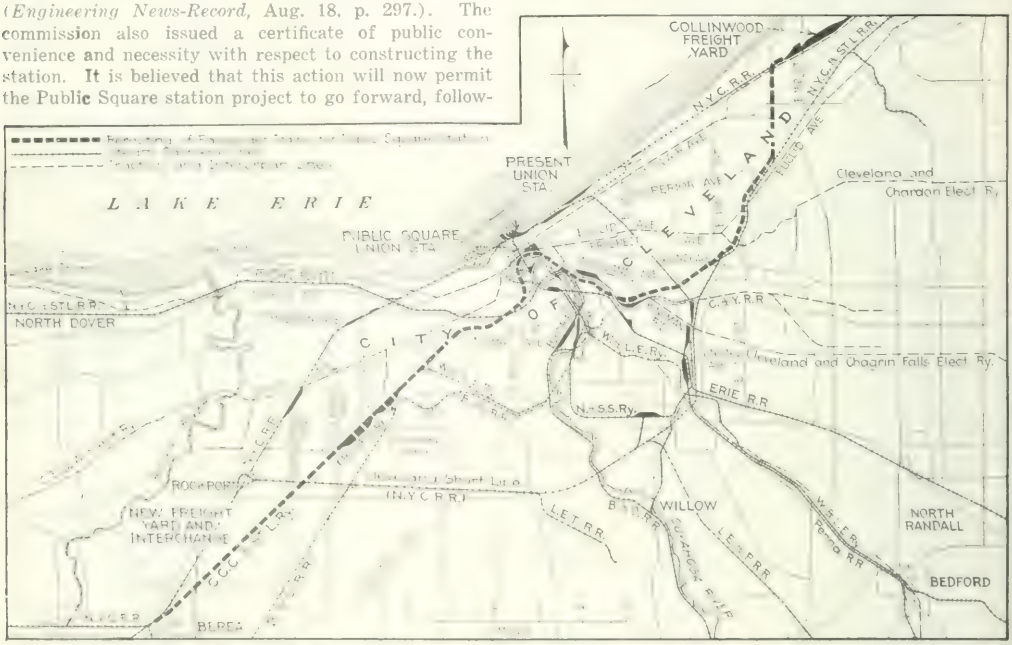



FIG. 1. PRESENT RAILROAD LINES AND PLAN OF PUBLIC SQUARE TERMINAL

Applications were made by the three railroad companies to the Interstate Commerce Commission on Feb. 14, 1921, and public hearings before the commission were held April 19 to 22, 1921. After the first applications were denied the railroads asked for a rehearing, which was held, Sept. 20-27. As negotiations now stand, the new station will be used initially only by the New York Central, the Big Four and the Nickel Plate. The Pennsylvania has stated it will not come into the station project and the other railroads, the Baltimore & Ohio, the Erie, and the Wheeling & Lake Erie, have not yet made a decision. Since the Pennsylvania now uses the present union station on the Lake Front, which is to be abandoned under the Public Square plan, it will probably make its principal passenger terminal at its present station located at East 55th St. and Euclid Ave. Although present negotiations do not contemplate the immediate use of the station by the Pennsylvania, the Baltimore & Ohio, the Erie and the Wheeling & Lake Erie, it is maintained that the site will provide for traffic expansion of all the railroads for the next fifty years and that additional expansion can be obtained by the acquisition of adjacent properties. The three railroads now planning to use the Public Square station operate about 70 per cent of the total number of steam railroad cars and receive about 70 per cent of the total ticket sales on all railroads entering Cleveland. It is also pointed out that track connections could be readily made to bring the Erie, the Pennsylvania, the B. & O. and the W. & L. E. into the new terminal.

The principal arguments presented at the hearing before the Interstate Commerce Commission in favor of the Public Square station were:

1.—That new passenger facilities are imperatively needed by the New York Central Lines because of the growth of population of Cleveland and because the present station is old and inadequate; the station and approach tracks are insufficient in number; the station tracks are generally too short; the switching at the station is interfered with by other operations; the station is inconveniently located, being

away from the business section of the city and from good street car service.

2—That the passenger traffic on the Lake Front line interferes with freight operations and the service to industries and the freight operations slow down the passenger movements.

3—That the present lines of the New York Central through Cleveland along the lake front and around the southern part of the city are congested.

4—That additional tracks along the lake front can only be obtained at very heavy cost and to the injury of the parks and industries which hem in the railroad on either side.

5—That additional tracks along the Cleveland Short Line can only be obtained at heavy cost because of tunnels, widening the viaduct over the Cuyahoga River, bridges over streets and adjacent parks.

6—That the lake front is an industrial section and should be kept free of passenger traffic so as to provide proper freight service for future industrial growth and for the rail and lake interchange when the city carries out its waterfront development.

7—That the passenger traffic should be removed from the lake front line to a new line so as to leave the present lines free for through freight and local and industrial traffic.

8—That there is not sufficient space on the lake front for future growth of the passenger terminal as well as increase of freight facilities required for growth of industrial business.

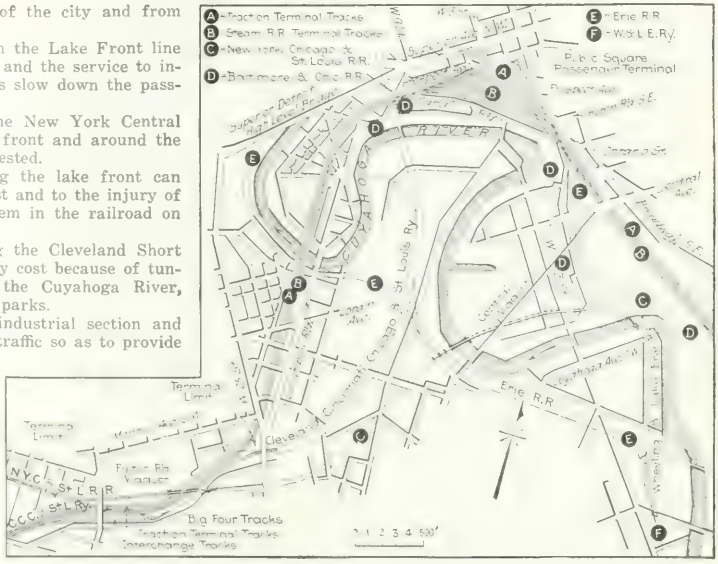



FIG. 2. APPROACHES TO PUBLIC SQUARE STATION WITHIN TERMINAL LIMITS

9—That the Public Square station is the most convenient for the public, being near the business and office centers and on the main street car lines.

10—That it is so situated as to be readily accessible for all the railroads.

11—That there is ample space for future growth of station facilities.

12—That the interurban and rapid transit lines will be in the same terminal with the steam lines and that they will develop the short haul business, leaving the steam railroads free to handle the long haul business.

13—That the new route for passenger trains in connection with the Public Square station will solve the congestion difficulties of the New York Central Lines while the lake front plan will not do so.

14—That the complete Public Square project can be carried out more cheaply than any other known plan that will solve the congestion problem of the New York Central Lines.

The engineering plans prepared jointly by the railroads and the terminals company call for but one track level—30 ft. below normal street level—instead of segregating traction and steam railroad traffic on two levels as proposed in earlier studies. It is also the aim to distribute and segregate the traction and steam railroad passenger traffic by providing independent concourses and passageways, in so far as possible, and to segregate non-passengers passing through the station by providing separate accessible passageways.

Since the adoption by popular vote of the City of Cleveland of the ordinance on Jan. 6, 1919, authorizing the construction of the Public Square Terminal, the original plans and the method of operation contemplated have undergone considerable revision. It is now planned to have initially nine station platform tracks for traction lines and ten station platform tracks for steam railroad lines on the one level. A coach yard is also

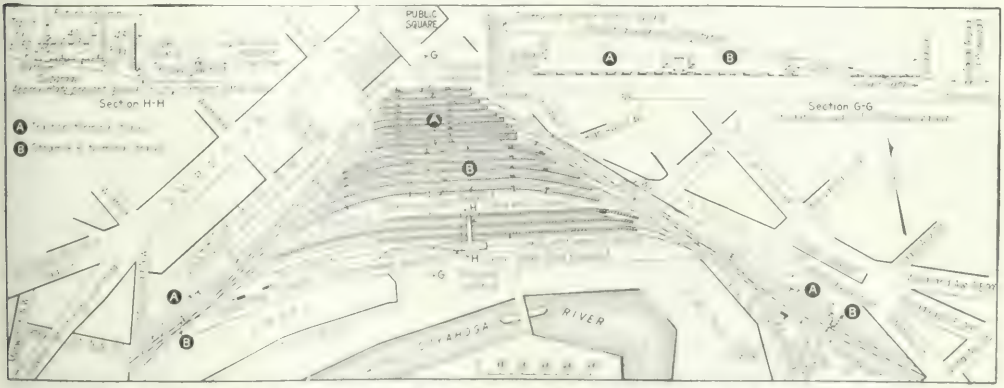
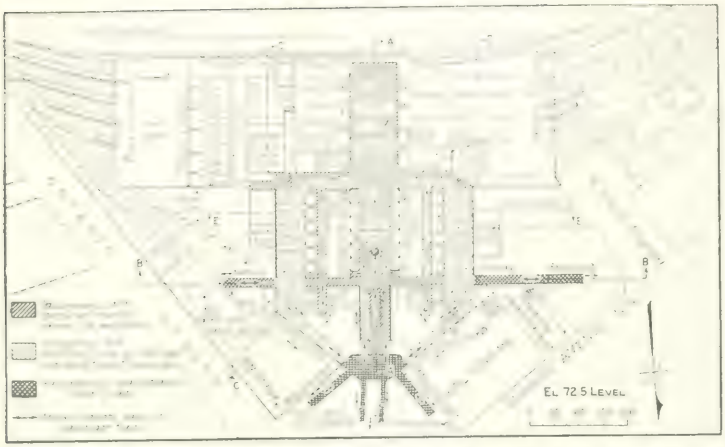



FIG. 3. TEN STEAM LINE AND NINE RAPID TRANSIT TRACKS PROVIDED IN INITIAL LAYOUT
Nine tracks could be used later to be removed to outlying point to accommodate part of space for [illegible] additional steam line tracks for future expansion.

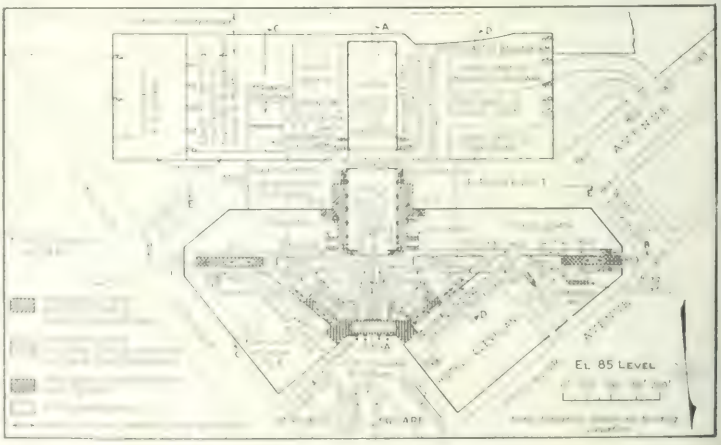



[illegible] CONCOURSE LEVEL—DIVISION OF PASSENGER TRAFFIC—RAMP APPROACHES

provided in the terminal, paralleling the platform tracks and occupying a space later to be used for expansion of steam railroad facilities to a total of twenty-three tracks. Plans for approaches and connections from the outer terminal limits are practically the same. Plans for the station itself have been made with a view to the greatest convenience for the public and to obviating the objection raised that congestion would be caused by adding the station traffic to that already existing at the Public Square.

For about twenty years new passenger station facilities have been the subject of controversy in Cleveland and the adoption of the Public Square plan by popular vote, Jan. 6, 1919, followed the previous adoption of a plan to locate a Union passenger terminal on the lake front. It was first proposed to build a stub-end, two-level station at the Public Square; then a two-level through station, and now plans developed by the railroads and the terminal company provide for a one-track-level through station. Since 1918 there has been a spirited controversy in Cleveland over the rival lake-front Public Square project. A comparison of the two plans appeared in *Engineering News-Record*, Jan. 30, 1919, p. 240, with editorial comment in the same issue criticising the Public Square project.

In answer to the criticism that congestion would be increased by a station at the Public Square, the railroads have contended that a large portion of their traffic now passes through the square since a large number of their passengers transfer there from station cars to main car lines, and that the steam railroad traffic is so small in comparison with that now using the square and is so distributed over the twenty-four hours that its addition would have little effect. Since interurban and rapid transit cars now terminating at the Public Square run at infrequent intervals, the railroads point out that passengers collect in the square while waiting for trains, and that if these lines terminate in the proposed station, all this traffic will be removed from the street surface, and further, the interchange of passengers between these lines and the steam railroads will take place without the passengers going upon the street surface. It is also maintained by the railroads that the Public Square is an exceptionally large open space that can accommodate vastly greater traffic than it now does if properly laid out and if traffic is properly handled; that there is now more confusion than congestion at the square due to the return looping of all cars at this point and the operating of cars against the normal currents of traffic; that traction passengers traveling between the east and west sides of the city are forced to transfer in the Public Square or if they go only a short distance beyond the square have to leave the cars and continue their trip on foot; that in order to obtain a seat during the evening rush the people walk to the square to take the cars instead of taking them along the line; that the present difficulties at the square would largely be avoided by through routing of cars to points beyond the square; that the entrances and exits of the station are so located at points exterior to the Public Square proper as to divert traffic away from the square only one of the five entrances being directly on the square; that a future subway under the square, which has been heretofore proposed by the city, and additional viaducts between the east and west sides of the city, as are proposed, will remove much traffic from the square.




[illegible] PUBLIC PASSAGES THROUGH ARCADES

In answer to the criticism that the Public Square site would not afford opportunity for the necessary expansion of railroad facilities in the future, an analysis was presented to the Interstate Commerce Commission by the New York Central indicating that space is provided in the present plan for additional facilities to meet the requirements of all of the railroads entering Cleveland for the next fifty years at the present rate of passenger train increase of 1.33 per cent compounded annually, and that additional space is available for further expansion. It was not considered feasible by the railroads to locate the station adjacent to the east approach tracks east of the Public Square, since existing streets, large industrial plants, the Cuyahoga River, and other railroad properties already developed, restrict the space necessary for expansion. In reply to questions raised as to the economic soundness of monumental passenger terminals at the cost of millions of dollars, it was stated by the railroads that the plans for the project as now worked out in detail do not call for a monumental structure, but only for the railroad facilities required, and that structures above the street level will be commercial buildings from which revenue will be derived, with station entrances and exits through them.

With the track level below the concourses and the development of extensive air rights over the terminal itself, electrification will be necessary. The probable limits of electrification and points of changing power will be at Collinwood on the east and at Linndale on the west. The rerouting of New York Central passenger trains from the lake front main line is shown in Fig. 1, and in this connection it is the present intention of the New York Central to route its westbound freight over the present lake front line and eastbound freight over the Cleveland Short Line, using the Nickel Plate eastbound track between Quincy Ave. and Superior Ave., jointly with that road. For the present, the principal construction work necessary for approaches, involving the use of the terminal only by the New York Central, the Nickel Plate and the Big Four, would be the grading, viaduct, bridges, and trackage on the west approach from about 25th St., over the Cuyahoga River valley into the station, and on the east the building of additional approach tracks with heavy grading and retaining walls paralleling the Nickel Plate from the terminal limits and continuing into the station.

Within the switching limits of the terminal, the plans call initially for four approach tracks for steam railroad traffic and two tracks outside of these limits. Calculations of the New York Central indicate that enough trackage has been provided at the throats and on the approaches, but it is stated that additional approach tracks for steam railroad traffic can be obtained by temporary or permanent use of traction line trackage if required on account of congestion, and by the construction of additional tracks if needed. Maximum grade on the approaches is 0.72 per cent, which is the ruling grade on the Big Four in this locality. Maximum curvature on the approaches of 4 deg. 40 min. occurs on the curve just west of the terminal.

As indicated in Fig. 3, ten steam railroad platform tracks are provided in the initial layout for a maximum peak traffic of twelve trains in the station during the busiest hour, and six trains in the station at one time. Of the three railroads using the station, eighty trains per day under present schedules would be handled. It is pointed out that ninety-eight trains per day are handled through the present lake front station on nine platform tracks, some of which are short. The three railroads consider the final track layout adequate for future expansion since it provides an increase of 130 per cent in the number of platform tracks, and if the number of trains continue to increase at the same rate as for the past eight years, namely, 1.33 per cent compounded annually, the layout would provide for a normal growth of sixty-three years. If all of the railroads entering Cleveland should use the terminal, there would be 152 trains per day on present schedules; 25 trains in the station during the busiest hour, and 9 trains in the station at any one time. In this case it is stated that the initial platform tracks will probably be increased to twelve in number, and the final layout would provide for an increase of 90 per cent, sufficient for normal growth of traffic at the present rate for forty-nine years. The station area can be extended southerly in the future to provide further expansion of track facilities. Should it become necessary, it is contemplated that four of the traction platform tracks would be taken over for steam railroad purposes.

It is proposed to lease to a company known as the Cleveland Traction Terminals Co., those portions of the passenger terminal to be used for interurban and rapid transit purposes, as well as the concession space and the right to use the joint area. Nine interurban and rapid transit platform tracks are proposed initially, and provision has been made for additional station tracks and platforms for this service. Tracks on the approaches for the interurban and rapid transit trains—two

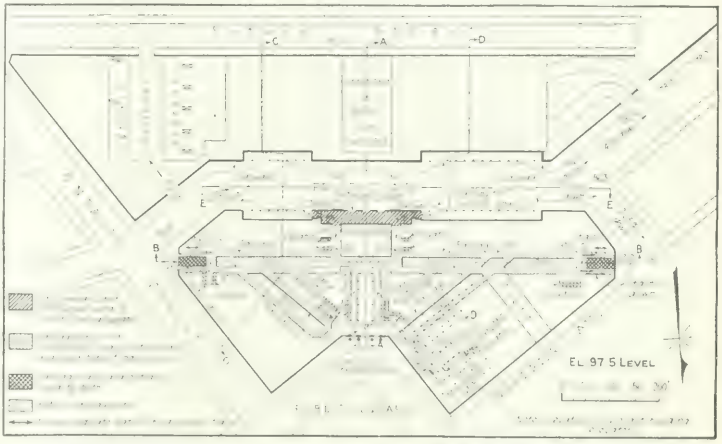



FIG. 6. PROSPECT AVENUE ENTRANCE AT LEVEL C . . . UPPER PASSAGES

initially and four finally—will extend to the terminal limits, approximately two miles from the center of the station, and beyond these points it is planned that trunk lines will be constructed from which branches will connect with suburban developments to relieve the steam lines of this traffic. It is pointed out that the Shaker Heights rapid transit line, already in operation, can readily be connected to the terminal, having been constructed with this in view.

The principal considerations in the layout of the station, as developed in plans shown in Figs. 4, 5, 6, and 7, have been (1) to fit the floors in with different levels of streets; (2) to segregate steam railroad from traction passenger traffic, in so far as possible, and (3) to segregate non-passengers passing through the terminal from passengers. The concourse level—El. 72.5—which is shown in Fig. 4, is reached from the Public Square, Ontario St., and West Third St. (diverted) by ramps downward, and from Superior Ave. by a stairway from El. 83 to El. 72.5. A stairway is provided at the Ontario St. ramp from El. 94 to El. 85, since the street elevation at this point is higher than at the other location above mentioned. Access to the concourse level from the Prospect Ave. entrance, El. 96.0, is gained by stairways on either side of the entrance lobby, connecting with short passages, and thence by other sets of stairways down to the ticket lobby, from which the steam railroad concourse is reached directly. Separate concourses for interurban and rapid transit traffic are located on both the east and west sides of the station, connected by direct passageways with the Public Square entrance. The interurban and rapid transit concourses are also reached by joint passages from the Ontario St., the Superior Ave., and the West Third St. entrances. Track platforms, El. 52.75 (top of rail being at El. 52), are reached directly by stairways from the concourses at El. 72.5. Platforms and stairways for steam railroad lines are provided between each pair of tracks and for the traction lines between each two tracks. The location of mail and baggage elevators is indicated in Fig. 4, which also shows the baggage trucking passageway around the rear of the station over the track and platform level. The purpose of this arrangement is to minimize the amount of trucking necessary on track platforms in order not to interfere with passenger traffic.

Segregation of passenger traffic is indicated by the legend on Figs. 4, 5, and 6, showing areas and passageways used jointly by steam railroad and traction passengers, by steam railroad passengers only, and by traction passengers only. Figs. 5 and 6, together with Fig. 7, showing sections and elevations, indicate provision for non-passengers passing through the station (see legend, Figs. 5 and 6). Experience in the larger passenger terminals, notably the Grand Central Terminal in New York City, has demonstrated that a large number of people will inevitably pass through a terminal of this size, fronting on two or more streets and located in a busy part of a city. It was therefore considered important to segregate non-passenger pedestrians passing through the terminal from the passenger traffic. The principal passageway for this purpose will connect the West Third St. entrance at normal street level, El. 83, with the Ontario Street entrance, a stairway being provided at the east end to connect the Ontario St. entrance at El. 94 with the passageway at El. 85.0 and two stairways at the west end to connect the West 3rd St. entrance with the passageway at El. 97.5. A branch passageway is carried to Superior Ave. at normal street level, El. 83, and two diagonal passageways as well as two shorter passageways alongside the entrance lobby, connecting the main passageway with the Public Square entrance at El. 83 are also provided. The main and diagonal passageways will be built in the

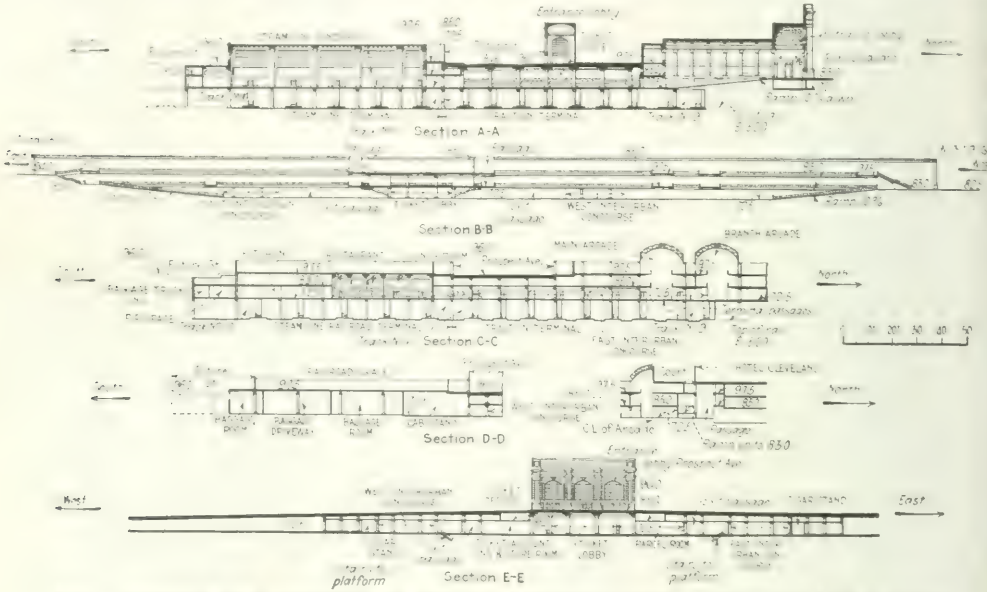



FIG. SECTIONS SHOW NECESSITY OF MEETING DIFFERENT STREET LEVELS (SEE FIGS. 5 AND 6)

form of double deck arcades with corridors on both levels on each side of a central opening over the terminal passageways as indicated by section C-C, Fig. 7. Single ramped passages will also connect the Public Square entrance with the main passageway at El. 97.5, and branch passageways will be provided off the main passageway at this level. Along each pair of corridors, at Els. 85.0 and 97.5 and along portions of the terminal passages at El. 72.5, space for shops or other purposes will be leased.

The terminals company has not yet made any plans for the construction of buildings above the terminal south of Prospect Ave., and will only construct the necessary terminal facilities in this area. Columns and foundations, however, will be designed to carry buildings of possibly eleven stories in height above the street. These buildings would have direct connections into the passenger terminal where feasible. A direct connection by stairway and ramp will be provided between the existing Hotel Cleveland and the west traction passageway.

In the area between Prospect Ave. and the Public Square and along Ontario St. east of Prospect Ave., buildings will probably be constructed about the same time the terminal structures are built. The building at the southwest corner of the square may possibly be twenty stories above the street and the others somewhat lower. The areas above the terminal may be developed by the terminals company or leased for the construction of buildings as has been done in the case of the areas over the Grand Central Terminal, New York City.

The plans for the project have been worked out in collaboration between the three railroads, by George A. Harwood, assistant to the president, and H. D. Jouett, terminal engineer, New York Central Lines, and the Cleveland Union Terminals Co., represented by W. E. Pease, chief engineer of the Cleveland Union Terminals Co.

### Maine's Road Maintenance Costs

Road maintenance work in Maine during 1920, according to the annual report of the State Highway Commission, was performed generally by patrol maintenance; 494 patrolmen were employed in caring for 4,241.11 miles of road in 495 towns. Of this mileage 709.34 miles was improved state highway; 949.99 miles was improved state aid highway; and the balance of 2,581.78 miles was unimproved road. There was also maintained by special arrangement with the towns 159.97 miles of improved state-aid road.

A total expenditure for labor and material of $765,073.18 was made on this work, including $18,130.43 furnished by the state for road machine work. The state also furnished supervision and inspection for the work amounting to $34,047.51, making the total gross expenditure chargeable to maintenance of $799,720.69. Of this amount the state furnished $562,252.74 and the cities and towns furnished $237,467.95. The average expenditure per mile was $181.71.

On the 709.34 miles of improved state highway, the expenditure for labor and material and supervision was $374,085.26 or an average expenditure per mile of $527.37. The expenditure on the 3,531.77 miles of other road under patrol for labor, material and supervision was $399,306.29 or an average expenditure per mile of $113.06.

## Practical Public Administration Under a City Manager

### Human Element, Not Profits Governs in City Work Success Conditioned on Equipment, Men and Personality

THE chief problem in the city-manager form of government is the city manager and his success is conditioned on the equipment with which he must work, on the personnel of his organization and on the personality of the administrator, said E. J. Fort, city manager, Niagara Falls, at the recent convention of the City Managers' Association in an analysis of the problem of public administration under the city-manager form of government. "The present managers do not perhaps measure up to their jobs and are not the supermen or the highly endowed specialists they have need to be," said Mr. Fort, but prospects of permanency and success are not yet such as to attract the highest type of business managers. The rewards do not yet compare with those in commercial life, and the opportunities for a career are not sufficiently sure and satisfactory to attract the highest grade of talent and to induce men to make it a life undertaking. The necessary qualities of a city manager are much the same as those generally set forth for captains of industry. The manager "must be essentially an idealist, imaginative, enthusiastic, more or less impulsive, intensely human, a dreamer of dreams with the power to make the dreams come true—in short, an artist capable both of great imaginative conception and fine technical execution; possessed both of the power to conceive and to do."

Further views of Mr. Fort on the three factors which in his opinion make a successful municipal administration follow:

*Equipment.* — The equipment with which the administrator of the affairs of cities must carry on his work is composed primarily of state laws, municipal ordinances and especially the charter of the city. Fortunately, the general form of the charter which we believe lends itself most readily to the proper and efficient admintration of a city has been well worked out and needs only adaption to the laws of the state, but the general ordinances of the average American city of the second or third class are a heterogeneous collection of rules relating to many matters, some of which have little relation to public convenience or welfare. For the satisfaction of his own pride in his work, in the interest of the city and in furtherance of his success, the administrator should see that such ordinances are revised and embody the latest and most progressive ideas upon all matters with which they deal. In order to do this successfully, he must be personally familiar both by study and experience with the methods of dealing with such matters which have been found to be most satisfactory by cities which have passed through the stage of growth and development through which his city is passing. He should be experienced in writing ordinances, building codes, zoning and other restrictions, contracts and specifications. He should have a fair understanding of contract law. He need not be a specialist in either law or engineering, but it will be vastly to his advantage if he is reasonably familiar with them as they apply to municipal problems and can arrive independently at correct decisions in regard to matters with which they deal and which are constantly up for consideration.

*Personnel.* — For the personnel of the organization with which the administrator must work, I do not assume that, in the majority of our cities, he will be able to secure the services of well trained specialists as the heads of

bureaus and departments in all cases; men who are well versed in the administration of the offices and the technique of their work; who can decide unerringly questions of procedure, equipment and organization, and as a consequence, the final decision upon many of such questions, even in relation to minor details, must fail to him. This in itself is a problem of some difficulty and importance and upon its correct solution depends the smooth and satisfactory operation of the departments. The mental equipment required for this purpose cannot be acquired in a correspondence school or from a short course in a school of public administration, but must be acquired in the hard school of experience. I thoroughly believe that the one selected to be the head of a department should be allowed and required to administer the affairs of that department in all its details and should be held responsible for results. He should not be allowed to lean too heavily upon his superior in matters of detail or in anything except the more important matters of procedure and policy. Credit properly goes with responsibility.

LOYALTY, FIRST REQUISITE

*Personality.* — Were I to name the qualities which should attach to the head of a department and which should determine his selection, I should unhesitatingly place first in order, loyalty—loyalty to the interests of the public which he serves, that attitude of mind which prompts him to judge of the merits of an act or method of procedure by the manner in which it serves the interests of the public, loyalty to his superiors, sympathy with their purposes, the results which they aim to accomplish and the methods which they propose to pursue in accomplishing them, loyalty to his task. The man is loyal to his task who places the success of his work and the service which he renders through it above consideration of self, whose mind is not busy with schemes for his own advancement and aggrandizement, but whose reward is in doing most efficiently the thing which he has in hand.

I should place second in order, integrity, without which he is worse than worthless in any position of trust or responsibility.

Third is industry. Higher standards of living are constantly compelling city governments to undertake new duties and to perform the older ones more efficiently and economically. The appetite for service grows by what it feeds upon. At the same time, the expenses of government are constantly increasing, debt limits and limits of taxation fixed by state laws loom ominously in the foreground and higher rates of taxation are frowned upon by the public. The chief of a department, in order to reconcile these conditions, must therefore not only be diligent in the performance of the duties of the day, but he must be diligent in informing himself as to what others in his own line are doing. He must keep abreast of the times and preferably ahead of them and, in doing so, in almost any branch of municipal work I venture the assertion that he will have need to extend his working hours far beyond those of the employee who watches the office clock.

Fourth in the order of importance is education and experience. Native ability and other personal attributes may equip one man without education and experience better for the duties of the head of a department or chief of a bureau than do the education and exerience of another. However, this is the exceptional case. It has been said that a goat cannot be educated to be a sheep, but he can by this means be made a much better goat. Education and experience are indispensable for the heads of certain technical departments such as the city engineer, the corporation counsel and the health officer.

The fifth place I would assign to tact. There is no department of the public service in which the official head is not obliged to deal with the public. It is the public's business in which he is engaged. It is well to remember that the public is not too well informed as to the details of its business and through lack of information or misinformation the official acts of the administrator are likely to be misjudged. On the other hand, his reputation and influence in the community, his success in his undertakings and ultimately his tenure of office depend upon the good will of the community. It would seem to follow, therefore, both from reasons of principle and from reasons of policy, that his attitude toward the public should be carefully considered and should be correct. He should be endowed with and should practice a never failing courtesy which shows no distinction between the rich and the poor, the wise and the ignorant, friend and supporter and bitterest opponent.

Tact in dealing with subordinates is also of first rate importance, for without it the administrator will not generally receive their full co-operation and enthusiasm in their work which springs from esprit de corps. By it many a large undertaking has been carried through to success. In most cases this success has been the result of the tact of the head of that organization in the treatment of its members in such a manner as to arouse their enthusiasm for success. The manager's pathway to success will be doubly difficult if he lacks a proper appreciation of the importance of the enthusiastic support of his organization.

I assume that every man who is fit for a position of responsibility has learned the lesson of a respectful and tactful attitude toward his superiors and that it does not need discussion.

# Wide Asphalt Joints Not Essential in Brick Pavements

## For Lugless Brick Unnecessary Worry and Expense Incurred To Secure Uniform Spacing— Squeegee Joint Filler

BY HARLAN H. EDWARDS
City Engineer, Danville, Ill

VARIOUS engineers and inspectors on brick road construction where lugless brick and asphalt filler have been used have voiced considerable complaint recently because of the apparent difficulty encountered in filling every joint between every brick its entire depth

HOT FILLER IS FED INTO CRACKS AHEAD OF SEMI-CIRCULAR SQUEEGEE

with asphalt. They bewail the fact that the lug brick has been abandoned and declare that the pavements will not give good service because the bricks sometimes lie so close that the filler cannot penetrate between them.

A careful review of the facts in the case, however, indicates that the admonition "fill every joint from top to bottom" when cement grout filler is used, has been so well learned that the real function of the bituminous filler has too often been lost sight of.

Flexibility, cleanliness and the elimination of expansion stresses are the greatest points in favor of the asphalt filler. The first and the last points were fulfilled by the sand filler, with which many of our oldest and best brick streets were constructed, and in which, incidentally, lugless brick were used. Protection of the edges of the brick at the points was not afforded by sand and the item of cleanliness was not seriously thought of. Bituminous fillers, however, fulfill all the conditions demanded, and in addition have the advantage of reducing wear at the joints and of being quiet and clean, which in these days of greater sanitation is an important item.

Wire-cut lug and repressed brick with lugs were used when bituminous fillers were introduced, and they continued in favor until it was seen that with the wide joints the filler was "cut out" by traffic, thus permitting the cobbling of the edges of the brick in a short time. To eliminate these bad features the lugless brick and the vertical fiber brick were gradually adopted, and their use has met with much favor.

From the standpoint of permanent smoothness and continuity of surface as well as cleanliness narrow joints are desirable. Where brick are in such close contact that even liquid asphalt at high temperature will not penetrate the joints, it is folly to worry. Since close contact reduces the cobbling or wear of the brick at the joints and cuts down the wearing of the filler from the joints, it makes for a smoother, longer lived surface and a lower annual maintenance cost to have the narrowest joints possible.

The assumption that bituminous filler produces a waterproof pavement is not true. An examination of many pavements at different intervals shows that the sand cushion or bedding course under the brick is always wet after a rain. It shows also that contraction of the surface in cold weather produced cracks between bricks and the filler which are sometimes large enough to admit a knife blade. Manifestly, then, the idea of waterproofness is erroneous and the need on this account for filling every joint, however small, with bituminous filler, does not exist.

Many bituminous-filled brick pavements have been constructed with uniformly good results, and the best of them all are those in which lugless and vertical fiber brick were used. Various methods of applying the filler have been used, all of which are good.

### Applying Filler

For use in cold weather, either the conical pouring cans or the hot iron squeegees have proved their worth, but for general use during the warmer construction season the cheapest and most reliable method of application has been by the use of the combined rubber squeegee and asphalt pot. In this contrivance the hot filler is kept in a square metal box mounted directly above the squeegee, which is semi-circular in shape. The filler is applied from the box to the pavement through a hole directly in front of the squeegee. All the joints are filled at once with the hot asphalt while the excess material is always drawn forward with the machine by the semi-circular squeegee. Little time is afforded for the filler to cool before it gets to the bottom of of the brick. Good work has been done by this method with the temperature as low as 20 deg. F.

Many of us are prone to make a big fuss over little unessential things while at the same time we disregard the larger things which are really the controlling factors in determining whether or not the pavement as laid will give its proper service. Contrary to the characteristics of the cement grout filler, bituminous filler will not permit stresses which will "pop off" the tops of the brick in hot weather if it penetrates but a fraction of the entire depth of the brick. In consequence it is not so essential that the sand cushion be such that it will not work up part way between the brick under the roller, and thus prevent a full penetration of the filler to the entire depth of the brick. Full penetration is desirable, but not so much so that it would warrant an increased cost or a sacrifice of wearing qualities of the pavement to insure it.

## Precast Stone Trim Produced For Baltimore Refinery

### Casting and Storage Yards Elaborate—Batch Cars on Elevated Track Chute Concrete to Forms—Daily Output 600 Cu.Ft.

By J. Roscoe Sharp
Foreman, Stone & Webster, Inc., Baltimore, Md.

THE plans for the refinery of the American Sugar Refining Co. at Baltimore, Md., contemplated the use of precast stone trim, more commonly referred to as cast stone. For the entire project, planned requirements were 40,000 lin.ft., or approximately 30,000 cu.ft.

The plant was designed on the basis of meeting the

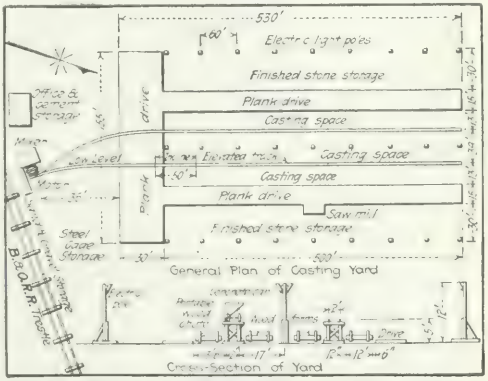



FIG. 1. GENERAL LAYOUT OF CASTING AND STORAGE YARD

complete requirements within three months, and consisted (1) of an electrically-driven mixer of a capacity of 10 cu.ft., with attendant storage for concrete materials, elevated 5 ft. above the level of an industrial track; (2) two industrial tracks of a 24-in. gage, leading from the mixer up and 8 per cent incline to two parallel trestles 50 ft. apart, each 400 ft. long and elevated 5 ft. above the ground; (3) two industrial bottom-spout hopper cars; (4) a crane with a 30-ft. boom; (5) 1¼-in. water lines along each trestle, and (6) two 15-ft. plank roadways each 400 ft. long, for operation of crane and portable wooden concrete chutes.

Fig. 1 shows the general layout of the casting and

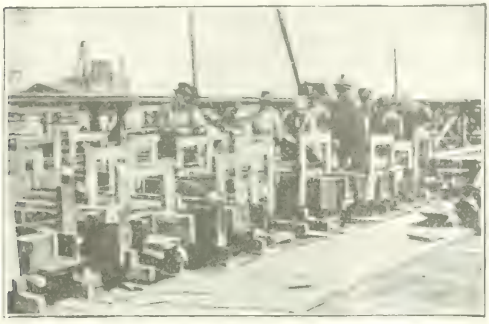


FIG. 2. SETTING THE PRECAST STONE JOISTS

storage yard, and Fig. 2 a general view of the forms. The forms were built knockdown of 2-in. material, and were held in place by yokes made of 2-in. x 4-in. pieces and ½-in. diameter rods threaded at both ends. The form bottoms were set about 18 in. apart to give working space, and leveled on 4 x 4-in. sills. Sides, ends, and yokes were put on by carpenters and the whole again leveled and squared.

To insure a good face, all stone was cast face down. One inch of 1:2 mortar was first placed in the forms, then the reinforcing, consisting of four ½-in. bars made into cages using No. 1 wire. The 1:2:4 concrete was then placed by laborers, by chuting from the car on

finishers with hardwood floats. After finishing, the stone was again covered with burlap bags kept wet.

At the end of four days the stone was handled into storage by the crane. All stone except those with a return face were cast with holes in the ends for convenience in handling with chain dogs. The storage piles were kept wet for ten or more days to insure the curing of the stone.

When the forms were erected, a linen tag was attached to each, giving the number of the stone. This number was transferred to the stone, using paint, just before stripping the forms. The system of numbering was such that all pieces of one section and one length had the same number, regardless of its location on the building.

The force employed consisted of thirty carpenters, thirty-six laborers, fourteen cement finishers, two crane engineers, and one general foreman. The output was 800 fin.ft. per day.

The construction work was done under the supervision of the construction board of the American Sugar Refining Co., C. T. Main, designing engineer, and Stone & Webster, general contractors.

## Geological Survey Activities

The work of the United States Geological Survey for last year included detailed geologic surveys of 4,600 sq.mi., reconnaissance geologic surveys of 21,500 sq.mi., exploratory geologic surveys of 18,000 sq.mi., co-operative geologic work with seventeen state organizations,

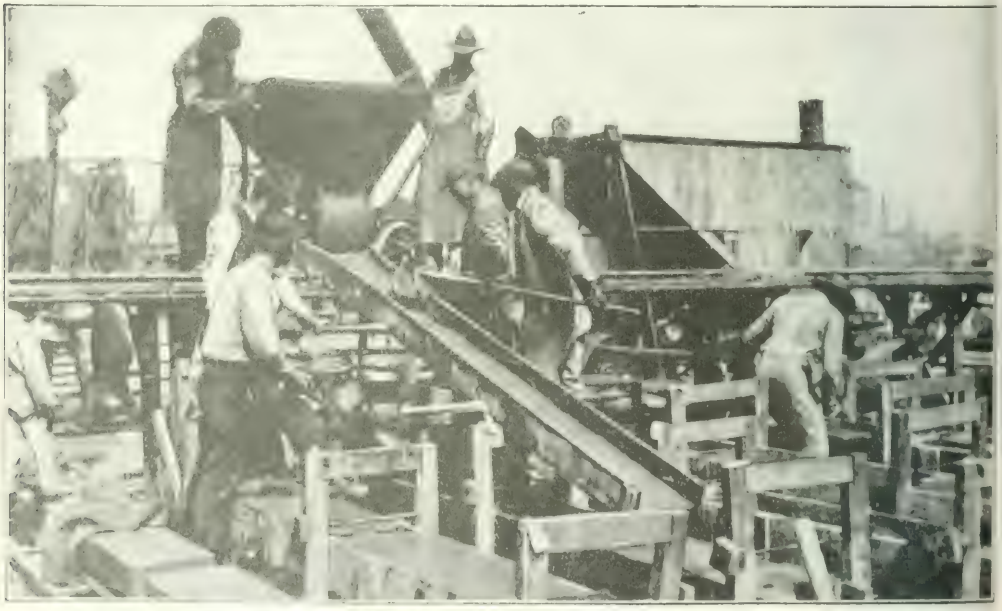


FIG. [illegible] PLACING CONCRETE DIRECT TO FORMS

the elevated track through the wooden chutes. After [illegible] burlap bags kept wet to prevent hair cracks. Twenty-four hours later the side forms were stripped and the stone was turned over onto 4 x 4-in. sills. This operation left the stone face up convenient for finishing. The finish was [illegible]

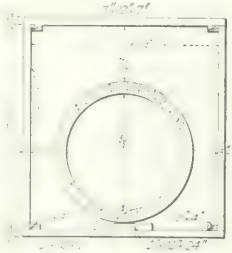
studies of ore deposits in ten states, oil and rock surveys in ten states, geologic surveys in Alaska of 1,500 sq.mi., and the continuation of studies of mineral deposits in Alaska. Other important work included topographic surveys in the United States of 12,311 sq.mi., running of 4,796 miles of levels, establishing 1,123 benchmarks, and making 576 mi. of river surveys.

# Concrete Pipe Line Augments Kansas City Water-Supply

## Pipe Made on Site Hauled by Crawler Tractor Over Soggy Soil and Placed in Tunnels with Home-Made Derrick Car—Water-tightness Tests

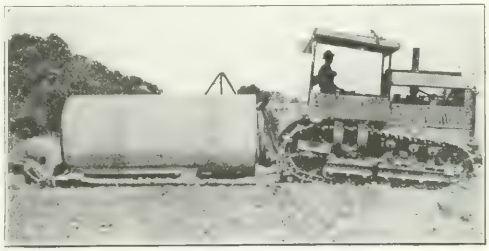
By Frank E. Miller
Assistant Engineer, Water Department, Kansas City, Mo.

With the new 48-in. concrete gravity conduit between Quindaro and the Turkey Creek pumping stations of the Kansas City water department in operation the daily delivery of water to Turkey Creek has been increased about 10 m.g.d. This makes the maximum daily capacity of the works 85 m.g.d., as the 48-in. steel main and 36-in. cast-iron mains together can carry 75 m.g.d. The new concrete line was put into regular service Jan. 21. Two sections aggregating 1,800 ft. in length are laid in tunnel 15 to 30 ft. below the surface. The remainder of the 7,785 ft. of pipe is laid in open cut. The pipe lengths were made on the job, hauled over soft ground to place on a steel skid by crawler tractors and placed in the tunnels by a special car carrying a cantilever beam. Five tests for water-tightness were made. The conduit is laid from Edgewater Junction to the east line of the water-works property at Quindaro along the south side of the Missouri Pacific right-of-way. At each end the concrete line was connected to 48-in. cast-iron mains on the opposite side of the tracks. A pipe-making plant was established midway of the length of the line adjoining the right-of-way. A stiff-leg derrick with 90-ft. steel boom was utilized for setting and removing forms, setting reinforcing, handling concrete and placing completed pipe in the store yard. A small horizontal boiler was used for operating the machine shop and for supplying steam for curing the pipe. The cast-iron rings forming the bell and spigot, furnished by local foundries, were machined at the pipe plant. The outside of the spigot ring was machined to a true circle, the front end forming a truncated cone. The inside of the bell ring was machined to a perfect circle with a groove machined into it to receive the lead gasket. These rings were set in place with the reinforcing bars. Each pipe was reinforced with ⅜-in. round rods—eight longitudinally and 34 circumferentially. The longitudinal rods were hooked into the bell-and-spigot rings and assembled on mandrels, after which they were set in place by the boom inside of the steel forms. The 1:1½:2½ concrete was mixed on the ground level by two ½-yd. mixers operated by gasoline engines, and dumped into a chute whence it passed into a ½-yd. conical bucket handled to the forms by the boom. Each of the 648 pipes was 12 ft. long, had 5-in. walls and weighed 5½ tons when completed.



TYPICAL TUNNEL SECTION, KANSAS CITY CONDUIT

As the conduit is located along the toe of the bluffs adjoining the railroad right-of-way, all of the surface water from the hills flowed to this site and through culverts under the tracks, making it difficult to do any heavy hauling. The pipes were delivered over new roads with a 10-ton crawler tractor. A skid with a steel bottom, 4 ft. wide and 16 ft. long, at the end of which was a wheel 3 ft. wide and 24 in. in diameter, was used in moving the pipes. Loading was done by hand, after which the tractor was hooked to the skid. The tractor operated in the mud about as well as on hard



HAULING 48-IN. CONCRETE PIPE ON STEEL SKID

dry soil. The use of wagons for hauling the pipe would have been almost impossible.

The 5,985 ft. of open ditch excavation was done by contract with the Halpin-Dwyer Construction Co., of Kansas City, under the supervision of Wm. D. Boyle. A trench 7½ ft. wide and from 7 to 12 ft. in depth was excavated by a steam shovel operating on skids over the center of the ditch. The excavated dirt was piled along the south side of the ditch and pulled back into the trench with a backfilling machine after the pipe was laid. It was necessary to brace most of the trench to prevent caving. The shovel excavated about 75 ft. of trench a day, just keeping ahead of the pipe-laying outfit.

Since the bottom of the trench, when excavated, was found to be a wet soggy soil with quicksand in some places, a mat was constructed the entire length consisting of two 4 x 6-in. stringers or sills onto which 3 x 12-in. x 7-ft. plank were spiked. This work was done by separate contract with the excavating contractor who placed the mat just ahead of the pipe layers to prevent any settlement.

### Tunnel Excavation

Two tunnels were driven where the conduit was from 15 to 30 ft. below the surface of the ground. The first tunnel, 800 ft. long on a tangent, was driven from three working shafts 16 ft. long by 8 ft. wide and 400 ft. apart. The second tunnel was 1 000 ft. long and driven on a 1-deg. curve from four working shafts, 333 ft. apart. For lining the tunnels, 3 x 12-in. yellow pine planks 7 ft. long for top, bottom and sides were used. The bottom 3 x 12-in. plank was set in place first, then the top plank was set and held in place with a screw ditch-brace; the side planks were then set, driven to place and cleated at corners with 2 x 4-in. nailing strips. As each lineal foot was excavated, a set of the 3 x 12-in. lining plank was set. The excavated dirt was wheeled to the shafts in wheelbarrows where it was hoisted to the surface with windlasses operated by hand. The inside dimensions of the tunnels when completed were

7 ft. [illegible]. Hand pumps handled the water which came from springs causing headings to cave. Extra bracing then had to be used to support the roof.

This work was done by the water department forces operating in two shifts, from 7 a.m. to 3 p.m. and from 3 p.m. to 11 p.m. It was necessary to employ three 8-hr. working shifts to complete the headings on the two center shafts. A working shift in each heading consisted of nine men: Two to excavate and brace, one to load wheelbarrows, two to wheel out excavated dirt, two on the windlass and two wheelers on top to handle excavated dirt.

The pipes were rolled by hand onto skids over the ditch where they were picked up with a derrick mounted on wagon wheels spanning the ditch and set in place. The joint was made up by placing a lead gasket in

LIFTING DERRICK ON WAGON WHEELS

the machined groove in the bell ring. The spigot end was entered and pulled to place with a clamp fastened to the last pipe laid and to a bar across the end of the pipe being laid. This operation caused a tight pull forcing the spigot end in tight against the lead gasket in the bell ring. The joint was completed by troweling a 1:1 mortar of cement and sand into the joint inside and outside of the pipe.

In the tunnels the pipe was handled with a four-wheel car operated on light rails by a gasoline engine and a niggerhead. A 12 x 12-in. timber 20 ft. long was rigged up on the car making a cantilever boom 8 ft. of which projected ahead of the car, which was 20 ft. long. The pipes were lowered into the tunnels through the working shafts, where they were picked up with the boom. By entering the boom about half way into a pipe length and tightening a chain block on the other end of the boom the pipes were lifted off the floor of the tunnel and suspended on the end of the boom. The back end of the car was loaded with sacks of sand to counterbalance the load and to prevent the car from tilting. A 4-hp. gasoline engine mounted on the car [illegible] to the shaft again with the niggerhead ready to pick up another pipe, which was lowered after the car was back past the shaft. This method was employed in laying all pipes in the tunnels and was found to be very satisfactory. After the pipes were laid in the tunnels and in the open trench on the mat, concrete was placed under them, extending about 12 in. each side of the center line. This was done to overcome the knife-edge pressure on the bottom and firmly to set the pipes on the mat and give them a uniform bearing.

The tunnels were back-filled with earth after the pipe laying was completed by excavating shafts 50 ft. apart on the center line, 3 ft. square and down through the roof of tunnel. The dirt was placed in the shafts with teams and slips. In the tunnels it was pulled to place by hand.

At the Edgewater crossing the tracks were timbered and the pipes were laid in an open trench about 10 ft. deep. At the Quindaro end a tunnel 75 ft. long was driven under the tracks and filled with concrete after the pipe had been laid. Two 48-in. valves were set on the cast-iron line near the ends of the concrete pipe. Four 24-in. manholes with 3-in. air valves in the top of the plates and two 12-in. drains were placed in the line.

The concrete main was designed to withstand a working head of 100 ft. and a guarantee was submitted by the contractors, the Lock Joint Pipe Co., that the completed pipe line, upon being put in service, would not leak to exceed 0.4 cu.ft. per lineal foot of completed line in 24 hr., which is equivalent to 16.15 gal. per minute for the entire 7,785 feet.

The conduit was filled with water Dec. 24, four days after completion, and allowed to stand for about two weeks when tests for leakage were made at the east end of the line through a 2-in. pipe. A 5-in. double-acting plunger pump, operated by a 4-hp. gasoline engine, was used to raise the pressure on the concrete conduit, the 48-in. valves at the ends of the line being closed. The water going into the conduit was measured with meters which were tested just before being used. The pressure gage used was also tested and corrected. The manhole plate on the highest point on the line, 8.7 ft. above the lowest point on the line, was removed and allowed to remain open during one night to detect any leakage there might be through the valves at the ends of the line; they were found to be tight.

The results of the leakage tests are summarized as follows:

| Date | Pressure, Lb. per Sq.In. | Length Tested, Ft. | Total Leakage per Min. | Remarks |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | 51.57 | |
| [illegible] | [illegible] | [illegible] | 46.98 | Normal working pressure |
| [illegible] | [illegible] | [illegible] | 58.38 | |
| [illegible] | [illegible] | 24 | 32.75 | |
| [illegible] | [illegible] | 4 | 21.63 | After 10 hr. [illegible] |

After the test of Jan. 21 the line was again put in service. Three leaks appeared on the surface over different parts of the line but they have since taken up and stopped. From the present observation on the surface the line is not leaking.

The work was done by the Board of Fire and Water Commissioners of which G. W. Humphry is president. The design and construction was carried out under the general direction of W. B. Goodwin, superintendent, and C. S. Foreman, first assistant engineer. The writer was resident engineer in charge of construction. The Lock Joint Pipe Co. was represented by J. C. Mitchell, general manager, and W. W. Trickey, superintendent.

## Computing Reservoir Outflow and Height from Inflow and Capacity

By J. C. Stevens
Of Stevens & Koon, Consulting Engineers, Portland, Oregon.

GIVEN the inflow to a lake or reservoir, the areas of the reservoir and the discharge rating of the reservoir outlet, it is often required to compute the outflow or the rise of the reservoir for a given inflow. The customary method of solving this problem is by a "cut and try" process and is often very tedious.

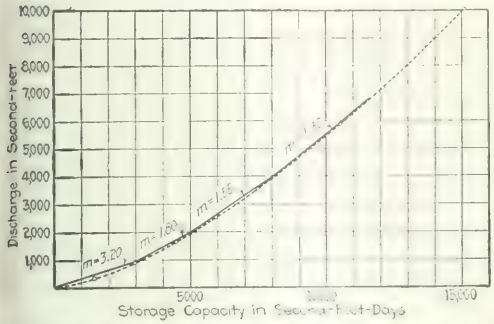
Prof. Pardoe has outlined a solution in *Engineering News-Record*, Jan. 20, 1921, p. 114. A much simpler method is given below:

Let $i$ = rate of inflow into a reservoir;
$q$ = rate of outflow from a reservoir;
$s$ = storage capacity of the reservoir.

In any interval of time $dt$ the quantity flowing into the reservoir is equal to the quantity flowing out plus that stored in the reservoir, hence the fundamental equation

$$i\,dt = q\,dt + ds \qquad (1)$$

The last term of this equation may be positive or negative, according as $i$ is greater or less than $q$.




RELATION BETWEEN OUTFLOW AND STORAGE CAPACITY

Now the storage capacity of a reservoir and the rate of outflow are both functions of the height or elevation of the water surface, hence it is possible to express the storage capacity in terms of rate of outflow. If therefore we can determine the rate of outflow we can determine the height of the water from the height discharge relation of the outlet.

Thus we may write the equation

$$s = f(q) \qquad (2)$$

whence

$$ds = f'(q)\,dq \qquad (3)$$

But $f'(q)$ is the slope of the curve in which storage capacity and rate of outflow are plotted as co-ordinates, and may be expressed by a quantity $m$. Thus (1) becomes

$$i\,dt = q\,dt + m\,dq \qquad (4)$$

Now for many reservoirs $m$ may be practically constant or may in all cases be safely considered as constant between certain limits of $q$. This is equivalent to substituting a series of chords for the curve $s = f(q)$.

Now consider $i$ as the mean rate of inflow during any finite time interval $\delta t$;
also $Q$ as the rate of outflow at the beginning of that time interval;
and $q$ as the rate of outflow at the end of that time interval.

We may then consider the mean rate of outflow during that time interval to be $\frac{q+Q}{2}$ and from (4) we may write

$$i\,\delta t = \frac{q+Q}{2}\,\delta t + m(q-Q) \qquad (5)$$

Solving for $q$ we have

$$q = \frac{\frac{i}{\frac{m}{\delta t}+\frac{1}{2}} + Q\,\frac{\frac{m}{\delta t}-\frac{1}{2}}{\frac{m}{\delta t}+\frac{1}{2}}}{} \qquad (6)$$

As will be shown later, we may drop the $\frac{1}{2}$ added to $\frac{m}{\delta t}$ in the first term of the right-hand number of the above equation without appreciable error, hence (6) becomes

$$q = \frac{i\,\delta t}{m} + Q\,\frac{\frac{m}{\delta t}-\frac{1}{2}}{\frac{m}{\delta t}+\frac{1}{2}} \qquad (7)$$

By applying formula (7) to successive time intervals, we may very rapidly tabulate the outflow, remembering that the $q$ for one interval becomes the $Q$ for the succeeding one. From the outflow we may readily determine the height of the reservoir at any time.

By way of illustration the solution of Prof. Pardoe's problem by this method will be given, but I would like to digress for a moment and show the advantages of using the second-foot-day as a unit of storage.

The second-foot-day (abbreviated s.f.d.) is the quantity of water yielded by 1 cu.ft. per sec. flowing for 24 hours. It is 86,400 cu.ft. If this quantity falls 1 ft. it represents almost exactly 2 kilowatt-hours of energy. For all practical purposes the second-foot-day is converted into acre-feet by multiplying by 2 (s.f.d. $\times$ 2 = acre-feet) and into mean flow by dividing by the number of days $\left(\frac{\text{s.f.d.}}{n} = \text{mean sec.-ft. for } n \text{ days}\right)$.

In storage calculations, if we express time intervals in days or fractions thereof and storage capacities in second-foot-days we have the inflow, outflow, and storage all expressed in the same units and the calculations are thereby greatly simplified.

Table I gives the storage and discharge relation for Prof. Pardoe's reservoir.

TABLE I

| Reservoir Height, Feet, $h$ | Storage Capacity, s.f.d. $s$ | Outflow, Sec.-Ft. $q$ |
|---|---|---|
| 0 | 0 | 0 |
| 0.5 | 1,480 | 918 |
| 1.0 | 2,970 | 900 |
| 1.5 | 4,460 | 1,650 |
| 2.0 | 5,950 | 2,540 |
| 2.5 | 7,460 | 3,560 |
| 3.0 | 8,980 | 4,670 |
| 3.5 | 10,500 | 5,890 |
| 4.0 | 12,100 | 7,190 |

The accompanying curve shows the relation between outflow and storage capacity plotted from Table I and is a graph of $s = f(q)$. The substitution of chords having slopes $m$ for the actual curve is also shown. Prof. Pardoe used 4-hour and 1-hour periods for which $\delta t = \frac{1}{6}$ day and $\frac{1}{24}$ day respectively. Substituting these values in equation (6) we have:

| | $\delta t$ | $m$ | $\frac{m}{\delta t}$ | $\frac{m-\frac{1}{2}}{\delta t}$ / $\frac{m+\frac{1}{2}}{\delta t}$ |
|---|---|---|---|---|
| For value of $q$ between | | | | |
| 0 and 1,000 | $\frac{1}{6}$ | 3.20 | 19.2 | 0.950 |

| | | | | |
|---|---|---|---|---|
| 1,000 and 2,000 | | 1.80 | 10.8 | 0.911 |
| 2,000 and 4,000 | | 1.55 | 9.3 | 0.898 |
| | | 1.55 | 37.2 | 0.973 |
| | $\delta t$ | $m$ | $\frac{m}{\delta t} - \frac{1}{2}$ | $\frac{m}{\delta t} + \frac{1}{2}$ |
| For value of $q$ between | | 1.30 | 7.8 | 0.880 |
| 4,000 and 7,000 | | 1.30 | 31.2 | 0.969 |

Table II gives the computations for obtaining the outflow $q$.

The reservoir height $h$ is obtained from the weir formula.

TABLE II

| $t$ Hours | $\delta t$ Hours | $i$ Sec.-ft. | $m$ | $Q$ | $q$ | $m$ | $h$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 3.20 | 0 | |
| 4 | 4 | 2,580 | 134 | 0 | 134 | 3.20 | |
| 8 | 4 | 2,900 | 151 | 127 | 278 | 3.20 | |
| 12 | 4 | 3,220 | 168 | 264 | 432 | 3.20 | |
| 16 | 4 | 3,540 | 184 | 410 | 594 | 3.20 | |
| 20 | 4 | 3,870 | 202 | 564 | 766 | 3.20 | |
| 24 | 4 | 4,190 | 218 | 727 | 945 | 3.20 | 1.02 |
| 28 | 4 | 4,510 | 410 | 860 | 1,276 | 1.80 | |
| 32 | 4 | 4,840 | 448 | 1,162 | 1,610 | 1.80 | 1.48 |
| 36 | 4 | 5,490 | 508 | 1,465 | 1,973 | 1.80 | |
| 40 | 4 | 5,810 | 625 | 1,775 | 2,400 | 1.55 | 1.93 |
| 44 | 4 | 6,130 | 660 | 2,160 | 2,820 | 1.55 | |
| 45 | ¼ | 8,710 | 264 | 2,740 | 2,974 | 1.55 | 2.24 |
| 46 | ¼ | 22,600 | 605 | 2,895 | 3,500 | 1.55 | 2.50 |
| 47 | ¼ | 32,200 | 1,030 | 3,390 | 4,420 | 1.30 | 2.90 |
| 48 | ¼ | 80,500 | 2,570 | 4,280 | 6,750 | 1.30 | 3.84 |
| 52 | 4 | 0 | 0 | 5,940 | 5,940 | 1.30 | 3.52 |
| 56 | 4 | 0 | 0 | 5,230 | 5,230 | 1.30 | 3.19 |
| 60 | 4 | 0 | 0 | 4,600 | 4,600 | 1.30 | 2.97 |

The maximum rate of outflow was 6,750 sec.-ft. corresponding to a head on the weir of 3.84 ft. Prof. Pardoe gives "about 7,000" with a head of 3.94. The difference is doubtless due to the inability to obtain from the diagram the same rates of inflow and reservoir areas used by him.

Formula (7) may also be obtained by solving the differential equation (4), which is linear if placed in the following form, in which $i$ is some unknown function of time.

$$\frac{dq}{dt} + \frac{1}{m}q = \frac{1}{m}F(t) \qquad (8)$$

The integrating factor for this is $e^{\frac{t}{m}}$ and the solution is

$$q = e^{-\frac{t}{m}}\int e^{\frac{t}{m}}F(t)dt + Ce^{-\frac{t}{m}} \qquad (9)$$

Since we have no mathematical expression for the inflow $F(t)$ the evaluation of the equation and the determination of the constant of integration is mathematically impossible. As close an approximation as may be desired is however possible by considering the integral as the summation of the product of a finite number of values of $i = F(t)$ and finite values of $dt$. Considered in this light we may say that at the beginning of the time considered or when $t = o$, $q$ has the initial value $Q$ and the integral vanishes since $dt$ is also zero, giving $C = Q$. Considered also as a means of evaluating $q$ for successive time intervals, we may substitute for the variable $F(t)$ a constant having a single mean value $i$ during the interval $\delta t$ whence (9) becomes

$$q = \frac{i}{m}\delta t + Qe^{-\frac{t}{m}} \qquad (10)$$

If $e^{-\frac{t}{m}}$ and $\frac{\frac{m}{\delta t} - 1}{\frac{m}{\delta t} + 1}$ are each expanded into a series they will be found to be identical for the first three terms of the expansion, hence equations (7) or (10) may be used interchangeably, provided $\frac{\delta t}{m}$ is a proper fraction.

The solution of the general differential equation when $m$ is not a constant is, impossible so far as I am aware. Assume that the outflow rating may be expressed by

$$q = ah^n \qquad (11)$$

and that the storage capacity is given by

$$s = bh^r \qquad (12)$$

where $h$ is the height above the point of zero outflow. Eliminating $h$ from these equations we obtain

$$s = b\left(\frac{q}{a}\right)^{\frac{r}{n}} \quad \text{or} \quad s = cq^{\frac{r}{n}} \qquad (13)$$

whence

$$ds = c\frac{r}{n}q^{\frac{r}{n}-1}dq \qquad (14)$$

which substituted in (1) gives

$$c\frac{r}{n}q^{\frac{r}{n}-1}\frac{dq}{dt} + q = i \qquad (15)$$

To simplify we may place $q = v^{\frac{n}{r}}$ and obtain

$$\frac{dv}{dt} + \frac{1}{c}v = \frac{i}{c} \qquad (16)$$

as a general differential equation for the outflow from a reservoir in its simplest terms. Except for $\frac{n}{r} = 1$, I know of no solution to this general equation unless $i = F(t)$ can be expressed mathematically, which is obviously impracticable.

## Schenectady Sewage Works Again in Use

By John V. Lewis
Superintendent, Bureau of Sewage Disposal
Schenectady, N. Y.

After having been out of operation for eighteen months, the sewage works of Schenectady, N. Y., was again placed in use on Nov. 16. The plant was originally put in service in January, 1915. In the five years which followed there was a slow disintegration of the concrete structures above and at the normal flow line of the sewage. It is believed that the disintegration was caused by frost action. The thin vertical curtain walls, separating the sedimentation chambers and gas vents of the Imhoff tanks, had also proved to be too light to withstand the pressure exerted by the scum and gas confined within the vents and one failure of these walls had resulted. There was also deposition of large quantities of settling solids in the open influent channels of the tanks.

The disintegrated concrete has been torn out and replaced and the curtain walls strengthened. The open influent channels have been superseded by cast-iron conduits placed in the tank proper which will not only overcome the deposition troubles but facilitate the reversing of flow through the tanks as well. The size and shape of the dosing tanks has also been changed to improve the distribution on the trickling filters. As an addition, 25,000 sq.ft. of sludge drying bed area has been provided.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Temperature Stresses in Concrete Pavement

Sir—In cases where it appears advisable to use a reinforced-concrete pavement from the standpoint of economy or for other reasons it is gratifying to note the growing tendency on the part of the leading highway engineers and designers to reinforce these pavements against temperature stresses and incipient failures caused by these stresses.

I have felt for some time that damage to concrete pavements was primarily caused by the pounding of traffic upon the small cracks resulting from temperature stresses. In spite of our present meager knowledge and data on the location of and amount of maximum stress in a pavement due to static load, impact and varying subgrade conditions, we are at least making a very important forward step in taking care of the stresses due to temperature, awaiting in the meantime for more data on stresses due to other causes.

C. N. CONNER,
Assistant Engineer, North Carolina State Highway Commission.

Raleigh, N. C., Dec. 2.

## Roof-Shield Tunneling and Imbedded Rush Rods for Jacking

Sir—The writer, who visited the Flatbush Ave. subway tunnel work on several occasions, feels that Mr. Briggs' paper in your Oct. 27 issue (p. 676) is a notable addition to soft-ground tunneling literature. His illustrations, his descriptions of methods employed and his progress data all will prove useful. The use of "push rods" in wet concrete to take the reaction from the hydraulic jacks is, however, not new as Mr. Briggs intimates. The method was used in the Cambridge subway built by the Boston elevated road several years since. In looking through his files for more data on this Cambridge tunnel, he found in the seventh annual report of the Boston Transit Commission (1901) a description of the work on the East Boston tunnel, where the same method was employed. The sixteenth annual report of this commission also states that the Beacon Hill tunnel work was similarly handled. Both reports are profusely illustrated.

The following memoranda are from the 1901 report of Chief Engineer Carson:

"1892: Roof-shield to run on side walls unsuccessfully tried in Howard St. tunnel in Baltimore.

August, 1895, to October, 1896: Roof-shield running upon a track of wood and steel laid on the ground underlying the arch (not on the tunnel walls) by M. Chagnaud on the Collecteur de Clichy, Paris.

December, 1896, to April, 1897: Roof-shield running on side walls of the tunnel, section 6 of the Boston subway.

1899: Roof-shields running on side walls used on the extension of the Orleans R.R. into Paris. Roof-shields running on track of wood and steel used on the Metropolitan tunnels.

The suggestion of using imbedded metal rods in masonry walls for jacks to push against was made by Walton I. Aims of New York in conversation with the writer in 1892, about four years before it was first made use of on section 6 of the Boston subway."

On section 6 "push rods" were used in the arch of brick masonry. The shield used in the Beacon Hill tunnel weighed 65 tons without jacks, was 32 ft. 6 in. wide, 12 ft. 6 in. long, and had fourteen 8-in. jacks of 80 tons capacity. The normal progress in "a very hard mixture of sandy clay with numerous small stones and boulders" was 40 to 50 ft. per week, as compared with 155 ft. per month on Flatbush Ave.

JAMES F. FOUHY,
Consulting Engineer.

New York, Nov. 16.

## Data On An Ancient Dam

Sir—Mr. Prelini's article on ancient dams in the issue of Oct. 6 was very interesting and it is to be regretted that he did not discuss the subject at greater length.

There is some disagreement as to the date of construction and dimensions of the Elche dam in Spain. Mr. Prelini states that it was constructed in 913 A.D., while the year 1590 is mentioned in Johnson's Universal Cyclopaedia. If built during the reign of Abderraman III Mr. Prelini is undoubtedly correct. His figures for the height and thickness at base are 52 ft. and 150 ft., respectively. The former agrees closely with the height of 55 ft. given in the Encyclopaedia Britannica but according to Johnson's Cyclopaedia the height is 76 ft. and base 40 ft. These figures of Johnson's as well as those for a number of other dams, agree with Wegmann's profiles.

N. B. HUNT.

Denver, Colo., Nov. 4.

Sir—Answering Mr. Hunt's queries, the article "Some Dams of the Ancients" was written for the purpose of detecting the rule followed by the ancients in designing these kind of structures. In it only a few dams were mentioned and among them preference was given to those whereof the dimensions were known.

The apparent disagreement about the dimensions of the Elche dam is easily explained, when we consider that the present dam enclosing the reservoir at Elche is not the original one built by the Moors. The lands in the southern part of Spain were brought to the highest degree of production under the Moorish domination, and such a result was obtained by an elaborate system of irrigation in which the winter waters were stored and used to bath the lands in the dry summer months. According to S. P. Scott, "History of the Moorish Empire in Europe," during the reign of Abderraman III the city of Elche built a reservoir by means of a dam of the dimensions indicated in the article. The slight difference between the dimensions of the Elche dam as given by Scott and the Brittanica, is probably due to the conversion of the Moorish standard measure into the English. The dam built in 913 at the time of the Moorish domination must have collapsed in the course of time, for in order to preserve the fertility of the soil and maintain the irrigation around Elche, another dam was built perhaps in 1590, as stated in Johnson's Encyclopedia, the latter structure of larger dimensions than the old one.

My article mentioned only some peculiar dams built in different countries and by entirely different peoples, but anyone interested in these studies, would find great similarity in many important events recorded in history involving the construction of temporary dams, as for instance the crossing of the Jordan by the Israelites under the guidance of Joshua, and the taking of the city of Mantinea by Agesipolis as described by Xenophon in "Hellenica." Unfortunately the modern engineer is too busy to devote part of his time to the study of what has been done in the past, but time will come when these refinements of our profession will be better appreciated and investigated.

CHARLES PRELINI.

New York, Nov. 10.

## Double-Slab Concrete Road Successful in California

Sir—I am interested in the article in *Engineering News-Record*, Nov. 17, 1921, p. 804, entitled "New York Develops Double-Slab Concrete Roads."

We have been building the same type of road since 1919. The first one-half mile experimental section met with so much favor that we now have completed a total of 32.7 miles. We make our concrete slab 8 ft. wide and the macadam center 4 ft. wide but add a 2 ft. macadam shoulder on each side, making the road 24 ft. wide over all. The macadam shoulder is found to be a great protection to the outer edge of the concrete slab and also protects the subgrade from drying out during the dry season.

Most of this type of road has been built on an adobe subgrade. In fact, the idea of designing it was to get a slab which would not crack longitudinally. So far, it has proven satisfactory, not a single crack has shown up since placing the macadam center and shoulder.

The greatest advantage developed so far is increased safety. On our heavily curved sections, no driver has ever

been caught cutting the corners. The driving public is very enthusiastic about the pavement and not only claims it is safer to drive on, but finds it faster with the same degree of safety.

After two years' experience with the 8-ft. slab we do not feel that we would be justified in making it wider, but would prefer using the same money in extra thickness or additional subgrade work. We have been making our concrete slab 5 in. thick, and the oil macadam 5 in. thick, with a crown, so that it is 2 in. higher than the concrete.

Martinez, Cal., Nov. 23. R. R. ARNOLD, County Surveyor.

## Public-Utility Motor Vehicles Should Pay More Than Private Cars

Sir—It has been my pleasure to read your painstaking study of "The Trend of Motor-Vehicle Legislation," published in your issue of Sept. 1, p. 354. Again, one is struck by the fact that our division into 48 detail sovereignties and one blanket sovereignty is a great hindrance to the settlement of problems that have no real relation to political subdivisions.

Yet despite the great variety and diversity of the practices listed, no wide recognition seems to have been given to the difference between the privately used motor vehicle and the public-utility motor vehicle. The difference can be very great. A private automobile mounted on pneumatic tires may use the public highway to the extent of but 5,000 to 10,000 miles per annum; a public motor-bus mounted on solid tires, but carrying an engine of the same horse-power rating, may be running over the same highway to the extent of 30,000 to 40,000 miles a year. It would clearly be unjust to treat both vehicles alike from the tax-gatherer's standpoint.

Great Britain's experience with public-utility motor vehicles goes back farther than our own, so that possibly our legislators may gain something of value from her. Until the passage of the Roads Act of 1920, the principal tax was one of 12c. per Imperial gallon (277¼ cu.in.) of gasoline to those who bought less than 500 gal. a year, and half that amount of those who bought more. Practically, then, the public-utility operator as a wholesale user was being favored over the people who imposed less wear and tear on the roads! This tax in its earlier form (1910) had been imposed "for the improvement, construction and maintenance of roads in the United Kingdom, and to render financial assistance to the County Councils," but by 1915 war conditions led to the end of this pleasing arrangement. During the following years, the county councils made their own rules as to how much local public utilities should pay toward road upkeep regardless of their national gasoline tax and nominal license fees. These roadway upkeep charges varied from 1 to 8c. per vehicle-mile, and their fluctuations from year to year and county to county were a source of severe irritation to the operators of public-utility vehicles such as motor-buses and *char-a-bancs*.

In the legislation known as the Roads Act of 1920, we see the advantage of dealing with one government instead of 49. The taxing powers of the county councils have been abolished because the new taxes are intended to cover every proper assessment against motor vehicle operation. The funds from this taxation go to the Ministry of Transport which, in turn, may assist the several councils in road maintenance. Thus, Sir Henry Maybury, director-general of the Ministry of Transport told the Devonshire County Council on Sept. 17, 1920, that it was the intention of the government to subsidize first-class roads (say 20 ft. wide) to the extent of 50 per cent and second-class roads to the extent of 25 per cent. In any case, the writer has observed that subsidies are being granted from time to time, even to the extent of helping to pay for individual machines like a road roller.

Now with regard to the details of the taxes which became effective Jan. 1, 1921: A clear distinction is made between public-utility vehicles and private vehicles; and there is also a distinction between the use of the former in the London metropolitan area and outside of it. Otherwise, all rates are uniform throughout the United Kingdom. The lowest tax, 15 shillings ($3 at present exchange of $4 to the pound), is charged against street cars, inasmuch as street railways make heavy payments for paving under long existing franchise obligations. We then come to motor-buses and *char-a-bancs* which are rated as follows:

| | In London Area | Elsewhere |
|---|---|---|
| Not more than 6 seats | £ 15 | £ 12 |
| Not more than 14 seats | £ 30 | £ 24 |
| Not more than 20 seats | £ 45 | £ 36 |
| Not more than 26 seats | £ 60 | £ 48 |
| Not more than 32 seats | £ 72 | £ 60 |
| More than 32 seats | £ 84 | £ 70 |

With regard to the foregoing, it is a truism that no sooner is a law passed than its weaknesses begin to come out. This summer the writer ran across a British operator who had deliberately removed two seats from his 26-seat buses in order to save £12 a year tax. It will also be seen that the tax does not contemplate buses seating much more than 32. When the Act was passed, most buses in London were 34-seaters; now the standard is 46 seats with plenty of 51-seaters under way. The London General Omnibus Co. averaged £63 annual total taxes under the old rules for every bus in stock or £79 for the average number of buses in operation. The new tax of £84 is per bus in stock, but there has been no real increase in taxation per seat.

Without going into detail, it may be pointed out that private cars are taxed on a horse-power basis, £6 if not exceeding 6 hp. and £1 for each additional horse-power or fraction thereof. Motor-trucks are taxed on an unladen weight basis from £10 for vehicles of 1.2 long tons to £30 for trucks of 4 long tons plus £2 for a trailer. The low-speed road locomotives so popular in England are charged £25 up to 8 tons, £28 up to 12 tons and £30 if over 12 tons. Tractors cost from £6 to £21, but plowing engines, etc., for farm use pay the nominal charge of only 5 shillings. Cycles range from £1/10 for weights of less than 200 lb. to £4 for motor-cycles with side car.

This is the situation to-day, but there are strong automotive interests agitating for a tax based primarily upon fuel consumption. This idea is opposed, for obvious reasons, by public-utility operators.

New York City, Nov. 19. WALTER JACKSON, Motor Bus Consultant.

## Motor Fees Yield $108,213,165 in 6 Months

A total of 9,245,195 passenger automobiles, trucks, and commercial vehicles, 28,114 trailers, and 177,234 motor cycles were registered in the 48 states and the District of Columbia during the first six months of the present year, according to the U. S. Bureau of Public Roads. As a result of these registrations and the licensing of drivers, the states and district collected, during that period, a total gross revenue of $108,213,165. The figures show an increase of nearly $6,000,000 over the full year of 1920, when such revenues totaled $102,546,212. "Of the 1920 registration revenues," says the bureau, "$97,671,742, or 95 per cent, was available for road work. Of the registration revenues collected during the first six months of the current year $101,793,416 is available for road work, either by the state highway departments or local road officials" is 94 per cent—an apparent decrease of 1 per cent, but the increase seems more apparent than real, because in some states the funds do not become available until the end of the year. Ten state legislatures have imposed a tax on gasoline during the current year. They are Arkansas, Arizona, Connecticut, Florida, Georgia, Montana, North Carolina, Pennsylvania, South Dakota, and Washington. Prior to this year Colorado, Kentucky, New Mexico, and Oregon had levied such a tax.

# HINTS FOR THE CONTRACTOR

## Pile Holes Blasted for Ocean Pier

By H. H. Braun
Engineer Constructor, Manila, P. I.

PRECAST concrete piles set in holes drilled 13 to 15 ft. deep in a hard bottom were employed in building a reinforced-concrete pier at Manila, P. I. The bottom, ranging in depth from 10 to 26 ft., is a volcanic formation, intermediate between soft rock and very hard hardpan, with no overburden. It was utterly impossible to drive a pile directly in any manner.

The first effort to meet the conditions failed. A 12-in. iron pipe was rigged in the leads of the pile driver, lowered to the bottom, and a heavy 11½-in. well drill bit, operated by the pile-driver engine, put to work. Two holes were completed, but it was impossible to drive an 18-in. pile into a 12-in. hole.

The next method proved very successful. A frame and scaffold was built out over the end of a flat scow, supporting three 3-in. pipes, spaced to agree with the three piles in the bent. Two piles only were used in the stem of the pier. After the scow was properly lined and centered, the pipes were lowered to the bottom, an expansion bit, Fig. 1, inserted and a 3½-in. hole drilled about 18 in. into the rock, into which the pipe was lowered. This served to center and hold the 3-in. pipe casing for subsequent drilling and blasting.

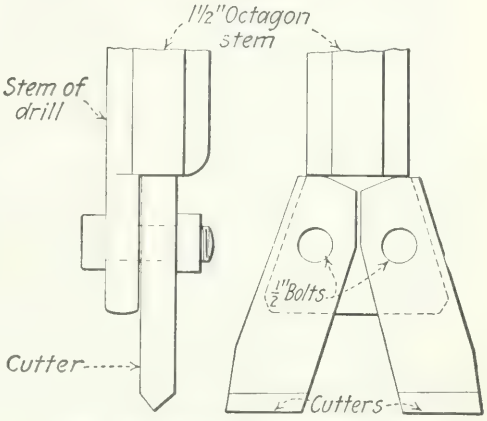



FIG. 1 EXPANSION BIT FOR CHURN DRILLS

Holes were then drilled down through the pipes. Three bits were used, each 4 ft. long, and 2½ in., 2¼ in. and 2 in. in diameter respectively, made to screw onto the end of a long 1½-in. common pipe handle.

Progress was slow and the work difficult, partly because the swells made it hard to center and hold the scow in place. It required usually 12 hours to drill and blast a set of holes to a depth of 10 to 13 ft.

During typhoons, the pier is subject to violent wave action. The water is 23 ft. deep at low tide, the deck is 12 ft. higher, and as the piles driven into the blasted rock seemed to be deficient in lateral stability, it was deemed necessary to incorporate a thorough system of bracing. As it was not practicable to drive batter piles for this purpose; each pile was braced each way by reinforced-concrete horizontal struts at low water, and diagonal sway braces from these struts to the deck beams, Fig. 2. In the stem of the pier every second pair of bents only was thus braced.

To connect the bracing system to the precast piles, the pile was first roughened, and a wide piece of wire

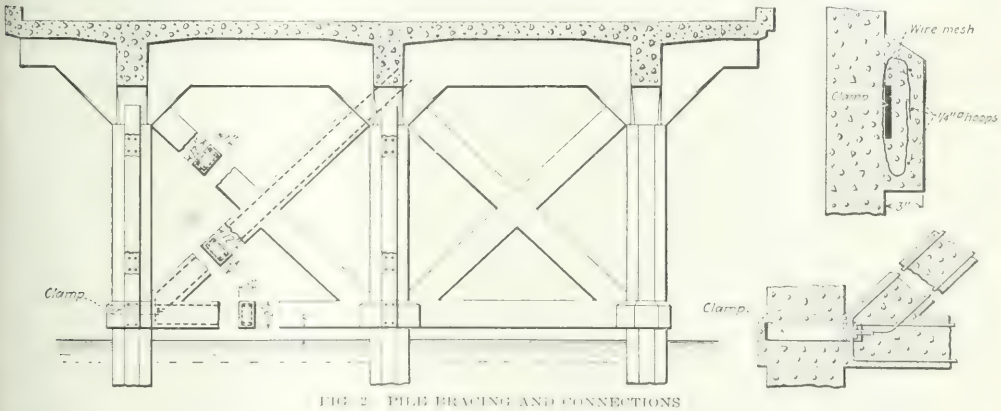



FIG. 2 PILE BRACING AND CONNECTIONS

mesh wrapped around it. Then a heavy clamp, made of ½ x 4-in. flat iron was bolted around the pile, and over the mesh. The brace reinforcement was then hooked around and through the clamp bolts, the wire mesh bent over the clamp, and the joint braces concreted at the same time as the deck.

This design, with bracing below the deck and down to low water, would present elements of danger in any location subject to wave action, if ice or debris were liable to accumulate. While there are terrific waves at the site, there is almost no debris, and there is of course no ice problem. Reinforced concrete in tropical seas is particularly liable to failure if all steel is not deeply embedded in the concrete. Extreme care was exercised in constructing the brace joints, to obtain a sufficient cover of rich, impervious concrete.

# NEWS OF THE WEEK

New York, December 22, 1921

## Federal Budget Provides for Engineering Work

Details of $73,000,000 Appropriation Announced in Last Week's Issue

For the current fiscal year $9,000,000 has been made available for canal work, and next only $6,741,174 is asked for that work during the next fiscal year. The reduction in the Interior Department estimate is due largely to the decrease in the amount requested for reclamation work. The amount appropriated for the current year was unusually large, due to the accumulation of funds under the oil-land leasing act.

DETAILS OF APPROPRIATIONS

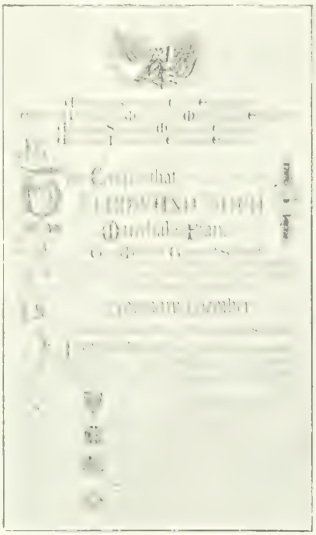
For public works under the Treasury Department, which include: construction, extensions and repairs to customs houses, postoffices, hospitals, quarantine stations, and other public buildings, $5,471,800 is asked. The appropriation for the current fiscal year was $2,560,631 for public works in the Treasury Department. The estimates call for $48,457,722 for public works coming under the jurisdiction of the War Department. The appropriations for this item for the current fiscal year aggregate $34,775,578. The amount requested for public works under the Navy Department is $5,134,000, as compared with $4,837,000 appropriated for the current fiscal year. The total asked for the Interior Department public works is $8,414,750, whereas $21,113,000 was appropriated for the current year. The sum of $1,283,500 is asked for the construction and repair of lighthouses, beacons and fog-signals, which are under the jurisdiction of the Department of Commerce, as compared with $1,006,500, the current year's appropriation.

The larger items which make up the public works total are as follows: For the construction of a three-story building to provide vault space for the Treasury Department $1,000,000; for the site of the National Archives Building, $500,000; quarantine stations, $77,000; marine hospitals, $351,000; for extension and repair of public buildings, $931,500; for installation and repair of mechanical equipment in completed public buildings, $855,000; fortifications and other works of defense, $7,000,000; for repairs and improvements at arsenals and depots, $805,000; for the construction and enlargement of military posts in the Hawaiian Islands, $1,059,490; for constructon and enlargement of buldings at military posts $916,000; Gatun storage plant, $1,028,800; Fort Clayton, C. Z. barracks and quarters, $1,567,600; buildings and grounds in and around Washington, $752,126.

Other items are: Rivers and harbors (including continuing contract work), $34,955,260; repairs Capitol building, $153,500; bridge Navy Yard, Portsmouth, N. H., $250,000; dredging and pile caps, Philadelphia Navy Yard, $200,000; wharves and quay-walls and dredging, Mare Island Navy Yard, $350,000; pier No. 4 rifle range, central power plant Puget Sound Navy Yard, $700,000; addition to machine shop, warehouses, water supply, Pearl Harbor Naval Station, $681,000; submarine base, Guam Naval Station, $200,000; ordinance storage and water front improvements Cavite Naval Station, $163,000; shore protection and harbor improvement, Great Lakes Training Station, $425,000; marine corps base, San Diego, $500,000; naval hospital, San Diego, $500,000; submarine base, San Pedro, Cal., $100,000; destroyer base, San Diego, $200,000.

## Hold Bonds for Premium Bid

An offer of par value and accrued interest for the $1,250,000 issue of street improvement bonds voted in September, has been refused by the city of Dallas, Texas. The bonds are expected to bring a premium.



*Certificate of Honorary Membership in National Engineering Societies Presented to Marshal Foch, Dec. 13*

## Progress Reported in Paving Brick Standardization

As indicative of the progress which is being made in the standardization of paving brick (See *Engineering News-Record*, Nov. 24 p. 869) the National Paving Brick Manufacturers Association has recently received a letter from the commander in charge of the U. S. Naval Academy, to the effect that compliance had been made with the new specifications. The U. S. Naval Academy requisitions for repressed paving brick have been changed from the 3-in. to the 3½-in. depth, in accordance with the new specifications.

## Katy Road Plans Betterments

The Missouri Kansas & Texas R.R. plans to replace its 66-lb. rails with 85-lb. rails between Gainesville and Wichita Falls, Texas. The new track-laying program will be a $1,000,000 project according to W. M. Whittenton, chief operating officer. Work on the widening of the tracks will be begun after Jan. 1 and will be finished by the middle of the year.

Completion of a general inspection of the Katy Line has been completed by E. C. Henderson of New York, general counsel for the reorganization committee to perfect plans for the dissolution of the Katy receivership. The physical condition of the lines in Texas was found to be excellent.

## Conference on Uniform Contracts Makes Progress

Inspired by the announcement of Secretary Herbert Hoover, who opened the sessions, that its determinations would have the influence and backing of the Department of Commerce, the conference on uniform construction contracts held Dec. 15 and 16, in Washington, D. C., made progress in organizing for the task before it.

Delegates, or their alternates, were present from each of the nine national organizations listed in *Engineering News-Record*, Nov. 24, p. 873. To this membership the committee added R. C. Marshall, Jr., representing the Associated General Contractors and William B. King, representing the American Bar Association. Onward Bates of Chicago, representing the Western Society of Engineers, was elected permanent chairman and Ward P. Christie, research engineer, Associated General Contractors, was appointed secretary. Washington, D. C., was tentatively adopted as the meeting place for the committee in session.

Statements were received from William S. Parker, W. D. Faucette and H. K. Bishop explaining the purpose and the procedure followed in developing the standard contracts of the American Institute of Architects, the American Railway Engineering Association and the U. S. Bureau of Public Roads. A standard form of agreement for all constructon and schedules of general conditions for highway construction, building construction and railway construction, which had been drafted by the Associated General Contractors, were then read and accepted as a basis for discussion. The procedure, it was agreed, should be to consider first the standard agreement, section by section, to adopt or reject each section, and redraft the adopted sections as general principles governing all contracts. With this task completed the committee, it was considered, would be co-ordinated with the task before it so that it could determine a plan of procedure which could be placed before the various organizations with requests for authority to proceed.

## Florida County to Sell Road Bonds

The first part of the Orange County (Florida) $2,250,000 road bond issue is to go on the market soon. Funds received from the sale of the bonds will build, according to present plans, a 15-mile stretch to be known as the Mount Dora and Plymouth Highway. It is possible that the Major Charles A. Brown, state highway engineer, will take charge of the county program which includes the construction of close to 50 miles of road.

## Hydraulic Plant for Diamond Mining in Arkansas

Part of the large amount of equipment that is being purchased and installed for the operation of diamond mines in Pike County, Ark., will be a hydraulic plant, as extraction of diamonds there is susceptible of that method. At present only experimental work has been done, but a company capitalized at $10,000,000 has been formed and several large gems have been mined.

## New Jersey Commuters Organize for Rapid Transit to New York

A New Jersey Metropolitan Rapid Transit Committee of 15 to take steps to secure facilities for landing passengers in New York City near their places of business is to be appointed as a result of a Bi-State Rapid Transit Conference of representatives of the five New Jersey counties of northeastern New Jersey held at Paterson, N. J., Dec. 15, under the auspices of the City Plan Commission of Paterson. The committee will be appointed by B. H. Saunders, chairman of the commission and of the conference.

The discussion at the conference was centered on an address by Herbert S. Swann, city planner, New York City, epitomizing a longer address on "A Bi-State Rapid Transit Plan" recently made to the Paterson City Plan Commission and now available in printed form. In brief, Mr. Swann advocates "bringing the Jersey railroads into Manhattan and linking them with New York Central, New Haven and Long Island lines in a manner to provide faster travel for the whole metropolitan area." Mr. Swann also urges the need for better north and south transit facilities in the New Jersey metropolitan district so as to obviate the present necessity of travelling to the Jersey shore of the Hudson on one radial line and back again on another —to get from Paterson to Plainfield, for instance.

Besides addresses by residents of the proposed New Jersey Metropolitan Rapid Transit District, Daniel L. Turner, consulting engineer, New York Transit Construction Commission, spoke on "The New Jersey Commuter in the Subways" and remarks were made by representatives of several railways. A letter was sent by Samuel Rea, president of the Pennsylvania Railroad, in which he stated Mr. Swann's suggestion for the use of the Pennsylvania tunnels and terminals by still other railways is barred by the fact that the capacity of these facilities has been reached, so it is only a question before the Baltimore & Ohio and Lehigh can no longer be accommodated.

## Hoist Runners—Not Engineers

At a recent meeting of the New York Assembly, American Association of Engineers, held in Albany, N. Y., the following resolution was unanimously adopted:

"It is the sense of this meeting that engineers, when drawing up contracts, supplementary agreements for extra work, and at all other times, should discontinue the designation as engineer, of hoist runners, engine drivers, and all others engaged in allied trades and employment."

## To Call for Bids on Hudson Vehicle Tunnel

**With the signing of the long delayed contract with the Erie Railroad, involving property rights in Jersey City in the vicinity of the proposed tunnel entrance and ventilating shafts, the chief obstacle in the way of starting work on the vehicular tunnels under the Hudson River from New York City, has been removed and present plans of the New York and New Jersey Tunnel Commissions contemplate issuing a call for bids on or about Dec. 27.**

**C. M. Holland, chief engineer, has announced the completion of the New York ventilating shafts by the firm of Holbrook, Cabot & Rollins, the contractor. The work has proceeded without a hitch and the final estimate of $643,195 was approved Dec. 14.**

## Wisconsin Plans Road School for State Employees

The Wisconsin Highway Commission's Road School will be held in Madison commencing, Jan. 23, 1922, and continue in session throughout that week. All of the engineers in the employ of the state department and county road officials will be in attendance. The registration in 1921 was over 900.

The exhibiting of road machinery is encouraged by the commission, especially that machinery which is designed to meet up-to-the minute needs in road construction.

## Florida Road Bonds Unsalable Within Legal Limits

Close to $5,000,000 worth of public improvements are being held up in Florida, pending the ability of trustees to secure the minimum the law permits to accept for Florida bonds—95c. The Lake County $600,000, 6 per cent issue is the latest example, bids of less than 90c. having been recently rejected and the issue ordered readvertised.

The Escambia County $1,000,000 road bond issue, now two years old, is still awaiting a legal bid, as is Pasco County's $750,000 issue, which is as old. Marion County and Alachua each have arranged for issues of $500,000. Palm Beach County has had trouble in disposing of its issue of $400,000 and Monroe County bonds likewise await a call. Miami just rebonded for $400,000 having been unable to sell a $400,000 issue prior to a recent change in the form of government, which made necessary revoting the issue.

## Pennsylvania Contractors Hold Road Conference

### In Meeting With Material and Equipment Men at Harrisburg They Discuss Means of Reducing Costs

Lower road-building costs and strict adherence to its slogan of "Skill, Integrity, and Responsibility" formed the keynote of the Highway Construction Conference held in Harrisburg, Pa., Dec. 16, in conjunction with the second annual meeting of the Associated Pennsylvania Highway Contractors, the local organization of the Associated General Contractors of America. The morning and afternoon sessions were given over to discussion of road-building problems from the point of view of banker, surety company, material and equipment manufacturer and the state highway department, in order that closer co-operation might be secured among all interests concerned in the building of highways. H. H. Wilson, president of the Pennsylvania contractors' organization, and resident managing partner for Winston & Co., presided, and acted as toastmaster at the banquet which concluded the meeting in the evening.

The need for frankness on the part of the contractor in his dealings with the banker was emphasized by E. J. Stackpole, director of the First National Bank of Harrisburg. "Tell the banker," he said, "the whole story of your financial condition when you are seeking a loan." The banker, according to Mr. Stackpole, stands ready to co-operate with the contractor in meeting all reasonable demands for cash. The contractor must remember, he said, that a bank needs liquid assets, and loans should not be requested for too long a period, for the bank's main function, in his opinion, is to help the contractor over the peaks of his financial troubles.

#### Bonding Costs

A lively discussion was precipitated by the address on methods employed by surety companies in underwriting risks by E. C. Lunt, vice-president, Fidelity & Casualty Co., New York. The main points that interest the surety company are (1) the contractor's financial condition as determined from Dun and Bradstreet, from local bankers, and from the contractor's own financial statement; (2) the contractor's record on past work and the amount and conditions of his plant; (3) a comparison of his bid with the bids of other responsible contractors on the same job; and (4) the amount of work which a contractor already has on hand. The present rate charged by surety companies on state highway contracts, 1½ per cent, was regarded by several contractors as too high. The point was brought out that a lower rate should be given to an old-established, responsible bidder than to a newcomer in the contracting business. As matters now stand, however, a uniform rate of 1½ per cent is charged to all parties. The discussion ended in the passage of a resolution calling upon surety companies to lower their present rates and to exercise more care in the assumption of risks.

Speaking for the cement producers, William McIntyre, of the Atlas company, predicted for 1922 a substantial increase in the use of cement both on highway work and building construction. There will, however, be no cement

shortage next year. He urged contractors to arrange for deliveries well ahead of the actual need for them in order that mill production and shipments may be co-ordinated. Contractors can help the industry, he said, by exercising greater care in the handling of cement bags. Ernest Ashton, of the Lehigh Portland Cement Co., made a plea for the use of coarse aggregate of softer quality than is now generally specified for highway work. A resolution was passed indicating that the cost of highway construction could be lowered, without affecting the quality of roads, by changing state highway specifications so as to provide for other than extremely hard grades of coarse aggregate.

Speaking for the General Crushed Stone Co., Herbert Allen objected to the present high freight rates on crushed stone, a view in which he was supported by J. E. Carroll of the J. E. Carroll Sand & Gravel Co. The conference passed a resolution urging the reduction of freight rates on sand and stone.

For the asphalt producers, William King, of The Texas Co., and Louis Young, of the Atlantic Refining Co., reported satisfactory conditions during the year.

The morning session of the conference was concluded by the passage of a resolution offered by President H. H. Wilson stating that road-building costs could be reduced by the adoption of a form of contract between contractor and material or equipment manufacturer which would be more binding on both parties.

EQUIPMENT PROBLEMS

The policy of "Let the buyer beware" finds no place in present methods of selling construction equipment, according to Mr. Goodling, of the Galion Iron Works & Manufacturing Co. George Sherron, of the Koehring Machine Co., urged a closer relationship between contractor and manufacturer, and made a plea for simpler specifications for equipment and materials. In the field of paving mixers, he said, the trend is away from the steam operated plant and toward the gasoline-engine-driven unit. Robert M. Gates, of the Lakewood Engineering Co., in speaking of the mechanical handling of road material, pointed out the need for closer supervision of operations and the employment of more competent mechanics by contractors. For the Blaw-Knox Co., Edward N. Ornitz favored greater standardization of construction equipment, citing as a precedent the recent action of the brick manufacturers in reducing the variety of their products. The discussion on plant equipment ended by the passage of a resolution urging a greater degree of standardization and suggesting conferences between representatives of the Associated General Contractors and the equipment manufacturers.

Representing the Pennsylvania State Highway Department, Howard W. Fry commended the policy of personal interviews with contractors before awarding work in order to determine their construction experience and financial ability. A large letting of Pennsylvania work is scheduled for February, including [illegible] length of road divided into three sections.

[illegible] features of the road-building problem upon which a fuller public understanding is needed were offered in an address by R. K. Tomlin, Jr., associate editor, *Engineering News-Record*. In discussing this subject William Jabine, of *Successful Methods* concurred in the opinion that publicity for road work in the future should come from the road-builder rather than the road "booster."

The speakers at the banquet included Charles F. Puff, Jr., secretary and general manager of the Associated Pennsylvania Highway Contractors, Lt.-Gov. J. E. E. Beidleman, Daniel A. Garber, director of the Associated General Contractors, W. D. Hill, president-elect of the Pennsylvania organization, and Henry H. Wilson, the retiring president, who acted as toastmaster. Mr. Beidleman denied rumors that the year 1922 would see a curtailment of state highway activities in Pennsylvania. The state, he said, intends to proceed with its program and will be a leader among the states in permanent road construction.

Mr. Garber mentioned high freight rates as one of the contractor's most serious problems. He referred to the Lockwood Committee's investigations of the building industry in New York, emphasizing the point that in the list of indictments of equipment and material men the name of not a single contractor was to be found. A committee of the Associated General Contractors is now at work with representatives of the Department of Commerce to secure standard forms of contract and eliminate waste.

The Associated Pennsylvania Highway Contractors has shown a 115-per cent increase in membership during the year and now has on its rolls 90 members. The new officers elected are: President, William D. Hill, Samuel Gamble Co., Pittsburgh; first vice-president, Samuel M. Irwin, Union Paving Co., Philadelphia; treasurer, Lea Hunt, Hand-Hunt Co., Wilkes-Barre. The directors have reappointed Charles F. Puff, Jr., as secretary and general manager; it was through his efforts that the conference was arranged.

## Texas City to Extend Water and Sewer Facilities

The city council of Graham, Texas, has let a contract for the extension of the water and sewer mains to cover: An additional pump to be installed at the pumping station; a 300,000-gal. reinforced-concrete standpipe; a new sewage disposal plant; and a 10-in. water main from the pumping station to the standpipe.

## Ask Twenty-Seven Millions for Rivers and Harbors

The annual estimates of expenditures submitted to Congress Dec. 5 by the President and the Director of the Budget request appropriations totalling $27,885,260 for river and harbor work during the next fiscal year. This is exclusive of the continuing contract work, for which an additional $7,070,000 is asked. Of this latter amount, $6,670,000 is intended for flood-control work on the Mississippi and $400,000 for flood control work on the Sacramento river. During the current fiscal year, $15,250,000 was appropriated for the regular river and harbo· work and $7,170,000 for the flood-contr work.

## General Contractors Announce Convention Program

Two sessions daily and one evening session will be devoted to association business or technical discussion at the three-days' convention of the Associated General Contractors of America to be held Jan. 17-19, 1922, at Cleveland, Ohio. Speakers of national prominence will feature the opening session. Reports of standing committees of the association will be received and discussed at the second session.

On the second day building contractors, highway contractors, railroad contractors and public works contractors will hold separate meetings, morning and afternoon, and in the evening there will be a general session at which the chairmen of the sectional meetings will present summaries of the day's work for discussion and the action of the full convention.

With the exception of an address on the cost of financing construction, the final sessions will be devoted mostly to the transaction of association business.

## N. Y. Port Authority Makes Report on Plan

At a conference Dec. 7 of the so-called advisory council, made up of representatives of the various interests in the Port of New York, E. H. Outerbridge, chairman, Port of New York Authority, submitted what he called a preliminary report of a comprehensive plan for the development of the Port of New York. The act creating the Port Authority requires that body to submit to the two legislatures before Jan. 1, 1922, a so-called comprehensive plan of the development of the port. Such a plan had been worked out and reported by the bi-state port and harbor commission, which preceded the Port Authority. The latter body was under no obligation to report the same plan as its predecessor, although a large part of the personnel of the two bodies is the same and their technical staffs identical.

The scheme presented in the conference varies little from the comprehensive plan of the commission. It re-emphasizes the fact that the problem of the port is a railway terminal problem and to the solution of that problem it offers a number of belt lines divided into the inner or water-front group, the middle group, and the outer group. It reiterates the fact that the west water front of Manhattan Island must be cleared of terminals and made free for ocean shipping, that the opposite or Jersey shore should be developed for pierhead rail lines, and that the terminal break-up stations must be back of the Palisades on the Jersey shore and back from the Hudson water front on Manhattan Island, with the connecting tunnel and the automatic-electric railway emphasized in the earlier report. However, the current scheme places the necessity for the automatic-electric railway somewhat further off than did the earlier scheme and concentrates more attention on the development of the ferries for motor-truck transportation to inland union terminals.

## Bureau of Standards Asks $175,000 for Structural Study

For the continuation of its investigation of structural materials the Bureau of Standards has requested Congress to vote it $175,000 to apply on its work during the next fiscal year. A similar amount was appropriated for this year's work. Of the amount $50,000 is to be devoted exclusively to the collection of information tending to show approved methods in building, planning, construction, standardization and adaptability of structural units.

For the continuation of the investigation of fire-resisting properties of building materials, an appropriation of $25,000, the amount allowed for this year, is asked. This investigation includes a study of the conditions under which fire-resisting materials may be used most efficiently. Information concerning foreign progress in this particular also is to be undertaken.

For a study of methods of measurement and the technical processes used in the manufacture of clay products, a continuation of the annual appropriation of $25,000 is asked.

## Santa Fe Plans Industrial Extensions in Dallas

The Santa Fe R.R. is planning to make extensive additions and improvements in Dallas as a result of an inspection completed recently by the assistant general manager and other Santa Fe officials. Freight facilities have become inadequate and the Santa Fe officials have felt for some time the need of additional facilities for industrial uses along its terminal tracks.

## New Truck Ruling in Connecticut Involves Rated Capacity

As a result of a joint ruling made Nov. 4 by Charles J. Bennett, state highway commissioner of Connecticut and Robbins B. Stoeckel, commissioner of motor vehicles any person desiring to register a commercial motor vehicle for an increase over its rated capacity must secure from the engineering department of the company manufacturing such motor vehicle a certificate to the effect that such vehicle or type of vehicle is capable of being safely operated under all conditions at all times when loaded to the increased capacity applied for.

It is possible, says a recent bulletin of the National Automobile Chamber of Commerce, that the granting of such a certificate would constitute a warranty against possible mechanical failures in the motor vehicles resulting from the overloading authorized. Moreover, in case of accident arising from the operation of such an overloaded vehicle, the manufacturer issuing such a certificate might be liable for any injury to persons or damage to property. Truck manufacturers, it is pointed out, should further realize that by issuing such certificates they place themselves in the position of sponsoring or even fostering the overloading evil which the Truck Committee of the Chamber has been steadfastly opposing.

The new ruling does not change the highway department's policy of limiting gross loads to 25,000 lb. and loads per inch width of tire to 800 lb.

## Henry Turner Eddy

With the death of Prof. Henry T. Eddy last week one of the notable figures of an earlier generation in American engineering passed from the stage. For more than forty years Dr. Eddy taught engineering, retiring in 1912. During the past ten years he has been at work on various problems of the mechanics of reinforced concrete, in cooperation with C. A. P. Turner, of Minneapolis. Mr. Turner writes of Dr. Eddy thus:

"With exceptional mathematical knowledge and high scientific attainment he combined the fine characteristics of simplicity, courtly manners and gentleness which caused him to be honored, loved and respected by all who came in contact with him.

"He was born at Stoughton, Mass., on June 9, 1844. His early aptitude for mathematics was shown at Yale, where he received first prize in every competition and was awarded the senior gold medal on his graduation in 1864. He received the degree of Ph.D. there in 1868.

"From 1869 to 1873 he was assistant professor of mathematics and engineering at Cornell, where he received the degree of Civil Engineer, in 1870, and later the first degree of Ph.D. conferred by that university. He was adjunct professor of mathematics at Princeton in 1873, but in 1874 upon the organization of the new university at Cincinnati he was elected to the chair of mathematics, astronomy and civil engineering, remaining in this position until 1890. During this period, in 1879-1880, he was on leave of absence and studied mathematical physics at the University of Berlin and at the Sorbonne and the College de France, Paris.

"In 1890 he accepted the presidency of the Rose Polytechnic Institute at Terre Haute. He came to the University of Minnesota in 1894 as professor of engineering and mathematics in 1906 he was made dean of the graduate school of that institution; and in 1912 he retired, with the title professor of mechanics and Dean Emeritus. During the last fourteen years of his life, almost to the time of his death, he engaged more or less in research work in the field of reinforced concrete.

"Dr. Eddy was the author of many short treatises. Among them are 'Analytical Geometry' (1874), 'Researches in Graphical Statics' (1878), 'Thermodynamics' (1879), 'Neue Constructionen aus der Graphishen Statik' (1880), 'Maximum Stresses Under Concentrated Loads' (1890), 'Theory of Reinforced-Concrete Floor Slabs' (1913), and with the undersigned as co-author, 'Concrete Steel Construction' (1914, 1919).

"His treatises on 'Graphical Statics' (1878) deserves to be singled out from this list as a work of pioneer character rendering more advanced theoretical achievement practicable, and also a work which might well be adopted today in all schools of engineering.

"As the writer worked with Dr. Eddy for the past fifteen years, he may be permitted to recall that we first met in the laboratory of the University of Minnesota, where the writer was testing a steel girder to determine the relative stress distribution through the stiffeners and web plates. The acquaintance commenced with a friendly theoretical controversy upon various matters of structural mechanics which in effect continued without interruption up to the time of the illness of Mrs. Eddy. An earnest searcher for the truth, Eddy was ever as pleased to find his own premise in error as to prove that the opponent's position was untenable. Only ten days before his death he was planning to review the writer's work in stress-line analysis of problems of elasticity."

### *Truck Legislation in Oregon*

*One of the two definite considerations before the Oregon legislature which was called into special session Dec. 19 concerns the loading of motor vehicles. It is also possible that this special session will take some action on a $10,000,000 bond issue for state highway construction, the bonds to be paid for by a 1 cent additional tax on gasoline.*

## Railroad Commission Again Orders Los Angeles Union Station

Reaffirming its former conclusion that a union passenger station at the Plaza site is the fundamental solution of the grade crossing problem in Los Angeles, the California Railroad Commission on Dec. 9 directed the Southern Pacific, the Santa Fe and the Los Angeles and Salt Lake railroads to take immediate steps to obtain a site within the area defined as the plaza location in the former decision and to erect thereon a union terminal. This order came as the result of the rehearing concluded some weeks ago. The report of the original decision was published in *Engineering News-Record*, May 12, 1921, p. 829.

Although adhering to the original plan of using the plaza site as a joint depot for the roads named the decision after the rehearing has some modifications of the original order. The present order does not require the Pacific Electric Ry. to join with the steam lines in the use of the plaza site. Another modification is that the carriers themselves are now directed to submit plans and estimates instead of leaving this to a representative committee as in the original order. This modification was made after objection by the railroads. The three roads involved are required to file plans and estimates of cost of the proposed station within six months, together with a statement of the proportionate expense each is to bear. If the carriers are not able to agree on the division of cost the commission will fix the apportionment. After approval of the plans work must be started within ninety days and completed within three years, according to the decision.

## Arkansas Local Improvement Bonds Sold at Premium

A $2,225,000 bond issue of a local improvement district which is constructing two bridges at Little Rock, Ark., across the Arkansas River, was sold recently to a St. Louis bond house at a premium of .0105 cents on the dollar. The price was considered by local bond dealers as remarkable in view of the conditions of the bond market. The bonds bear 6 per cent interest.

*Water-Works School Planned for City Employees*

*A feature of the Dallas, Texas, Health Institute to be held at Baylor Medical College Jan. 16-21, under the direction of the State Director of Public Health, will be a water-works school for city employees. Various federal and state public health officials, as well as engineering educators are to lecture at the schools.*

### Florida Soon to Receive Bids on Roads Costing $2,500,000

Bids will be received by the Florida State Road Department on Jan. 4 and 5, for the construction of eight highway projects entailing the construction of 100 miles of highways and costing approximately $2,500,000. All roads will be 16 ft. wide with compacted rock base, surfaced with cement, concrete, asphalt, bituminous concrete or cement-grouted brick. Four of these projects will complete State Road No. 1 as far as Lake City from Jacksonville. The completion of the remaining two-thirds of the road awaits the sale of Escambia County bonds and the issuance of bonds by several intervening counties.

### Large Water Main Laying Program at Oakland, Cal.

A two-year program for new water mains and replacements of old mains at Oakland, Cal., involving 48.8 miles of pipe at an estimated cost of about $1,000,000, has been announced by George H. Wilhelm, vice-president and general manager, East Bay Water Co. There will be some ten miles of 10- to 30-in. "sheet iron" pipe and the balance will be of 16 to 4-in. cast iron.

### North Carolina Road Work Active

During October the North Carolina State Highway Commission awarded road contracts involving the construction of 138 miles of state highway to cost approximately $2,000,000. This was exclusive of the usual additional fees for engineering, contingencies, etc. On the 17 projects involved 274 bids were received. A little more than one-third of the mileage will be hard-surface in type, and, including usual clearing, draining, small reinforced concrete bridges, culverts and incidental work, the average cost per mile was $26,464. Pavement widths are 16 and 18 ft. The average price for the remaining mileage which included gravel, sand-clay or top-soil construction was $8,502 per mile, including the clearing, drainage structures, etc.

### Investigates Delay in Sewage Disposal Plant Building

The Mayor of Dallas, Texas, has under taken an investigation of the long delay in the construction of a sewage disposal plant by Fort Worth. Interest of the Dallas Mayor in the project is explained by the fact that both cities are on the Trinity River and inasmuch as Fort Worth is above Dallas, the latter city gets a highly-polluted water. Bonds for the construction of the disposal plant were issued more than a year ago, but for undetermined reasons constduction has been delayed.

### Chautauqua County Authorizes $1,000,000 Bond Issue

At the final session of the Chautauqua County, N. Y., supervisors held Dec. 9, approval of the issuance of $1,000,000 in road bonds was unanimously given.

### Campaign Nets Million Dollars for California Stadium

A double-deck, reinforced-concrete and steel stadium to cost about $1,000,000 and to accommodate 60,000 people is proposed for the southwest corner of the campus at the University of California, Berkeley, Cal. In a recent campaign to raise funds for building the structure, $1,014,500 was secured by the sale of $100 script books which are good for a period of ten years, redeemable in tickets to any football game played by the California team.

Under the terms of an agreement between the athletic boards of California and Stanford universities, the annual football game between these two schools was to be played for two successive years in the stadium first completed. Stanford completed a stadium just in time for the game this year. The 1923 and 1924 games, it is expected, will be played in the proposed Berkley stadium.

### Arkansas A. A. E. Organizes Advancement Society

Following the publication last year of articles dealing with the methods employed by local improvement districts in financing highway work, the Arkansas Chapter of the American Association of Engineer met recently to organize the Arkansas Advancement Society. The objects of the Society will be to combat untruths regarding the state and to spread truthful propaganda.

Investigation of the conditions has revealed the fact that not a penny of road-bond interest has been defaulted. Evidence of the activity of engineers in spreading the truth about the financial situation is seen by residents within the state in the result of a recent sale of bridge bonds by Pulaski county which brought $1.0105 in open competition.

### Close Bidding for Main Piers of Philadelphia-Camden Bridge

Eleven bids for building the two main piers of the Philadelphia-Camden suspension bridge were received by the Delaware River Bridge Joint Commission on Dec. 19. Lump-sum bids were asked, based on sinking the Philadelphia caisson to El. —62 and the Camden caisson to El. —86, with some excavation below cutting edge and some rock left above cutting edge. The totals ranged from $1,669,275 to $2,553,000, the average being $2,138,279. The individual bids were:

Holbrook, Cabot & Rollins Corp., New York, and Keystone State Construction Co., Philadelphia, $1,669,275; Foundation Co., New York, $1,843,750; Eyre & Johnson, Philadelphia, $1,943,744; Arthur McMullen, New York, and Arundel Corp., Baltimore, $2,091,800; Vang Construction Co., Cumberland, $2,092,500; Booth & Flinn, Ltd., Pittsburgh, $2,151,750; H. P. Converse Co., Boston, $2,166,000; Dravo Contracting Co., Pittsburgh, $2,275,000; P. McGovern, Inc., New York, $2,285,500; Underpinning & Foundation Co., New York, $2,448,750; Fred'k Snare Corp., Phila., $2,553,000.

## Engineering Societies

### Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

**The Engineering Society of Akron,** Ohio, Mechanical Section, will have a joint meeting with the local section of the American Society of Mechanical Engineers on Dec. 30. An address on "Various Phases of Engineering Society Activity" will be made by Dexter S. Kimball, dean of Cornell University and president-elect of the American Society of Mechanical Engineers.

**The National Highway Traffic Association** held a public meeting in New York Dec. 12 to consider the unsatisfactory condition of the taxicab situation.

**The Society of Municipal Engineers, Philadelphia Section,** at its meeting Dec. 16, will be addressed by Messrs. Ralph Modjeski, George S. Webster and Laurence A. Bell on, "The Delaware River Bridge."

## Personal Notes

C. L. ZULL, formerly assistant engineer on the Huffman dam, Miami Conservancy District, Dayton, Ohio, is now engineer for the Davis-Hunt Construction Co., Dayton.

L. M. SHUMAKER has been appointed resident engineer, Tennessee State Highway Department, at Erwin, Tenn.

WILLIAM T. PETERMAN, highway contractor, St. Landry, La., has been appointed chairman of the Louisiana State Highway Commission.

E. L. MILES has been appointed county engineer in addition to his regular duties as county road superintendent for the County of Victoria, Ont., with headquarters at Lindsay.

C. E. TILTON, town engineer of Phillipsburg, N. J., has resigned, to take effect Dec. 31.

RALPH A. BEEBEE has been appointed chief harbor engineer by the Oakland, Cal., City Council.

ROY N. TOWL, city commissioner, Omaha, Neb., for three years, has formed the civil engineering firm of Towl, Nelson & Schwartz, with offices in Omaha. During Mr. Towl's administration many large city planning projects were initiated and some of the

regrading projects were completed. Harry A. Nelson is a drainage engineer and Murray Schwartz city surveyor. The firm proposes to handle river bank protection, real estate development, paving, water and sewerage.

LEO HUDSON, who has been in consulting practice for the past fifteen years and JOHN P. MYRON, formerly with the Pittsburgh Filter Co., have formed a partnership under the name of Hudson & Myron, engineers, Pittsburgh.

THOMAS B. HUDSON, for the past five years superintendent of construction at the Baltimore plant of the Bethlehem Steel Co., is now with the Whiting-Turner Construction Co., Baltimore.

W. H. WILSON has resigned as secretary and general manager of the J. E. Moss Iron Works, Wheeling, W. Va., to engage in structural steel contracting, specializing in steel joist construction in Los Angeles, Cal., under the name of the Wilson Steel Co.

W. T. CHOLLAR, formerly with the advertising and sales promotion department of the Atlas Portland Cement Co. and the Lakewood Engineering Co., has joined the W. B. Conkey Co., Hammond, Ind., printers, publishers and bookbinders, as Eastern representative. He will be associated with E. W. Brenisen with headquarters in New York.

A. H. DUNLAP has assumed his duties as member of the Texas State Board of Water Engineers to fill the vacancy caused by the death of the late Judge W. T. Potter.

F. R. HODGDON of Joplin, Mo., has been appointed assistant engineer to S. Ashcraft, city engineer of Joplin. Credit H. S. Reifsnyder

WILLIAM C. WALKER, who has served the city of Altoona, Pa., for ten years, has resigned as construction engineer and superintendent of the bureau of highways, Altoona, to enter road-building work with headquarters at Hollidaysburg, Pa.

RALPH W. OREBAUGH has resigned as city manager of Westerville, Ohio, and will engage in the engineering and contracting business in Seattle, Wash.

COL. B. C. BALTYE, of London, England, representing the government of India, is in Canada in connection with the proposed establishment of a 100,000-hp. hydro-electric plant to supply Delhi and Lahore with light and power.

CHARLES O. BOYD, formerly district highway engineer of Raleigh County, W. Va., has resigned to become resident engineer with the Carolina Engineering Co. on street and sewer work for Wilmington, N. C.

BACKES & PFALLER, architects and engineers, have discontinued their Janesville, Wis., office and have opened an office in Milwaukee.

E. A. WINTHER, and Edward A. Juul, architects and engineers have opened offices in Sheboygan, Wis.

MAURICE L. MCKENNA has resigned as superintendent of construction for the City of Bridgeport, Conn. He held this position for four years and was formerly city engineer of Bridgeport.

EDWARD S. NETTLETON, acting city engineer of New Haven, Conn., since the resignation of Frederick L. Ford, has been appointed city engineer.

MAJOR G. E. HUMPHREY has resigned as manager of operations of the Federal barge line between St. Louis and New Orleans.

HENRY NEGSTAD has been appointed county highway superintendent of Brookings County, S. D.

J. GRESHAM, formerly engineer of Coldwell County, Tex., has been appointed engineer of Travis County, Tex.

A. A. EVERETT, assistant city engineer of Charleston, S. C., until a change occurred in the city administration in November, is now engaged on land survey and drainage work. His experience covers service with Taylor, Romine & Scott, civil and mining engineers; the City of McKeesport, Pa.; and the U. S. Steel Corp. His present address is Mt. Pleasant, S. C.

## OBITUARY

HENRY T. EDDY, dean emeritus of the University of Minnesota, died at Minneapolis on Dec. 11 of pneumonia complicated by heart weakness. A fuller notice of his career appears on a preceding page.

JOHN J. NOLAN, vice-president, secretary and director of the Dravo Contracting Co., died recently in Pittsburgh, Pa. He was born in Carbondale, Pa., and was a graduate of Lehigh University.

BERNARD A. MILLER, Major, Engineer Corps U. S. Army, chief engineer of the American forces in Germany, died at Coblenz, Dec. 18.

BURTON J. ASHLEY, one of the oldtime civil engineers of Chicago, died at his home in that city Dec. 4, after a brief illness. He was born near Marengo, Ohio, in 1857, and was for some time county surveyor of Morrow County, Ohio. He moved to Chicago in 1888, where he practiced as a surveyor and later made a specialty of sanitary engineering, especially in regard to isolated sewerage and sewage disposal plants for large institutions in country districts. He was a member of the Western Society of Engineers.

## BUSINESS NOTES

THE KOPPEL INDUSTRIAL CAR & EQUIPMENT CO., manufacturers of industrial cars, narrow-gage track materials, etc., with a plant at Koppel, Pa., and several branches throughout the country, has opened an office at Kansas City, Mo., with Harry C. Kraft as manager.

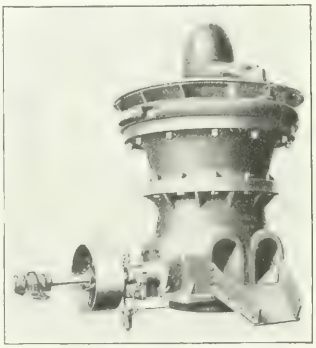
JOHN R. ALPINE has been appointed New York department manager of the Grinnell Co., representing the company's power piping, steam, hot water industrial piping interests.

The ASSOCIATED MACHINERY CORP. has been formed for the purpose of exporting construction equipment to India, Burma, and Ceylon. The following companies are incorporators: Pawling & Harnischfeger Co., Milwaukee; Novo Engine Co., Lansing, Mich.; Insley Manufacturing Co., Indianapolis, Ind.; Blaw-Knox Co., Pittsburgh, Pa.; and the Chain-Belt Co., Milwaukee. The managing director of the corporation has arrived in Burma where he will open offices and then proceed to India and Ceylon to open offices there. In addition to a full line of construction machinery, the corporation will handle a number of other products of American manufacture.

## EQUIPMENT AND MATERIALS

### Improved Gyratory Crusher

In a new gyratory crusher, built by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., the usual discharge opening is replaced by two openings separated by a vertical strut which forms a part of the shell casting. A larger opening and more free discharge are obtained, together with stronger construction. Three other openings are formed in the bottom shell, two of these



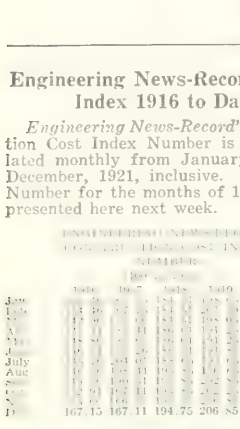
having light covers and the other having the countershaft bearing. This bearing may be placed on either side, for right hand or left hand drive as desired. A continuous ring on the spider surrounds the top of the shell and is split between the spider arms, so that by horizontal bolts at these joints the ring is clamped tightly against the shell. The contact faces of shell and ring are machined. The crushing shaft is shorter and of larger diameter than in other types of crushers built by this firm, and a steel bushing shrunk on the top journal enables the standard size to be restored without having to turn the bearing and use bushings in the spider. Another special feature is that oil is forced between the driving gear and the eccentric wearing ring, so that the gear and eccentric practically float on a film of oil. Lubrication is provided by a geared pump in a recess at the outer end of the countershaft bearing, but provision is made for dispensing with the pump and supplying oil from an overhead tank. Repairs and renewals of the principal working parts can be made without dismantling the entire machine.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Engineering News-Record's Cost Index 1916 to Date

*Engineering News-Record's* Construction Cost Index Number is here tabulated monthly from January, 1916, to December, 1921, inclusive. The Index Number for the months of 1915 will be presented here next week.



ENGINEERING NEWS-RECORD
CONSTRUCTION COST INDEX
NUMBER

| | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|---|---|
| Jan. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Feb. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Mar. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Apr. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| May | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| June | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| July | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Aug. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Sept. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Oct. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Nov. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Dec. | 167.15 | 167.11 | 194.75 | 206.85 | 251.62 | 167.82 |

## Successful Bids on Pine Piles for Portland, Me.

The tabulation gives the bids accepted by the Directors of the Port of Portland, Me., on Nov. 28, for creosoted southern pine piles for a state pier. Double the number of piles were required as are given in the second column of the table, and bids were asked for the complete list (Bid A), as well as for half the quantity as shown. There were four bids on the complete list, the minimum total bid being $237,449. Contracts were awarded to both the Georgia Creosoting Co. and the Creosoting Materials Co. of New Orleans, whose unit bids are listed. The totals are $107,729.25 and $114,585.50, respectively. Fay, Spofford & Thorndike are the consulting engineers; John Ayer, engineer in charge.

| [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|
| [illegible] | [illegible] | $25.97 | $25.42 |
| [illegible] | [illegible] | 27.75 | 31.92 |
| [illegible] | [illegible] | 30.97 | 34.72 |
| [illegible] | [illegible] | 33.39 | 37.52 |
| 75 to 84 | 175 | 36.70 | 40.32 |
| 75 to 84 | 250 | 40.36 | 45.12 |
| 60 to 84 | 350 | 43.87 | 48.72 |
| [illegible] | [illegible] | 47.05 | 48.72 |
| Additional Creosote Oil, 250 gal. | | 0.35 | 0.15 |

## Food and Wages

Retail prices are 49 per cent above the 1913 level, against 50 per cent in October, according to the Bureau of Labor statistics. The decline since November, 1920, is 28 per cent.

Payrolls of 118 steel-making establishments listed 124,147 men, $5,274,084, in November, 1921, against 185,547 men, $14,720,283, in the same month of 1920. The decrease in numbers is 33 per cent, in pay 64 per cent. There is a slight improvement over October, 1921.

The Associated Contractors of Massachusetts, by formal vote at Worcester, on Dec. 14, declared that wages in the building industry must be lower in 1922. They voted also not to permit unions connected with the industry to dictate working conditions and not to sign any written agreement with the unions.

## Six Salient Features of New Federal Tax Bill

### Excess Profits Tax Repealed—Surtax on Individual Incomes Reduced—Advantages of Incorporation

Among the numerous changes made by the new tax bill signed by President Harding on November 23d, six stand out as of great importance from the point of view of the business man and the investor. These are:

(1) The abolition of the Excess Profits Tax, from Jan. 1, 1922, coupled with an increase in the income tax on corporations at that time from 10 per cent to 12½; (2) reduction in the surtax rates on individual incomes; (3) establishment of a new class of income to be known as capital gain, which will be subject to a maximum rate of 12½ per cent; (4) broadening of the definition of "closed transaction," effective for the current year, which makes possible many exchanges of property without subjecting the gain to taxation; (5) recognition, beginning this year, of a net loss from one year's operation as an offset against any profits which may accrue in the two following years; (6) inducements offered to persons conducting business as individuals or partnerships to incorporate, thereby obtaining advantage of a lower total rate on corporate income.

*Excess Profits Tax Repeal.*—In spite of great pressure, Congress finally declined to repeal the profits tax for 1921 but did agree to abolish it thereafter. With it disappears the "personal service corporation," a special class established to care for certain corporations which it was desired to exempt from profits taxation. When the profits tax goes, the income tax rate on all net income of corporations rises from 10 to 12½ per cent. The change in the rate will cause corporations which make only moderate profits to pay slightly heavier taxes but the total tax burden on corporate income will be much lighter, the official estimates of revenue under the new bill calling for $1,030,000,000 from this source (ignoring back taxes) this fiscal year and only $695,000,000 for the next fiscal year, when the change will be in force.

The surtax rates on individual incomes are scheduled for reduction beginning with the first of next year.

The most revolutionary section in the new act is Section 206 which sets up a new division of income. After the first of next year money made by individuals by selling or exchanging property "held for profit or investment" is subject to a maximum rate of 12½ per cent, instead of the regular rates which range as high as 58 per cent (normal plus surtaxes). This is hedged about by several restrictions. The individual may not take advantage of the permission to use the 12½ per cent rate unless he is willing to pay at least 12½ per cent on his other income as well. The property "held for profit or investment" must have been so held for more than two years and may not include property "held for the personal use or consumption of the taxpayer or his family," or property which properly is subject to inventory. It is not necessary, however, that the property be connected with his trade or business.

*The "Closed Transaction."*—The advantage to the investor in property which is gaining in value, conferred by the section just described, is accentuated by the liberal provisions governing the "*closed transaction.*" This has long been a troublesome section of the field on income tax procedure. When one exchanges property for cash, no question arises. The transaction is "closed" and one accounts for his gain to the tax collector. But when one barters instead of sells, receiving other property instead of cash for this property, very serious questions arise. There are sometimes differences of opinion as to the value of the property received which lead to disputes and litigation. The old law went so far as to say that, in the case of such trades, the property received was to be treated as cash "to the amount of its fair market value, if any" (with certain exceptions in the case of such corporate reorganization, 1918 Law, Section 202). The new law goes much further. It now states positively that no gain or loss on trades shall be recognized unless the property received on the trade "has a readily realizable market value." The phrase, "*readily realizable,*" adds a new and liberalizing element.

*Net Losses.*—With one minor exception included in the 1918 law, it has been the practice since the beginning of income taxation in this country to treat each year as a unit and to refuse to permit the fact that one has lost money this year to affect the amount of profits he must report the following year. Each accounting period has been carefully "insulated" from other accounting periods. This practice has worked much hardship and the new law breaks away from the old precedents by inserting a provision, effective for 1921 (Section 204, with a restriction on mines), which permits a net loss suffered in one year to be offset against any net income in the next two succeeding years. In other words, losses may be used to blot off subsequent gains but losses are "outlawed" for this purpose after the expiration of two years.

*Corporate Tax Advantages.*—According to Section 229 an individual or a partnership engaged in trade or business, is given the option of being taxed for the year 1921 either as a corporation or as individuals, under the following conditions: (1) Capital must constitute an important income producing factor in the business; (2) the capital stock tax for 1921 must be paid by the taxpayer who is assessed on a corporate basis; (3) the business must be incorporated within four months after the passage of the act, which was signed by the President on Nov. 23; (4) the taxable income for the year 1921 must be equal to or more than 20 per cent of the invested capital.

## Lumber Mills Replenishing Stocks on Hand

An earnest effort on the part of the larger lumber producers of the country to increase their supply of stock on hand, is the outstanding trend of recent lumber activities according to A. Fletcher Marsh, chairman of the statistical committee of the American Wholesale Lumber Association. A compilation of figures for all associations shows that the lumber manufacturers are attempting to keep up lumber production at the mills in spite of the seasonal tendency at this time of the year for orders to fall off. A comparison between lumber production and the shipments of all revenue tonnage on the part of the railroads shows that although railroad loadings of all commodities are falling off sharply, the lumbermen are nevertheless attempting to keep up their production to replace the large volume of lumber shipped during the earlier fall months. For the week ending Dec. 3 production was 18 per cent larger than orders, and shipments covered by previous orders amounted to 20 per cent of new business, meaning that shipments for all reporting associations are ahead of production and orders.

In the largest producing fields the southern pine district and northwest Pacific coast, production is ahead of new business and shipments. It was in the woods from these districts that the heavy fall demand was felt for new building activity in house construction and railroad material. Southern pine orders were 72 per cent of production while on the northwest coast they were 77 per cent. Apparently little effort will be made on the part of sawmill operators to solicit new business until the turn of the year.

For the second week of December the volume of new business from the South and from the north Pacific coast is very close together, there being now a difference of only 5,000,000 ft. With new rate reductions from the north Pacific coast, effective Dec. 24, this difference in volume may become even less.

From compilation of the West Coast Association, where fir, hemlock, cedar and spruce are the four important woods, business for the week ending Dec. 10 showed 57 per cent for rail shipment, 31 per cent for domestic cargo shipment and 12 per cent for export, while the unshipped balance, showed orders on hand covering three weeks' business in rail shipment, five weeks in the domestic cargo trade and ten weeks in the export trade, giving a firm undertone to the export trade which has for some months been supporting the Coast business to a considerable extent.

## Bids Wanted on Big Jobs

Among the projects on which bids are either being asked or will soon be called for in Construction News, pp. 271@278, are the following:

Ore dock for the Great Northern R. R. at Superior, Wis., $2,000,000.

Hospital for the University of Wisconsin, Madison, $1,250,000.

Apartment Hotel at Chicago, $[illegible]

*Next Week—Paving Prices; Materials and Recent Contracts*

## Chicago Practically Open Shop for Carpenter Trade

The carpenters' union in Chicago, which has refused to accept the Landis award, attempted unsuccessfully Dec. 15 to obtain a temporary injunction restraining the banking interests from refusing to loan money except to builders who would carry out work under the Landis award. Another hearing was set for Dec. 21. A counter answer will be set up that the union is monopolistic.

The Citizens' Committee to Enforce the Landis Award holds almost daily meetings and was assured Dec. 9 by its executive committee that the fight for an open shop for carpenters had been attained beyond all reasonable doubt. Further, they asserted that it would probably soon be necessary to "open up" several other trades. Dec. 12 a delegation of lighting-fixture contractors served notice that neither they nor the union would accept the award conditions. A negative vote on the same question has been taken in the plumbers' union, which insists on retaining "monopolistic and wasteful" methods. Two unions, marble setters and machinery movers, have agreed to eliminate "wasteful" agreements and at a rehearing Dec. 8, Judge Landis increased their pay from 92½ to 97½c. per hour. Eight other unions refused to remove artificial restraints and were denied a rehearing by him.

### Trend of Business

**Bonds**—Rise continues for municipals, the bid for the $55,000,000 New York 4½s is said to be the highest since 1909 for this class of bond. Buffalo serial 4½s, offered Dec. 16, to yield 4.05 were quickly sold. The week's activity was principally in the municipals and foreign issues, industrials and public utilities running behind. On Dec. 19 the National City Co. bought $25,000,000 consolidated 4s of the Canadian Pacific Railway Co., and $30,000,000 Danish bonds. This is said to be the first premier security of the Canadian Pacific Railway Co. to be sold in the United States, London having taken all previous issues.

**Stock Market**—Interest centers chiefly in prospects for 1922.

**Foreign Exchange** — Sterling touched $4.24¾, highest since October, 1919. On Dec. 19 new high levels for the year were established in Denmark, Sweden, Holland and Switzerland rates, with sterling at $4.215, and the German mark at .56 cents.

**Money**—Market stiffened moderately owing to certain government operations. Call money advanced to 5½ per cent, with time rates unchanged. It is anticipated that money will be easier after Jan. 1.

**Steel**—Unfilled orders on the Steel Corporation books on Nov. 30 were only 4,250,542 tons, the smallest in six years. The Corporation operated at 52 per cent capacity.

**Auction of 1898 houses** and business buildings constituting Yorkship and Morgan Villages, Camden, N. J., owned by the U. S. Shipping Board, brought $4,594,445.

## Price-Trading Plan of Hardwood Men Declared Illegal

In a decision made public Dec. 19, the U. S. Supreme Court declared the "open competition" plan of the American Hardwood Manufacturers Association a restraint upon trade in violation of the Sherman anti-trust law. The association, consisting of 603 individuals and corporations, was charged, in the suit brought by the government, with enhancement of prices through exchange of bulletins and reports on stocks, prices and production. The vote was six to three on the decision, Justices Brandeis, Holmes and McKenna dissenting.

## Terra Cotta Men Fined

Fines of $3,000 each were imposed recently upon seven corporations and ten individuals engaged in New York in the manufacture and distribution of architectural terra cotta who pleaded guilty to an indictment drawn under the Sherman anti-trust law. The indictments resulted from evidence brought to light by the investigations being carried on by the Lockwood joint legislative committee on housing into building conditions in New York City.

## Charge Tile Men Still Active

Though punishment has been inflicted upon employers and union officials in the building trades the charge was made recently in testimony brought out by the Lockwood joint legislative committee on housing, investigating building conditions in New York City, that employers continue to meet regularly and "rig" bids, and unions persist in reinstating members who have served terms in jail. The testimony was brought out by Hyman L. Morse, a Brooklyn builder, who told the committee that about three weeks ago, a week after a group of tile contractors had been fined, four of them being sent to jail, he was informed by a tile contractor in Brooklyn that tile men were again holding their meetings. Testimony was also brought out to the effect that two union members of Plumbers Local 463, who had served terms in the penitentiary for coercion as a result of the Lockwood committee's inquiry, had been reinstated when they came out of jail.

## Distribution of Texas Pavements

Paved streets in Texas totaled only 706.171 miles or 15,281,174 sq.yd. at the beginning of 1921, according to L. W. Kemp, of The Texas Co. These were distributed among fourteen kinds of pavement, as follows:

| Kind | Square Yards | Miles |
|---|---|---|
| Warrenite-Bitulithic | 4,828,647.79 | 214.285 |
| Vitrified brick | 2,788,825.08 | 115.590 |
| Asphalt on concrete | 1,760,157.95 | 97.853 |
| Bitulithic on concrete | 1,284,202.81 | 63.138 |
| Creosoted wood blocks | 1,127,808.83 | 46.091 |
| Asphalt macadam | 975,090.82 | 49.068 |
| Concrete | 959,763.41 | 47.587 |
| Sheet asphalt | 660,598.32 | 25.751 |
| Bitulithic on brick | 471,912.06 | 24.586 |
| Asphalt block | 228,207.69 | 11.501 |
| Granite | 180,208.81 | 8.744 |
| Brick | 53,353.12 | 1.537 |
| Wood | 16,776.67 | 1.100 |
| Westurmite | 24,718.43 | 0.820 |

The Texas Highway Commission now has under construction approximately 2,500 miles for which more than $30,000,000 is available.

### Railroad Wage Meeting Set for January 16

The 52 railroads comprising the classification territory north of the Ohio and east of the Mississippi River have sent notices to their employees designating January 16 as the date on which conferences will start for the negotiation of wage adjustments. Decreases in pay ranging from 10 to 20 per cent have been asked by the railroads for train service and other classes of workers, while the shop craft and maintenance-of-way men have countered with demands for an increase in pay.

### Interstate Commerce Commission Agrees to Cut in Freight

The Interstate Commerce Commission has accepted the voluntary proposal of the railroads for the inauguration of a decrease in freight rates on practically all farm, range and orchard products in the United States outside of New England. The decrease approximates 10 per cent.

### Railroad Buying Continues

Among important transactions recently in railroad equipment were contracts placed by the New York Central for 125,000 tons of rails with an option of 25,000 tons additional and inquiries by the Union Pacific for 70 cars for passenger train service. The Pere Marquette announced the placing of orders with the Western Steel Car & Foundry Co. for 500 box cars with an option for 500 additional. Other contracts cover 800 steel and composite cars.

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving [illegible] prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, eight to ten cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1, the next on January 5.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb | $2.78 | $4.00 | $4.00 | $2.88 | $3.06 | $3.75 | $3.45 | $3.75 | $4.00 |
| Structural rivets, 100 lb | 3.00 | 5.25 | 5.50 | 3.43 | 4.15 | 4.25 | 5.50 | 4.25 | 6.50 |
| Reinforcing bars, ¼ in. and larger, 100 lb | 2.68 | 3.20 | 3.50 | 2.68 | 3.08½ | 3.57½ | 3.00 | 3.75 | 2.75 |
| Steel pipe, black, 2½ to 6 in. lap, discount | [illegible] | [illegible] | 45% | 57% | −61.9–5% | [illegible] | −53.7% | 50% | 35 10 |
| Cast-iron pipe, 6 in. and over, ton | [illegible] | 45.00 | 54.30 | 44.10 | 47.80 | 52.00 | 50.00 | 55.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.50 | 2.69 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | −3.12 |
| Gravel, ¾ in., cu.yd | 1.75 | 1.85 | 2.25 | 2.00 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd | 1.00 | 1.25 | 2.25 | 2.00 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd | 1.80 to 1.90 | 2.00 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft | 49.00 | 38.00 | 34.00 | 48.00 | 35.00 | 50.00 | 30.00 | −22.00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25.00 | 18.00 | 29.00 | 30.00 | 22.00 | 27.00 | 21.00 |
| Lime common, lump, per bbl. | 3.39@3.69 | 1.50 | 2.75 | 1.40 | 1.40 | [illegible] | 1.90 | 3.25 | 11.00 |
| Common brick, delivered, 1,000 | 17.40@18.40 | 9.00 | 12.72 | 11.00 | 17.00 | 14.00 | 15.50 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .0675 | .13 | .0824 | .0792 | .09 | .12½ | .10 | .08@.29 |
| Hollow partition tile 4x12x12, block | .11120 | .0675 | .13 | .0857 | [illegible] | .10 | .14½ | .11 | .. |
| Linseed oil, raw, 5 bbl. lots, gal | .72 | −.78 | [illegible] | .74 | .80 | .90 | .83 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | .55 | [illegible] | .72½ | .50 | .50@.55 | .75 | .50@.60 | .. |
| Common labor, non-union, hour | .20 | .35@.45 | [illegible] | .55@.40 | .50 | .35@.40 | .50@.55 | .50 | .25@.30 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by [illegible] Steel pipe prices are subject to varying discounts from list prices as given. 45-5% means a discount of 45 and 5 per cent, that is, a net price of 55 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforcing steel into bent lengths is usual. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 180 lb. net in bags and hydrated quoted f.o.b. cars New York. Sand, gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors' job. Gravel prices mixed $2 per cu.yd. **Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180 lb. net. **Minneapolis** quotes on ¼ in. instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement on trucks; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb bbl. Steel [illegible] crushed stone f.o.b. cars; other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stood at 91.2 cents). Exchange is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

### Changes Since Last Week

Increased discounts on wrought steel pipe and [illegible] are reported on the new Pittsburgh basing card of Dec. 15, averaging 3 per cent on black and 2½ per cent on galvanized. This is a reduction of about 8 per [illegible] and constitutes the first change on the basing card since Sept. 16. The mill change has been immediately reflected in warehouse quotations. [illegible] to 6 in., lap weld, black steel pipe is 61 per cent discount list; Denver quotes 41 per cent instead of 38 per cent and San Francisco 53.7 per cent as compared with 51.8 per cent.

Structural steel shapes continue at $1.50, Pittsburgh, in lots of 100 tons or more; smaller tonnages at $1.60 per 100 lb. Keen competition has resulted in quotations, at the mill, as low as $1.45 per 100 lb. on reinforcing bars.

With increasing lumber demand, particularly for export, an impending log shortage is reported in Seattle. Lumber mills and logging camps at this point are resuming operations on a [illegible] basis, many of them foreshortening the annual holiday shut down.

According to the National Lumber Manufacturers' Association production at 373 mills, for the week ending Dec. 10, at 176,554,176 ft., shipments at 155,405,188 ft., and orders for 146,953,064 ft. These figures show an increase in production of 16,248,444 ft. over the preceding week; a decrease of 9,957,330 ft. in shipments and an increase in orders of 13,861,007 ft. Total lumber production for the month of November, reported by seven members of the Association, show 705,714,521 ft. cut; shipments amounting to 729,290,377 ft. and orders covering 693,102,927 ft.

Lumber production stands at nearly 25 per cent; orders over 37 per cent and shipments at 35 per cent below normal. The lumber situation is further discussed on p. 1043 of this section.

Volume 87 New York, December 29, 1921 Number 26

# Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, TO WHICH IS INCORPORATED THE CONTRACTOR

E. J. MEHREN, *Editor*

**Variety of Movements Occur in Concrete Test Highway** 1048

CRACKS IN PAVEMENT COME ON CRESTS of longitudinal waves. Edges curve up in daytime and down at night. Test continuing.

*Engineering News-Record, December* 29, 1921. 7 cols. Ill.

**Keeping Track of Chlorine Cylinders** 1051

*Engineering News-Record*, December, 29, 1921. 1 col. Ill.

**International Division of St. Mary and Milk Rivers** 1052

ORDER OF JOINT COMMISSION allocating waters for irrigation and power to United States and Canada—with comment.

*Engineering News-Record*, December 29, 1921. 3¼ cols.

**Kings River Water-Right Litigation Halted by Engineer's Plan** 1053

*Engineering News-Record*, December 29, 1921. ¾ cols.

**London's Rapid Transit Mail Distribution System** 1054

CONSTRUCTION NOW GOING ON. Automatic electric trains to be transporting units. Twelve post offices to be linked.

*Engineering News-Record*, December 29, 1921. 1¾ cols. Ill.

**Sunken Dredge Raised by Jacking from Dry Dock Pontoons** 1056

BY JAMES H. POLHEMUS.

FOUR PONTOONS lying on the quarters swing hull in rope slings. Steel truss stiffens dredge against damage.

*Engineering News-Record*, December 29, 1921. 5 cols. Ill.

**Erection of Steel Building and 150-Ft. Truss** 1058

BY W. J. HOWARD.

SPECIAL METHODS for huge truss. Derrick on first floor with long boom places framing for six stories and roof.

*Engineering News-Record*, December 29, 1921. 4 cols, Ill.

**Loss of Head as a Criterion for Washing Filters** 1060

BY JAMES W. ARMSTRONG.

ARBITRARY TIME INTERVAL between washes replaced by a rational standard obtained by a new turbidity detector.

*Engineering News-Record*, December. 29, 1921. 1¼ cols. Ill.

**Concrete Armored Piles in Wharf at Port Orford, Ore.** 1061

METAL PIPE DRIVEN to serve as forms. Brackets in piles insure desired thickness of concrete at ground line.

*Engineering News-Record*, December 29, 1921. 2 cols. Ill.

**Utilizing Gas from Sewage Sludge as Motive Power** 1062

BY JOHN D. WATSON.

*Engineering News-Record*, December 29, 1921. 5 cols.

**Rectangular Enginehouse with Interior Turntable** 1064

TWO CANADIAN RAILWAYS adopt novel plan to reduce winter trouble at terminal by putting turntable under cover.

*Engineering News-Record*, December 29, 1921. 4 cols.

**Water Works Shares in Exhibit of St. Louis City Activities** 1066

BY T. CHIVVIS.

*Engineering News Record*, December 29, 1921. 1 col. Ill.

**The Probable Frequency of Given Rates of Rainfall** 1067

BY ADOLPH F. MEYER.

AVERAGE-RATE METHOD more economical for design of public works than uniform. Intensity method. Data reviewed.

**Breakwaters of Three Types in One Lake Harbor** 1069

RUBBLE MOUNDS, concrete caissons and rock filled pile cribs for U. S. Naval Station at Great Lakes, Ill.

*Engineering News-Record*, December 29, 1921. 4½ cols. Ill.

**Editorials** 1045

**Letters to the Editor** 1072

**Hints for the Contractor** 1075

**News of the Week** 1076

**Weekly Construction Market** 1084

**Construction News** 281

**Directory of Consulting Engineers** 118

**What and Where to Buy** 122

**Searchlight Section** 58

**Index to Advertisers** 128

**McGRAW-HILL COMPANY, INC., Tenth Ave. at 36th St., NEW YORK**

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice-President
A. MALCOLM MUIR, Vice-President
EDWARD D. CONKLIN, Vice-President
JAMES H. McGRAW, JR., Secy. and Treas.

WASHINGTON, D. C., Colorado Building
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
ST. LOUIS, 713 Star Building
SAN FRANCISCO, Rialto Building
LONDON, E. C., 6 Bouverie St

Cable Address: "Machinist, N. Y."

Publications:
Journal of Electricity and Western Industry
Electrical World
Electrical Merchandising
American Machinist
Power
Engineering and Mining Journal
Electrical Merchandising
Coal Age
Chemical and Metallurgical Engineering
Electric Railway Journal
Ingeniería Internacional

The normal subscription is $5 to any part of the United States, Canada, Mexico, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, Honduras, Nicaragua, Peru, Colombia, Bolivia [illegible] Salvador and Shanghai, China. Extra foreign postage $1 (total $6 or 38 shillings). Single copy, 25 cents.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least five days before the change takes place.

Copyright, 1921 by McGraw-Hill Company, Inc.

Published Weekly. Entered as second-class matter Apr. 11, 1917, at the Post Office at New York, under the Act of Mar. 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE, 29,647 COPIES

# Bent in Our Warehouse —for Less Money

Steel bent to specifications or fabricated into units ready to place in the forms—and when you want it.

That's Havemeyer Service! It saves time and money!

The chain of Havemeyer Warehouses makes it possible to serve every customer promptly—no matter where he may need reinforcing steel.

A complete line of steel building materials always in stock including Havemeyer Bars, Wall-Tys, Soffit Clips, Stair Tread, Form Clamps, Curb-Bars, Metal Lath, Channels, Corner Bead, Expanded Metal Lath, Wire Mesh, Bar-Tys, Ty-Chairs, Bar-Spacers, etc.

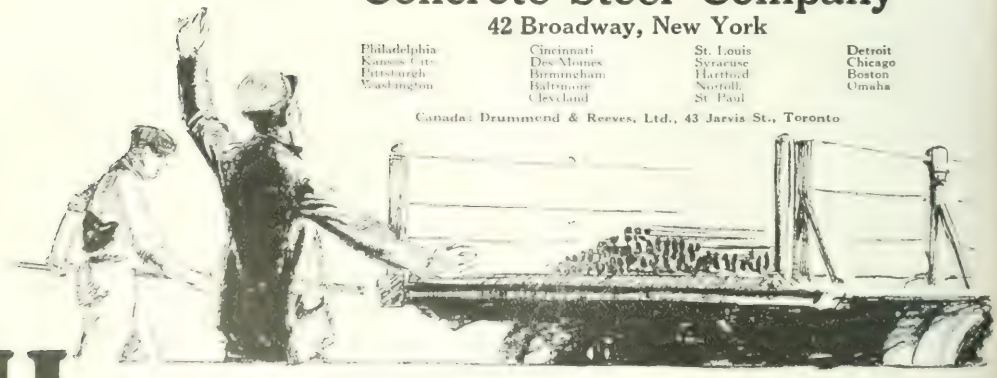
What do you need now? Catalogs on request.

## Concrete Steel Company

**42 Broadway, New York**

| | | | |
|---|---|---|---|
| Philadelphia | Cincinnati | St. Louis | Detroit |
| Kansas City | Des Moines | Syracuse | Chicago |
| Pittsburgh | Birmingham | Hartford | Boston |
| Washington | Baltimore | Norfolk | Omaha |
| | Cleveland | St. Paul | |

Canada: Drummond & Reeves, Ltd., 43 Jarvis St., Toronto



# HAVEMEYER SERVICE

# RAYMOND

—illustrating all it's necessary to know about Concrete Piles—the shell is left in the ground—

RAYMOND CONCRETE PILE COMPANY

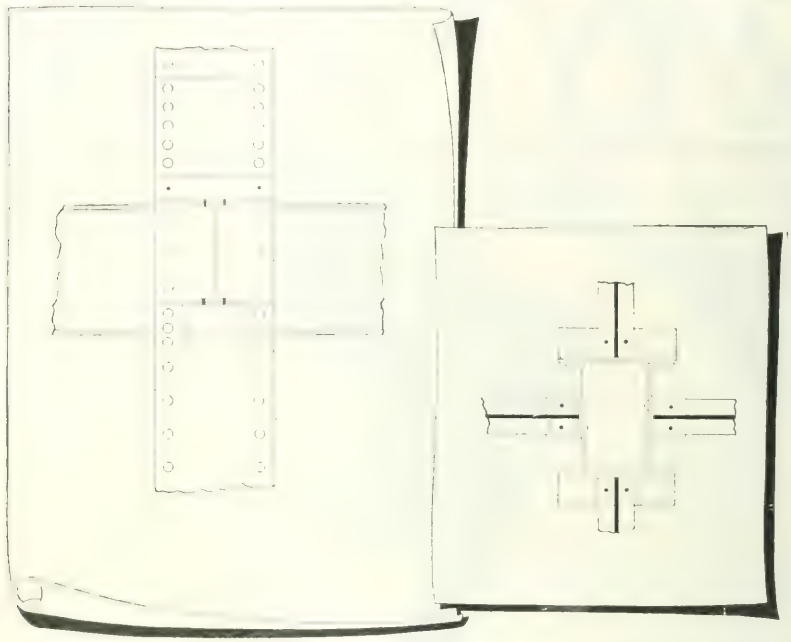
New York: 140 Cedar Street

Chicago: 111 W. Monroe Street

RAYMOND CONCRETE PILE CO., Ltd., Montreal, Quebec

Branch Offices in all Principal Cities

"A FORM FOR EVERY PILE—A PILE FOR EVERY PURPOSE"



# This part of the structure requires extra care in painting

A good shop coat of Red-Lead—that goes without saying. On erection, two more coats of Red-Lead should go on, and it can be obtained and applied in various dark colors, such as brown or green or black, to facilitate inspection and to suit color ideas.

Framing connections call for the greatest care—joined surfaces, rivet heads, etc., make hard painting with a big chance of poor covering—and they should always get an extra coat of Red-Lead.

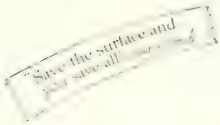
A common sight is that of a building skeleton or a bridge under erection with fresh bright paint marking every connection of beam and column.

Dutch Boy Red-Lead can be relied on to stick tight to clean metal surfaces and to keep out moisture and deleterious gases, thus protecting the metal from rust and corrosion.

Tests of all kinds have proved that Red-Lead excels every other known material for the protection of structural metal. Dutch Boy Red-Lead is pure Red-Lead in its most highly oxidized form. It is put up both as a convenient paste and a ready-to-use liquid Red-Lead.

For all metal surfaces, specify Dutch Boy Red-Lead.

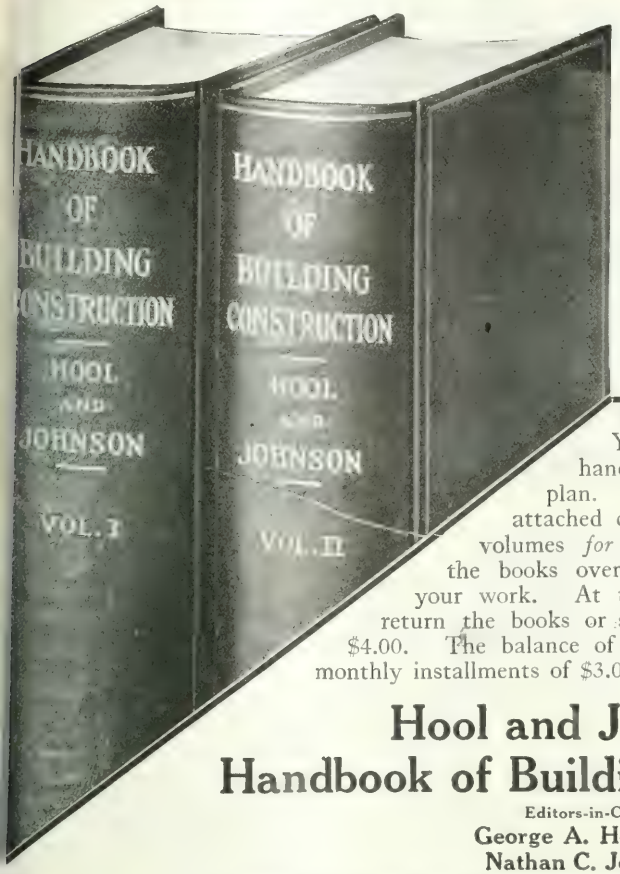
*Write for Painting Helps No. 5*




## NATIONAL LEAD COMPANY

New York Boston Cincinnati San Francisco
Cleveland Buffalo Chicago St. Louis
JOHN T. LEWIS & BROS. CO., Philadelphia NATIONAL LEAD & OIL CO., Pittsburgh

# Dutch Boy Red-Lead




# The Great Handbook on Building Construction

***pay for the books as you use them***

You can now purchase this great handbook on the deferred payment plan. If you will fill in and mail the attached coupon we will forward the two volumes *for ten days' examination.* Look the books over thoroughly—test them out in your work. At the end of ten days you may return the books or send us your first remittance of $4.00. The balance of $6.00 you may send us in two monthly installments of $3.00. See the coupon for details.

## Hool and Johnson's Handbook of Building Construction

**Editors-in-Chief**

**George A. Hool and Nathan C. Johnson**

***Assisted by 46 Specialists. Two volumes (not sold separately). 1474 pages 6 x 9, flexible, fully illustrated, $10.00 per set.***

Nearly fifty specialists collaborated to produce this great two-volume handbook on modern building design and construction. The records, the experience, the methods of big engineering companies and leading construction engineers have been incorporated in it. It is a digest of the best approved practice of modern building construction.

It offers architects, construction engineers, contractors and builders a body of information on practical construction that has never before been even approximated. Principles, methods, costs, tables and reference data are all spread out before you in these two handy books for quick reference and constant use.

A work without a parallel—a great achievement of technical authorship.

**These are the chapter headings:**

1—Elements of Structural Theory
2—Designing and Detailing
3—Structural Data
4—General Designing Data
5—Construction Methods
6—Construction Equipment
7—Building Materials
8—Estimating Steel Buildings
9—Estimating Concrete Buildings
10—Architectural Practice
11—Contracts
12—Specifications
13—Heating, Ventilation and Power
14—Water Supply
15—Sewage Disposal
16—Waterless Toilet Conveniences
17—Plumbing and Drainage
18—Electrical Equipment
19—Electric Lighting
20-21—Gas Lighting and Fitting
22—Elevators
23—Refrigeration
24—Compressed Air Systems
25—Lathing, Plastering
26—Vacuum Cleaning Equipment

**Sent on Approval**
**No Money Down**
**Only $4.00**
**in ten days**
**and $3.00 monthly for two months**

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.,
370 Seventh Ave.,
New York.

Send me on 10 days' approval Hool & Johnson's HANDBOOK OF BUILDING CONSTRUCTION (in 2 Volumes, $10.00). I agree to return the books, postpaid, in 10 days or to remit $4.00 in 10 days and $3.00 monthly for 2 months.

Name .....

Address .....
(Print name and address)

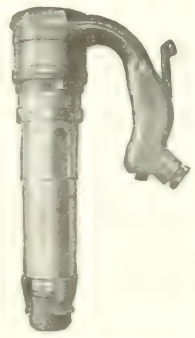
Official Position .....

Name of Company .....

Sales Mgr. News-Record .....Mem. Amer. Soc. C. E.?

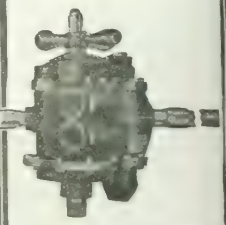
(Books sent on approval to engineers in the United States and Canada only)

N-R 12-29-21



Boyer Riveting Hammer, No. 50, with inverted handle. Used in the exceedingly heavy work of all compartment riveting.

Type "E" Little Giant Air Drill. Used exclusively for reaming and countersinking.



General Illustration shows the Industrial Canal, New Orleans, La., construction of which was supervised by Mr. A. Toohey for McClintic-Marshall Company, contractors. 2700 tons of steel and 300,000 7-8-inch rivets were used in its fabrication.

# *Boyers and Little Giants do Big Jobs Well*

THIS canal, requiring 300,000 7/8-inch rivets in its fabrication, was built with the aid of Boyer Riveting Hammers and Little Giant Air Drills.

Two types of Boyer Hammers were used—the No. 80 and the No. 50. The No. 80 was used on general riveting operations. The No. 50, with inverted handle, drove all inside compartment rivets.

A number of rivets were countersunk and ground to a finish. Each Boyer-driven rivet was so perfectly finished that little grinding was necessary.

All reaming and countersinking operations were performed by Class E Little Giant Air Drills.

Thus, on this difficult job—where *perfect rivets, air* and *maintenance economy,* were a necessity—the exacting requirements were fully met.

Boyer Riveting Hammer, No. 80, extensively employed in building this canal.

What are *your* needs? Name them—there's a Boyer or Little Giant to fulfill them. Ask for bulletins.

## Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and Service Branches all over the World*

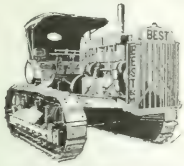
P-142

BOYER PNEUMATIC HAMMERS · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · VACUUM PUMPS · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES · ROCK DRILLS · COAL DRILLS

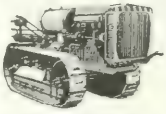
CHICAGO PNEUMATIC

*Depend upon* *that Name*

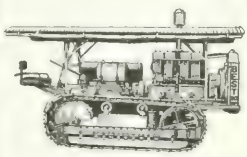
*There are three models of Best Tractors—the "Cruiser" (60), the "Thirty" and the "Sixty." All are factory-built—not assembled.*



*Best "Cruiser" (60)*



*Best "Thirty"*



*Best "Sixty"*

# Tractor Power in Road Building

Time is the essence of most contracts. By keeping pace with his schedule, by jumping ahead a few steps when possible, the road builder is able to get through the job clean and with his profit tucked away in the bank.

And it is right here that dependable BEST TRACTORS show their real value to the road-maker. BEST TRACTORS save time. They provide profit insurance. To begin with, work can be started or carried on in weather and with soil conditions that would keep animals off the job and in the stalls. The long, wide tracks enable BEST TRACTORS to work on soft, rough or sandy soil. Enforced idleness is reduced to the very minimum.

Then, with work under way, the tractor operates the elevating grader, the plow, scarifier, scrapers, blade graders and other tools at regular speeds and maximum capacities. No time is lost for frequent rests. No work is slighted because of tough going or tired animals. In fact, with BEST TRACTORS the contractor or engineer can map out for himself a shorter schedule than is possible where animals furnish the mobile power. And he does a better, cleaner piece of work.

BEST TRACTORS provide the engineer and contractor with reliable power in compact form, easy to maneuver, and managed by one man. Dependability, power and low cost of operation are proven qualities in BEST TRACTORS, the result of BEST design, choice of materials and workmanship. These, in turn, are the products of many years of successful tractor-building experience.

**BEST TRACKLAYER TRACTORS**

Let us send you further information on the use of tractors; also specifications, prices and names of nearest dealers.

## C. L. BEST TRACTOR CO.

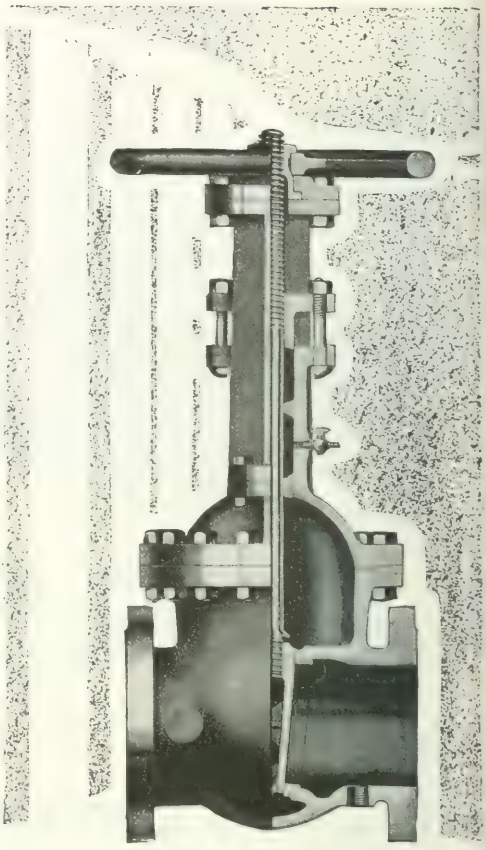
SAN LEANDRO - CALIFORNIA

# Chapman Valves

## Guaranteed Five Years

## Performance and Reputation Count

***This Guaranty applies to the Chapman List 63½ Cast Steel Gate Valves for Superheated Steam.***



"Why should we experiment with other valves when we know that we can always get Chapmans?

"We have passed the experimental stage and have found that a Chapman Valve always delivers. And whenever there is any kind of an improvement in valve design or construction it usually appears first with the CHAPMAN trade mark."

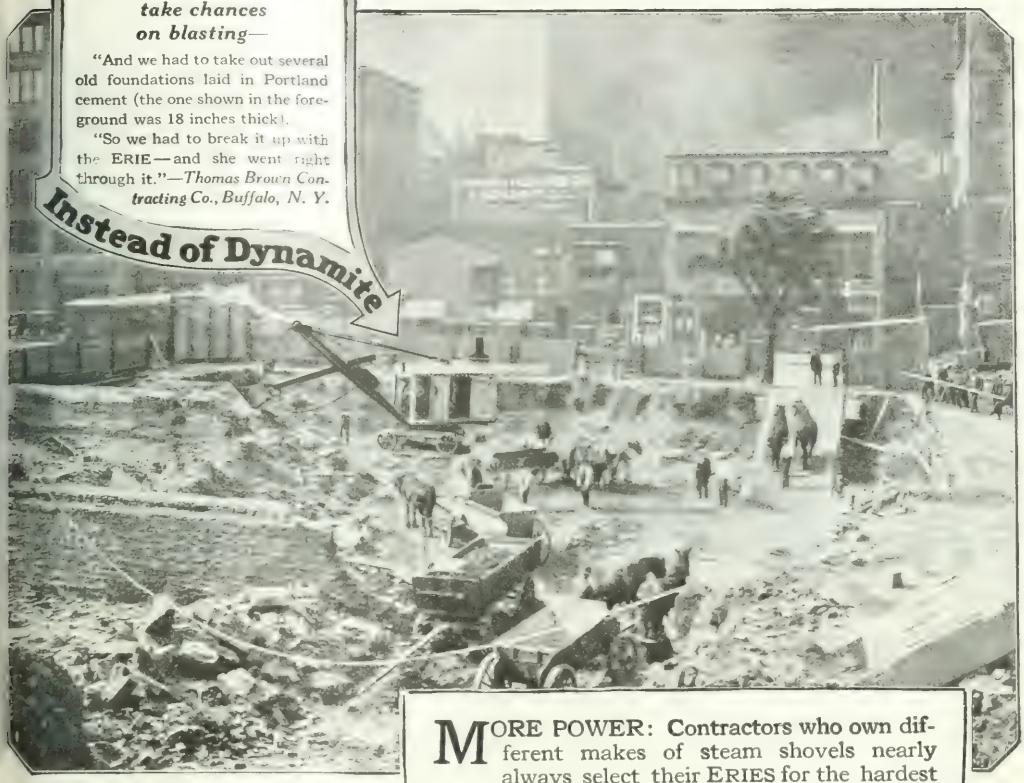
The Engineer who said this is only one of many who make their selection from the Chapman Valve Handbook No. 38.

***Have you your copy?***

BRANCHES

New York Boston [illegible] [illegible] Detroit Cleveland Chicago Los Angeles San Francisco Tulsa

# Chapman Valve Mfg. Co.,
## Indian Orchard, Mass., U. S. A.


Owner would not take chances on blasting—
"And we had to take out several old foundations laid in Portland cement (the one shown in the foreground was 18 inches thick).
"So we had to break it up with the ERIE—and she went right through it."—*Thomas Brown Contracting Co., Buffalo, N. Y.*
Instead of Dynamite

***Excavation for Loew's New State Street Theatre, Washington and Mohawk Streets, Buffalo.***

*You will feel this way, too when you own an Erie!—*

"After using other steam shovels for years, we purchased our first ERIE in 1915. We have found the ERIE Shovel far superior to any other shovel on the market, in every way, shape and form. It works faster and is more durable, which means better results."—*Thomas Brown, President, Thomas Brown Contracting Co., Buffalo, N. Y.*

MORE POWER: Contractors who own different makes of steam shovels nearly always select their ERIES for the hardest digging. This is the general practice—you see it everywhere—and it speaks for itself!

MORE ENDURANCE: Owners report that their ERIES average less than one-third as much upkeep cost as their other shovels. The ERIE is built with extra strength at every point of wear and strain.

GREATER SPEED: Faster swing; faster "crowd"; simple control, with only 3 levers for all digging and dumping operations.

LARGER OUTPUT: It is a common occurrence for ERIE Shovels to deliver 30% to 40% more actual yardage than other shovels on the same digging. Check this up for yourself—get figures direct from the owners.

We will be very glad to send you actual records, in proof of the statements made above. Just write and tell us what class of work you are interested in.

**BALL ENGINE CO., Erie, Pa., U. S. A.**

Builders of ERIE Steam Shovels, Locomotive Cranes, Railway Ditchers

Branch Offices: NEW YORK, BOSTON, PITTSBURGH, CHICAGO

Representatives throughout the U. S. A.

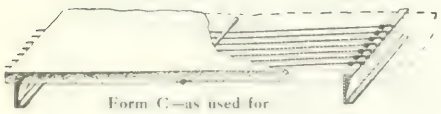
**ERIE Revolving Shovels** BALL Engine Co. Erie, Pa.

POURED IN PLACE

METROPOLITAN SYSTEM FLOORS AND ROOFS — KEYSTONE GYPSUM FIREPROOFING CORP. — NEW YORK CITY

MONOLITH CONSTRUCTION

1—Projectile Shop
2—Machine Shop
3—Substation
4—Forge and Furnace
5—Open Hearth
6—Heat Treatment
7—Boiler House
8—River Pump Station



Form C—as used for roofs of plant shown.

# U. S. Naval Ordnance Plant

South Charleston, W. Va.

# 905,450

square feet of poured gypsum roofing

KEYSTONE GYPSUM FIREPROOFING CORPORATION

1328 BROADWAY, NEW YORK

*Branches:*

Columbus, Ohio
67 East Long St.

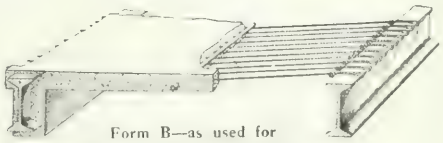
Cleveland, Ohio
112 Stuyvesant Bldg.

Pittsburgh, Pa.
1521 First National Bank Bldg.

# The Largest Poured Gypsum Roof Contract ever let by the Government

*On December 1st this contract was 96.2% finished, according to Government record.*

Battleship Construction
may be stopped
but Metropolitan Roofing
goes on forever



Form B—as used for
floor construction elsewhere.

## KEYSTONE GYPSUM FIREPROOFING CORPORATION

1328 BROADWAY, NEW YORK

*Branches:*

Philadelphia, Pa.
North American Bldg.

Toledo, O.
Summit and Superior Sts.

Cincinnati, Ohio
1207 Metropolitan Library Bldg.

Columbus, Ohio
65 East Long St.

Quebec
203 St. John St.

Washington, D. C.
Real Estate Trust Bldg.

Dayton, Ohio
1038 Reibold Bldg.

Cleveland, Ohio
11? Stuyvesant Bldg.

Toronto, Ont.
250 Richmond St., W.

Montreal
603 New Birks Bldg.

Pittsburgh, Pa.
1?21 First National Bank Bldg.

# *Ask the Man Who Knows!!*

Last week we showed you a photograph of Grand Central Station, New York, and asked you to visit this structure and see for yourself how Gunite protects steel.

Perhaps you do not get to New York and would like to know that the engineers of the City of Chicago, who have had longer experience with Gunite than any other engineers, specified that all the steel underneath the new Michigan Boulevard River Crossing should be covered with Gunite.

***Visit this structure and see for yourself.***

Gunite is hydrated at the nozzle
of the

CEMENT-GUN
TRADE MARK

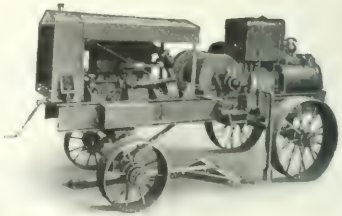
## CEMENT-GUN COMPANY

Incorporated
**Allentown, Pa.**

The "Cement-Gun" is not a restricted article. It may be purchased and operated by anyone.

**Branch Offices:**

New York Office, 30 Church St. Chicago Office, 611 Chamber of Commerce. Pittsburgh Office, 712 Empire Bldg. Los Angeles Office, Citizens National Bank Bldg. Seattle Office, 615 Mutual Bank Bldg. Kansas City Office, 12 Victor Bldg. Denver Office, 1544 Arapahoe St. Salt Lake City Office, 151 E. 1st St. Cleveland Office, 2 Arcade. The Cement-Gun Co. of New York, 50 Church St. Philadelphia Office, 45 Water St., Winnipeg, Man., Can., 38 Toronto St., Toronto, Ont.; Ferguson Block, Montreal, Que. Empire Block, Moncton, N. B.



Use Traylor Portable Compressors. They are compact, sturdy and free from vibration.

# The HAISS Creeper Loader is a good purchase

For you or for anyone else whose work has to do with handling stone, sand, gravel or other loose material—it *cuts costs* 75% over other machines and methods.

**And it is so reliable.** It is built sturdy and strong beyond precedent, and embodies certain exclusive features that immediately win the favor of those who are keen for economy of operation and performance.

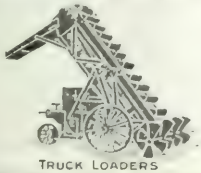
It loads at the rate of a yard and a half a minute at a power cost of 1 cent per yard of material handled. There is no theory about it—it's a good business proposition for any material handler.

**The George Haiss Mfg. Co., Inc.**
**140th St. and Rider Ave., New York**
Established 1892
Representatives throughout the world
*Millars' Timber & Trading Co., London, British representatives*

### A Word With the Haiss Engineer

"The self feeding device of all Haiss Loaders is positive acting. It does not depend for its effectiveness on the cohesion of the material—it does not interfere with the functioning of the buckets, nor does it necessitate backing in and out for 'cleaning up.' It moves the material directly in the path of the buckets and it 'cleans up' clean."

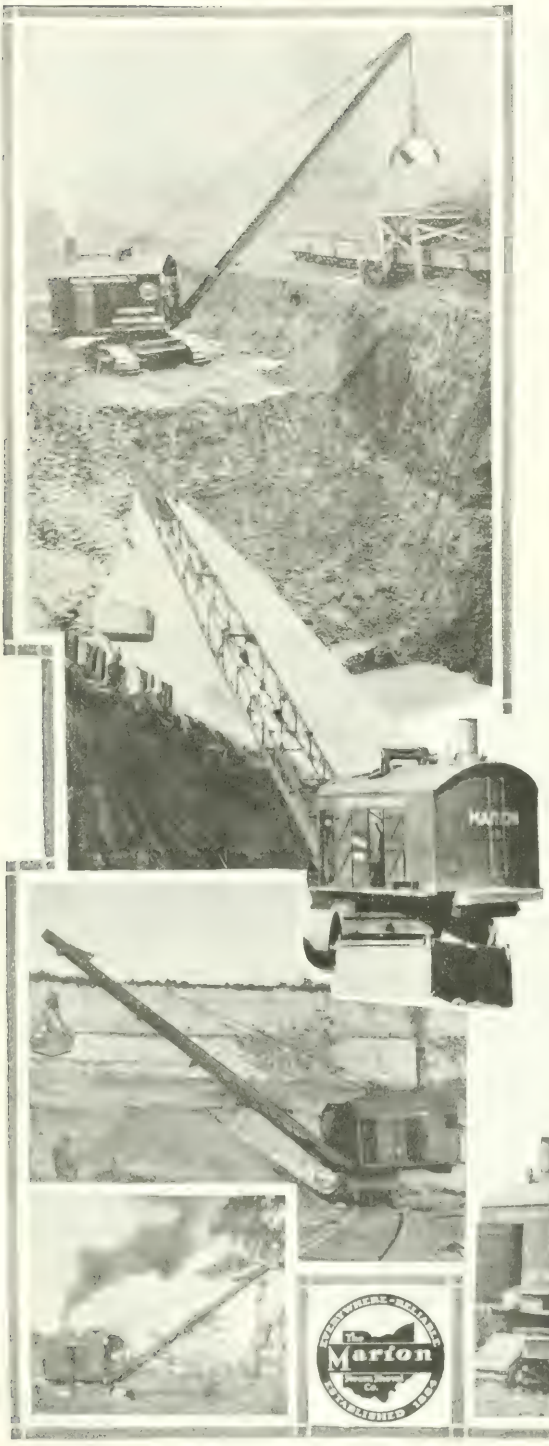
This feature is exclusive in Haiss Loaders. It is but one of their advantages. The Haiss Engineer will tell you of others from time to time. Watch this page.



TRUCK LOADERS

HAISS
MATERIALS-HANDLING EQUIPMENT
CLAM SHELL BUCKETS

PORTABLE BELT CONVEYORS




# This Versatility *of* MARION Revolving Shovels

## is of Inestimable Value to the general contractor

Every revolving Marion Shovel can be converted easily and quickly, into Dragline, Clamshell or Orangepeel Excavator or Crane. They are designed for this conversion because it enables the operator to handle a great range of work with one machine. And in each operation Marions have steam-shovel strength and efficiency.

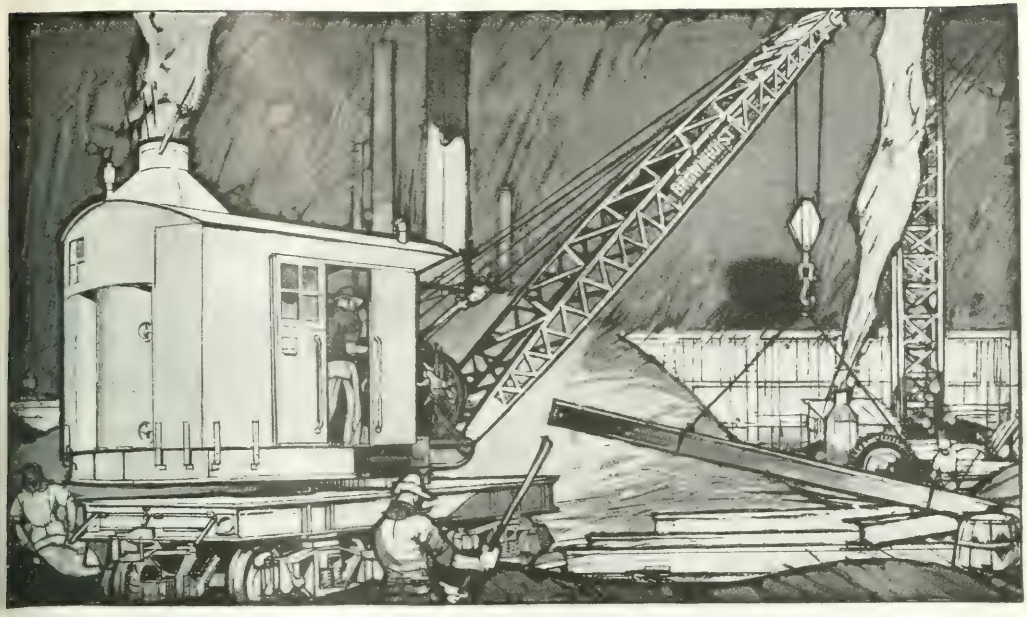
For small drainage and irrigation ditches they give capacity and economy; also wider working range and ability to deposit material at a greater distance from the ditch. For building levees handling sand and gravel from wet pit, making fills. High lift for basement and other wide-range work. Also as a pile driver.

THE NEW AND THOROUGHLY ILLUSTRATED MARION BOOKLET gives the complete story of Marion versatility and individual points of merit in Marion Shovels and other Excavating Machinery. We shall be glad to send you a copy.

## The Marion Steam Shovel Company

**210 Main Street, Marion, Ohio**

**Representatives in principal cities in U. S., Canada, South Africa, England, Siam, Mexico, Russia, Straits Settlement, Sweden and New Zealand.**




# Brownhoist Cranes Help Build New Cadillac Plant

In building the new modern plant where Cadillac Motor Cars are now made, six Brownhoist Cranes aided in speeding up construction immeasurably.

These cranes helped push construction all the time. Working with buckets, they moved gravel, sand and coal. Working with bottom block they sped-up the handling of forms and girders.

On any job where speed and handling costs are factors, Brownhoist Cranes give definite evidence of their ability, speed and sturdy strength.

Whether your handling job be large or small there is a Brownhoist to fit your need. Write for our Crane booklet. It shows many money-saving uses for Brownhoist Cranes.

*Brownnoist Products*

Locomotive Cranes
Concrete Bunkers
Overhead Cranes
Dock Machinery
Bridge Cranes
Buckets

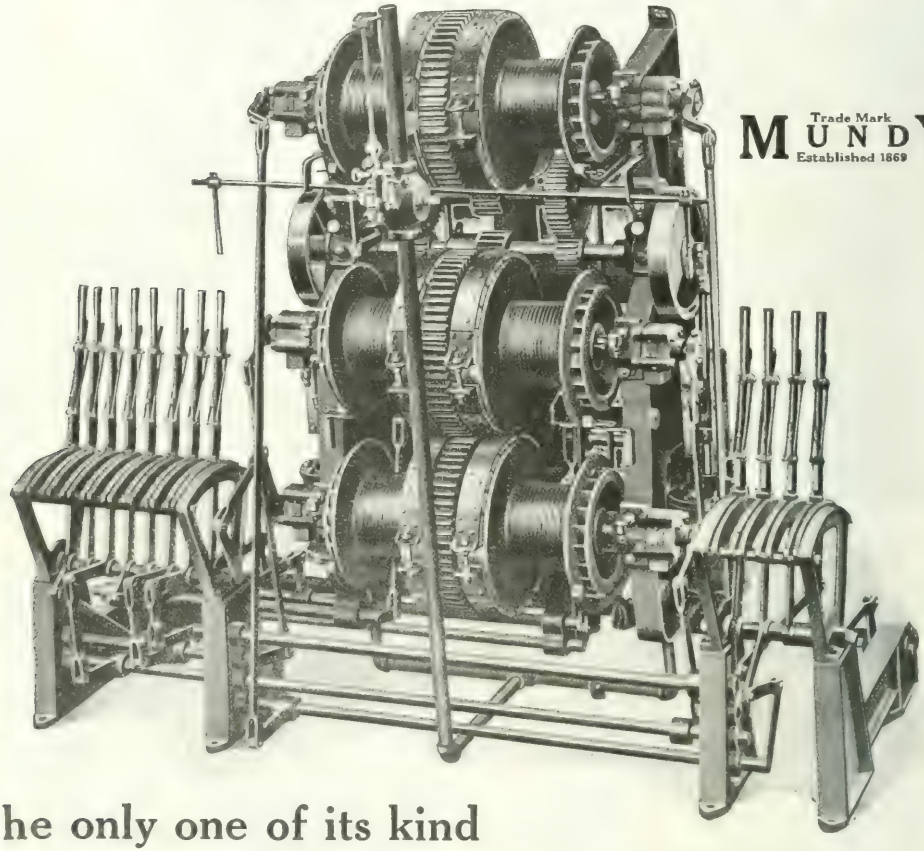
*Literature on Request*

The Brown Hoisting Machinery Co., *Cleveland, Ohio*
Brauches: New York, Chicago, Pittsburgh, San Francisco, New Orleans

BROWNHOIST

MATERIAL HANDLING MACHINERY

ESTABLISHED 1869



Trade Mark
MUNDY
Established 1869

# The only one of its kind

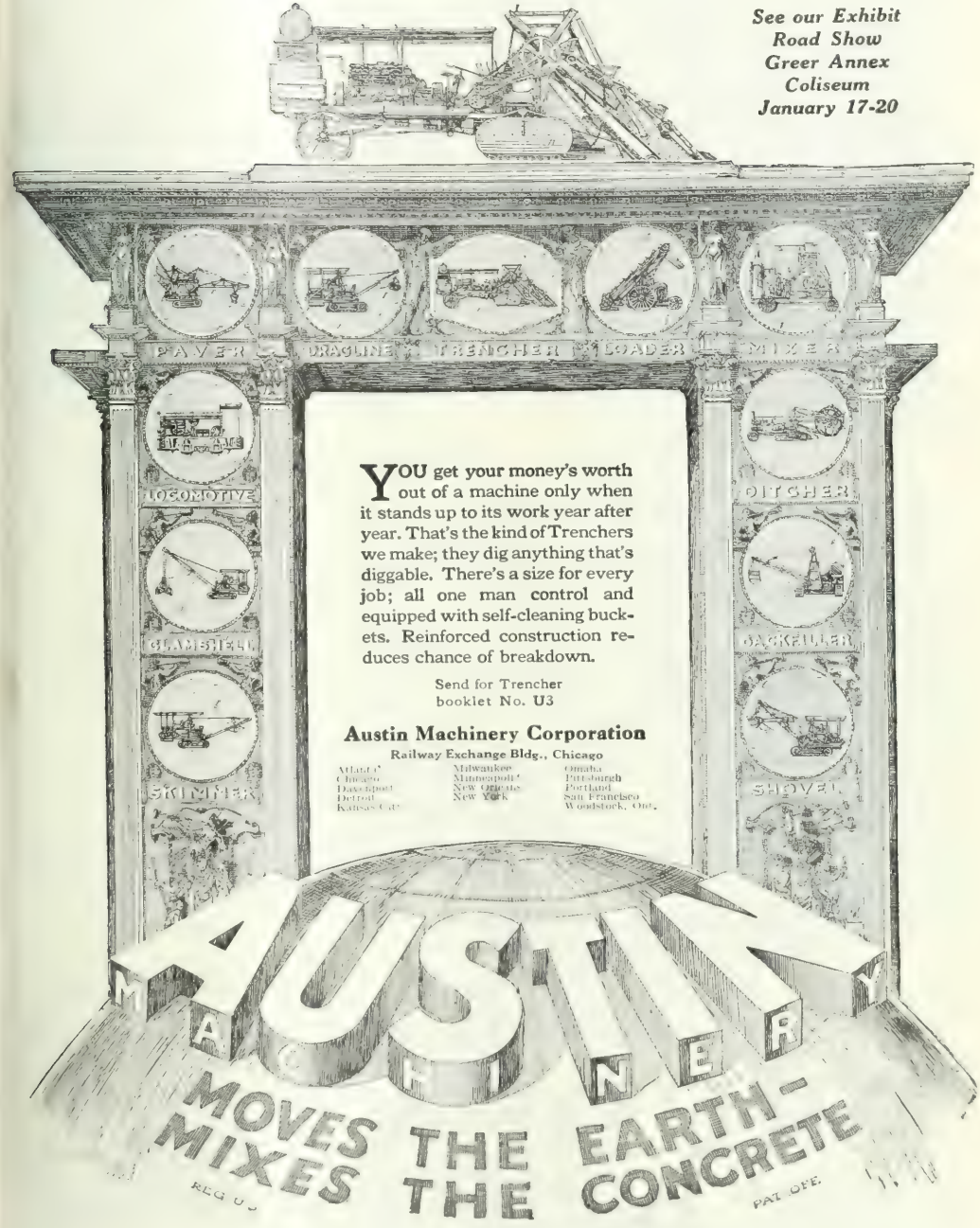
This 7½ in. x 10 engine was built for the Merritt and Chapman Derrick and Wrecking Company, and installed on their wrecking boat "Resolute."

The uppermost drums are slow speed for trimming boom, middle drums are for operating boom, lower drums for light fast cargo hoisting.

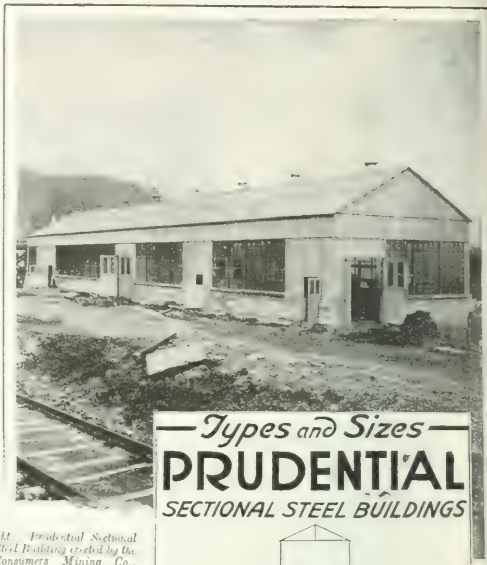
Typical of what our engineers produce when special work is required.

***Send for Catalog No. 16 fully describing this engine.***

ATLANTA, GA.
BIRMINGHAM, ALA.
BOSTON, MASS.
CHICAGO, ILL.
CINCINNATI, OHIO
CLEVELAND, OHIO
DALLAS, TEXAS
DAVENPORT, IOWA
DENVER, COLO.
HUNTINGTON, W. VA.
HOUSTON, TEX.
KANSAS CITY, KAN.
KNOXVILLE, TENN.
LOS ANGELES, CAL.
MOBILE, ALA.
MONTREAL, CANADA
NEW ORLEANS, LA.
NORFOLK, VA.
OTTAWA, CANADA
PHILADELPHIA, PA.
PITTSBURGH, PA.
PORTLAND, ORE.
RICHMOND, VA.
SAN FRANCISCO, CAL.
SALT LAKE CITY, UTAH
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.


See our Exhibit
Road Show
Greer Annex
Coliseum
January 17-20
PAVER
DRAGLINE
TRENCHER
LOADER
MIXER
LOCOMOTIVE
DITCHER
CLAMSHELL
BACKFILLER
SKIMMER
SHOVEL
YOU get your money's worth out of a machine only when it stands up to its work year after year. That's the kind of Trenchers we make; they dig anything that's diggable. There's a size for every job; all one man control and equipped with self-cleaning buckets. Reinforced construction reduces chance of breakdown.
Send for Trencher booklet No. U3
Austin Machinery Corporation
Railway Exchange Bldg., Chicago
Atlanta
Chicago
Davenport
Detroit
Kansas City
Milwaukee
Minneapolis
New Orleans
New York
Omaha
Pittsburgh
Portland
San Francisco
Woodstock, Ont.
AUSTIN
MACHINERY
MOVES THE EARTH—
MIXES THE CONCRETE
REG U.S. PAT. OFF.

*Everything's going up in smoke. How long will it take us to rebuild our plant?*

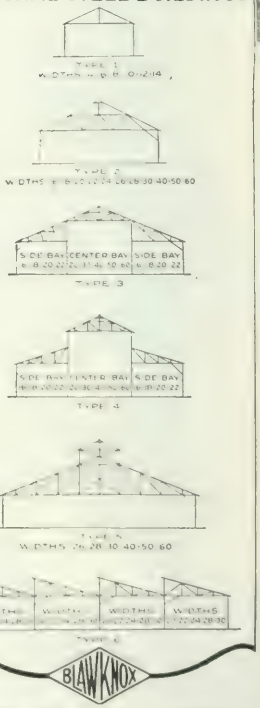


*Right—Prudential Sectional Steel Building erected by the Consumers Mining Co., and used as a blacksmith shop.*

*Types and Sizes*

**PRUDENTIAL**

*SECTIONAL STEEL BUILDINGS*




# Prudential Steel Buildings are Ready for Immediate Delivery

When fire or other disaster results in a building problem—where immediate delivery of fireproof, serviceable and lasting buildings is imperative—WIRE BLAW-KNOX.

As soon as your order is received a chain of motion is established which begins in our stock rooms and ends in your yards. There is no engineering to be done—no drawings to be made and changed—nothing but the selection of standard steel parts of cover, frame and equipment.

All buildings meet your exact specifications and are SHIPPED FROM STOCK.

Among many representative firms who use Prudential Buildings for every conceivable purpose from storage to power houses, are—

Worthington Pump Co.
Penna. Casting & Machine Works
City of Baltimore
C. & O. Railroad
Black Products Co.
Rockland & Rockport Lime Co.
Boston Consolidated Gas Co.

## PRUDENTIAL HIGH LIGHTS

All cover sheets press formed and galvanized.
A size for every need.
Structural steel frame made in our own shops.
Prudential Buildings have 100% salvage value.
Patented leakproof construction.
All parts standard.

## BLAW-KNOX COMPANY

**601 Farmer's Bank Building, PITTSBURGH, PA.**

New York
Chicago
Boston
Detroit
Baltimore
Kansas City
Birmingham
San Francisco

SEE OUR EXHIBIT

of Blaw-Knox Equipment for Road Builders at 13th NATIONAL GOOD ROADS SHOW A.R.B.A. Booths 106, 107, 108, 130, 131, 132. To be held in the Coliseum, Chicago, Ill., January 16th to 20th inclusive. Our representatives there will be at your service.

# PRUDENTIAL

## *Steel* BUILDINGS *Sectional*

# Wisconsin

CONSISTENT

## Furnishes Emergency Power on the longest Single-Leaf Bascule Bridge in the World.

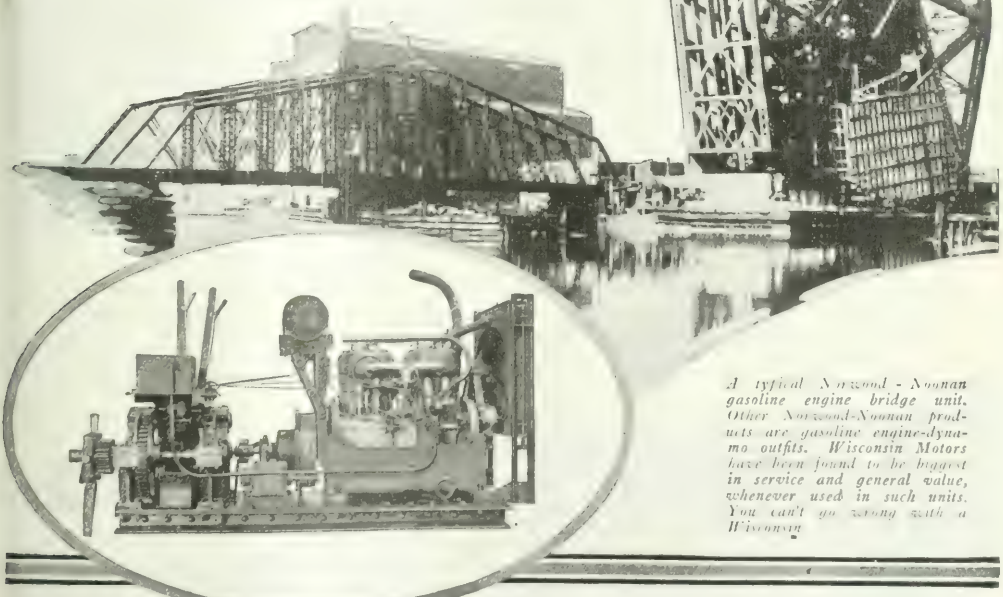
An outstanding example of the unusual range of users to which Wisconsin motors can be successfully applied is found in the St. Charles Air Line bridge across the Chicago River —the longest single leaf bridge yet built, 260 feet between trunnions and end bearings. It is of the Strauss type, superstructure design and plans being made by the Strauss Bascule Bridge Company. Total weight of the steel, 1544 tons.

A 60-hp. Wisconsin motor, used in a Norwood-Noonan gasoline bridge unit, is used for emergency power. Norwood-Noonan standardize Wisconsin motors for their unfailing dependability and reliability in this important service.

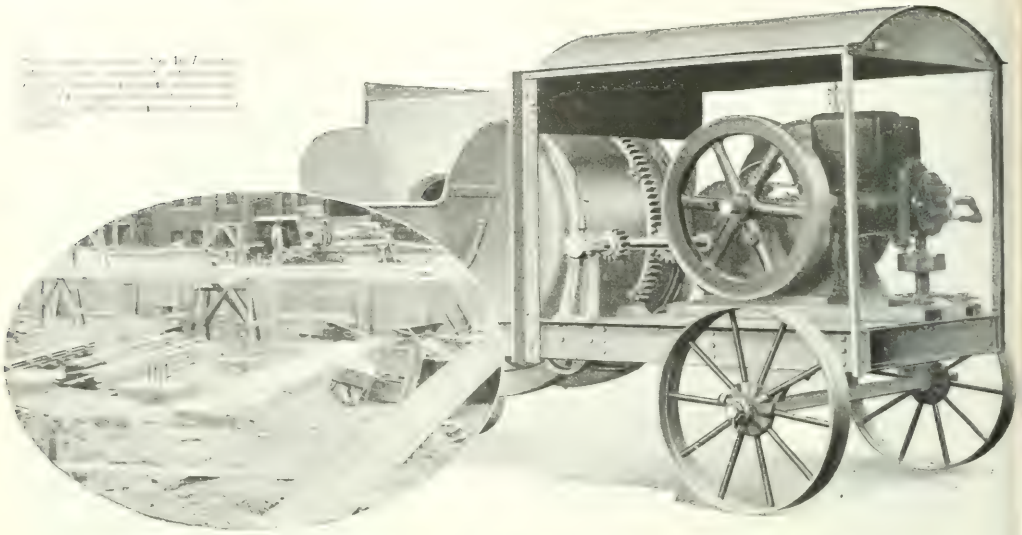
For range of application, for versatility, and for consistency second to none, Wisconsin motors gives results that manufacturers of industrial equipment find exactly suited to their products.

Our industrial bulletin [illegible] the application of Wisconsin [illegible] quirements. Your copy [illegible]

WISCONSIN MOTOR MANUFACTURING CO
Milwaukee, Wisconsin.



*A typical Norwood-Noonan gasoline engine bridge unit. Other Norwood-Noonan products are gasoline engine-dynamo outfits. Wisconsin Motors have been found to be biggest in service and general value, whenever used in such units. You can't go wrong with a Wisconsin*



# STANDARDIZE ON LANSING

Make sure that your wheelbarrows, hoists, concrete carts, material elevators, scrapers—as well as your concrete mixers—bear the Lansing name.

Standardization on Lansing products assures contractors that their equipment is built right and priced right.

Here are Lansing facts regarding construction, price and service:

CONSTRUCTION—The Lansing line of contractors' equipment assures dependable, standardized quality—the best design, materials and workmanship that can be produced by an organization that has specialized in the manufacture of concrete mixers, hoists, carts, elevators, wheelbarrows, etc., for nearly 40 years.

PRICE—The Lansing Company buys thousands of tons of steel annually. Other raw materials are purchased on a big quantity basis. A tremendous saving is effected. Then, too, with our own foundry and machine shop, the entire Lansing line is built in our own plant. You receive the benefit of our low manufacturing cost, which brings our selling price down to a level that cannot be reached by the smaller manufacturer of a product of equal quality.

SERVICE—Besides large repair stocks in our eight branches, Lansing dealers in all sections of the country are required to carry spare parts. As a result, owners of Lansing Mixers and other contractors' equipment are enabled to take advantage of service arrangements which for extent and thoroughness are unequalled. The Lansing Company insures prompt service to all contractors—in New England as well as on the Pacific Coast.

### *Write for Catalog*

Let us send you complete information about the Lansing line of contractors' equipment. Our engineers are particularly well qualified to co-operate with contractors intelligently. Write for our 50 page mixer catalog.

## LANSING-COMPANY

**26 North Cedar St., Lansing, Mich.**

Complete stock of Lansing Contractors' Equipment Carried in the following Branches:

Chicago, Boston, New York, Philadelphia, Minneapolis, San Francisco, Kansas City, Detroit.

Branch Manufacturing Plant: Poughkeepsie, N. Y.

(7)

LANSING COMPANY

CONCRETE MIXERS – CONTRACTORS' EQUIPMENT

ROAD MULTI FOOTE PAVER.
TRADE MARK REGISTERED

# Foote Service

No one knows better than Foote what first-class service means to the contractor. The MultiFoote Paver is built in the east but is used and sold in every part of the country.

Every one of our agents carry a complete stock of replacement parts and can supply you on a moment's notice with whatever equipment you may need in order to keep your outfit moving.

The Foote Company serve the Contractor operating in the far west just as they do the operator in the eastern states.

A telegram to the nearest agent and your order goes out on the first express accompanied if necessary by a Foote mechanic.

If you are operating a MultiFoote Paver, trouble will be the least concern you have — but should trouble develop you may be sure the Foote Agent is back of you one hundred per cent.

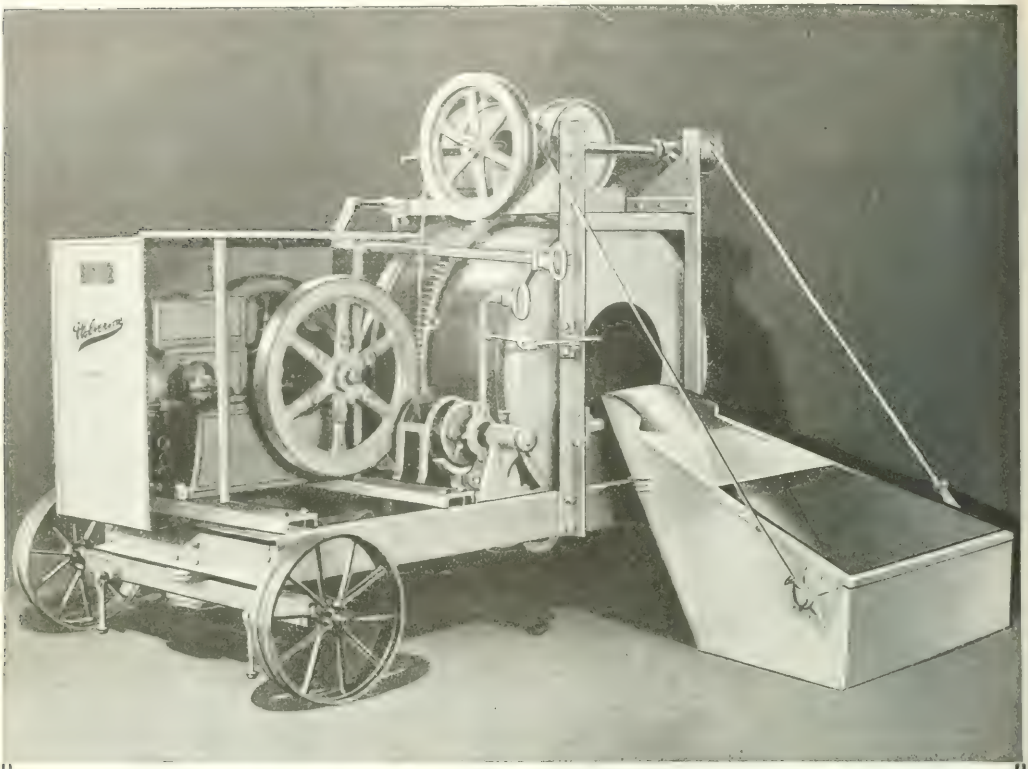
## Operating 16 Hours A Day In California

Rogers Brothers Co., of Los Angeles, used a 21 E MultiFoote gas paver in the construction of the Taft-Bakersfield concrete highway this past spring.

They operated two 8-hour shifts. The MultiFoote, a new machine, was run continuously 16 hours a day for 42 working days or over 67 days elapsed time — a remarkable test for a new piece of machinery. They reported no delays due to breakdown of the paver. No. 1 shift *averaged* 587 *feet per day* — No. 2 shift *averaged* 509 *feet per day* of 13-foot concrete road. Write the nearest Foote Agent for complete information and catalogs.

GENERAL AGENTS

Foote Concrete Machinery Co., 1241 Michigan Ave., Chicago, Ill.
Edward R. Bacon Co., 51 Minna St., San Francisco, Cal. Wilcox Bros., Inc., 30 Church St., New York, N. Y.
E. J. McHarg & Co., 3 Crandall St., Binghamton, N. Y. Burton Franklin, Volunteer Bldg., Chattanooga, Tenn.
Made by Foote Co., Inc., Nunda, N. Y.



DISTRIBUTORS

THE C. H. [illegible] Co., Denver [illegible]

HATCHER, McKENNA & CO., 3665 Market St., St. Louis, Mo.

GEO. W. FIFE EQUIP. CO., Mer[illegible] Bank Bldg., Indianapolis, Ind.

[illegible] Atlanta, Ga.

[illegible] & [illegible] Co., 606 E. Pike St., Clarksburg, W. Va.

SPEERS-JEVNE, Eighth Floor, [illegible] Minneapolis, Minn.

[illegible] Co., 2918 Southwest Blvd., Kansas City, Mo.

[illegible]

*Quick Deliveries and Service*

# A Knickerbocker Product

**$325.00 F.O.B. Factory** for The Wolverine Half-Bag Size Mixer, equipped with 3 hp. engine and magneto, also engine housing and low charging hopper, steel trucks with standard track—may be equipped with batch hopper.

**$595.00 F.O.B. Factory** for The Wolverine One-Bag Size Mixer, equipped with 5 hp. engine and magneto, steel engine housing, low charging hopper and steel trucks with standard track—may be equipped with power loader, automatic pressure water tank or batch hopper.

*Built by*

**The Knickerbocker Company**
**400 Liberty Street, Jackson, Michigan**

*Builders of Knickerbocker Concrete Mixers, sizes 21, 14, 7 and 3 cu. ft. Mortar Mixers and Portable Saw Rigs*

DISTRIBUTORS

THE DAY & MAHOOD CO., W. Second St., South of Dodson, Cleveland, Ohio.

H. KLEINHANS CO., Union Arcade, Pittsburgh, Pa.

LEWTER F. HOBBS, INC., 113 E. Twelfth St., Norfolk, Va.

THOMAS M. SMITH, 317 Powers Theatre Bldg., Grand Rapids, Mich.

THE HUBBARD-FLOYD CO., INC., 111[illegible] [illegible] Building, New York, N. Y.

THE KNICKERBOCKER CO., 709 Arch St., Philadelphia, Pa.

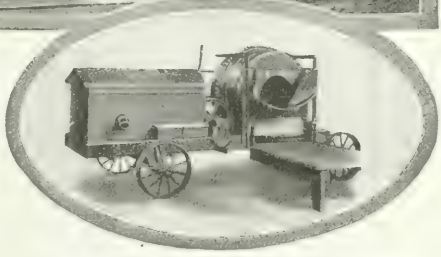
THE HUBBARD-FLOYD CO., Old South Bldg., Boston, Mass.

G. W. SIMMONS CO., 118 N. Front St., Memphis, Tenn.

[illegible] MACHINERY CO., 605 S. [illegible] St., Chicago, Ill.

*Quick Deliveries and Service*

**WE STAND BACK OF IT**



*Two Smith 7-S Mixers Were Used on the Studebaker Housing Project at South Bend*

# GREATER MIXER VALUE—

## IS NOW TO BE HAD IN SMITH 4-S AND 7-S MIXERS BECAUSE OF RECENT PRICE REDUCTIONS—

But in both these sizes we have maintained the well-known SMITH quality of materials and workmanship.

Due to lower manufacturing costs we are now able to sell these high-grade mixers at low-grade mixer prices.

Equip your jobs with SMITH mixers and be prepared to start work in 1922 with mixers that will profitably produce.

Bulletin 405-A tells how they are built and gives full information regarding their capacities, daily yardages, etc.

*Write for your copy of Bulletin* 405-A *today.*

SMITH

# The T. L. Smith Company

**General Sales Offices and Factory:**
**1155-32nd Street, MILWAUKEE, WIS.**

*Eastern Office and Warehouse, 50 Church St., New York.* *Western Warehouse, San Francisco*

**VALUE THAT ENDURES**

# TELSMITH Builds Wisconsin Roads

These two pictures show a Telsmith crushing and screening plant, operated by Sheboygan County, Wis. Sheboygan is one of the most progressive counties in a state noted for its good roads. Mr. John Ubelohde, Sheboygan County Highway Engineer, ranks very highly among Wisconsin's road builders. Under his management, this plant has produced gravel at a remarkably low cost—probably on the most economical basis of any county or municipal plant in Wisconsin.

Telsmith machinery in this plant is as follows:—

One No. 5 Telsmith Primary Breaker, manganese equipped; One No. 2 Telsmith Reduction Crusher, manganese equipped; One No. 6 Telsmith Belt Elevator 50 ft. centers; One Telsmith Heavy Duty Screen, 40 in. dia. by 16 ft. long.

The Sheboygan County outfit is not an exceptional plant; but merely a fair sample of Telsmith's product. Telsmith engineers analyze the customers' requirements; recommend the proper equipment and design the plant. Telsmith mechanics build all the machinery; and Telsmith guarantees a successful plant. Responsibility is centralized. There are no loop-holes—no alibis. Glad to send you our Catalog No. 155 (Telsmith Crushers) and our Bulletin No. G-P-2 (Telsmith General Catalog, describing screens, washers, bucket elevators, belt conveyors, sand tanks, etc.)

Sheboygan county has purchased 21 properties at suitable locations which are expected to supply sufficient gravel and stone for the next twenty years. In addition to that the county road and bridge committee has taken options on adjoining property which will furnish material for many years longer.

The gravel pit and crusher plant located east of Greenbush is regarded as a model of its kind. The plant is electrically operated and only three men are required in this connection. One of them operates the machinery and oversees the work, one is employed as belt tender, his duty being to keep the feed belt supplied with gravel and rock from the pit as it is hauled up to him by a huge electrically manipulated drag or shovel, and one who acts as a general utility man and machine wright.

This plant has a capacity of 500 cubic yards daily, but so far has not been operating to that extent because that has not been necessary to supply the demand. Rock and gravel bins hold 100 cubic yards and these are kept filled at all times. The plant cost $20,000 and this year its output has graveled 18 miles of road.—*Oct. issue, Good Roads for Wis.*

## SMITH ENGINEERING WORKS

**3198 Locust St., Milwaukee, Wis.**

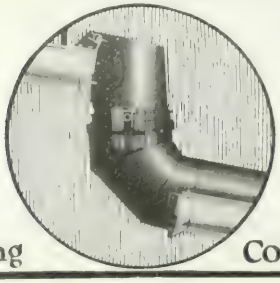
***Canadian Agents:*** **Canadian Ingersoll-Rand Co., Montreal, P. Q.**

# They're Speeding This Job With Lakewood Plant

The construction of the North Junior High School at Grand Rapids, Mich., is being pushed with all possible speed.

John C. McNabb & Sons chose a Lakewood Steel Tower and Lakewood Chutes to help them do the job. The Lakewood equipment includes a 150-ft. steel tower and counterweight plant.

Lakewood plant lends itself to economical operation and speedy construction. Have you the Lakewood bulletins?



**The Lakewood Engineering Company, Cleveland U.S.A.**

# What Hydraulic Steel Buildings Offer Your Industry

Aside from the feature of low cost, long life, and resistance to fire, Hydraulic Steel Buildings have another feature of real importance in the [illegible] industry: *They can be quickly taken down, moved and re-erected or sold.*

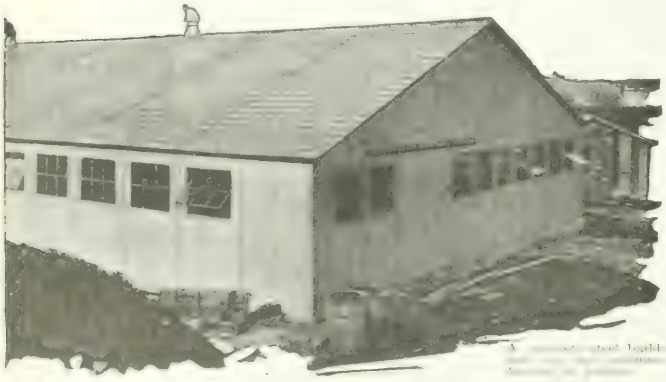
Whether you need a good, substantial building for your client or a quickly erected, sturdy building for yourself to house tools, supplies and equipment, you'll realize distinct savings by sending to Hydraulic.

Phone, wire or write our nearest district office for details.

THE HYDRAULIC STEELCRAFT COMPANY
of THE HYDRAULIC STEEL COMPANY
CLEVELAND, OHIO

*Branch Sales Offices:*

| | | | |
|---|---|---|---|
| New York | [illegible]go | Pittsburgh | Charleston, S. C. |
| St. Louis | Detroit | New Orleans | [illegible], W. Va. |
| Cincinnati | Minneapolis | Indianapolis | [illegible], Mich. |
| Norfolk, Va. | Atlanta | Roanoke, Va. | Richmond, Va. |
| Augusta, Ga. | [illegible] | Wichita, Kan | Kansas City, Mo |
| Omaha, Neb | Boston | [illegible] Ky. | Columbus, Ohio |



## *Salient Features of Hydraulic Steel Buildings*

Quick Erection
Strength—All Steel
Permanency—
(rust-resisting "HY-COP" sheets)
Portability
Fireproof
Low Cost
Immediate Shipment
High Salvage Value

# HYDRAULIC STEEL BUILDINGS

Standardized

# Insley Equipment for Concrete Distribution

THE proof of promised performance lies in actual accomplishment and when Insley Equipment is recommended to perform a certain task there is assurance that the recommendations made are capable of fulfillment.

Engineering Ability and a Wide Experience serve as the basis for the developments which are responsible for the most efficient concrete placing equipment which it is possible to place in a contractor's hands.

At the time of figuring your next contract let us tell you what the INSLEY STEEL TOWER, QUICK SHIFT, COUNTERWEIGHT CHUTE PLANT will do for you on that particular job.

The illustration shows a 140 ft. Steel Tower, Quick Shift, Counterweight Chute Floating Plant installation as used by H. P. Converse & Co. in the construction of a bridge across the Connecticut River at Springfield, Mass.

The plant has a free radius of distribution of 150 ft. through an arc of 85 degrees and is so designed as to be adaptable for ordinary building work at the conclusion of this special job.

INSLEY MANUFACTURING CO.

*Engineers and Manufacturers*

INDIANAPOLIS

INSLEY

CONCRETE PLACING EQUIPMENT
INDUSTRIAL CARS — DUMP BUCKETS
STEEL DERRICKS

238

VULCAN

# The Business Side of Locomotive Building

VULCAN Locomotives are not built or sold on the basis of price competition. They are built on a *performance* basis.

Only sound materials are used and we guard jealously the quality of workmanship which enters into the construction of VULCAN Locomotives.

It is not alone that we have been building locomotives for more than 45 years and wish to maintain the prestige we have earned, but also because we realize that economical transportation for you means an engine of correct design, plus a minimum of repair bills and maintenance charges.

These are the things you buy in a VULCAN Locomotive.

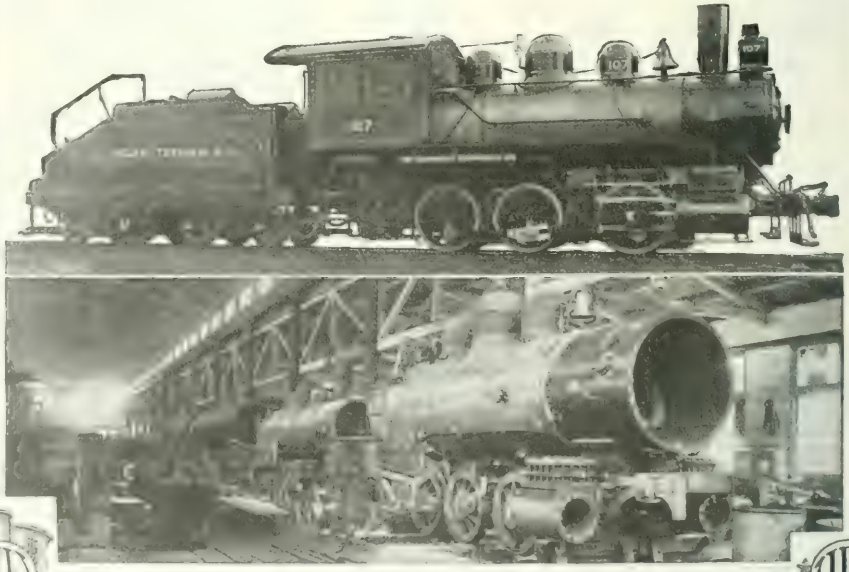
Your problems are our problems.

*Correspondence Solicited*

**VULCAN IRON WORKS**

"Established 1849"

**1737 Main Street, Wilkes-Barre, Pa.**



VULCAN

# "Little David" Pneumatic Tools

**Chipping Hammers**
For chipping, calking, beading, sealing, etc. Made in six sizes.

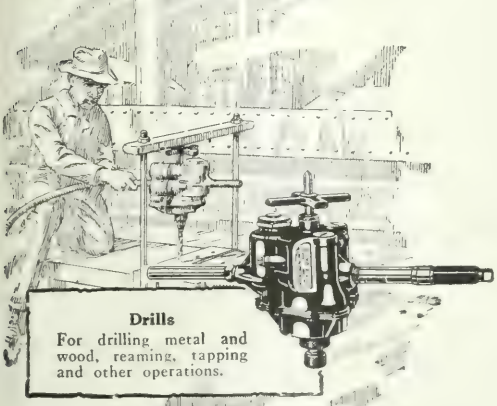
USE them for your repair, construction and assembly work—wherever you need portable, efficient power tools.

"Little David" Tools are distinguished by their simplicity, great ruggedness and ability to reduce costs.

Their simplicity means few working parts and few replacements. The tools are easy to handle, require little attention and stand up under long, hard use.

The complete line of air tools includes Riveting and Chipping Hammers, Reversible and Non-Reversible Air Drills and Reamers, Close Quarter Drills, Portable Grinders, Saws, Holders-on, Air Motor Hoists and Stationary Motors, Woodborers and Wire Brush Cleaners.

*Ask for Catalog 8000 describing this complete line of modern pneumatic tools*

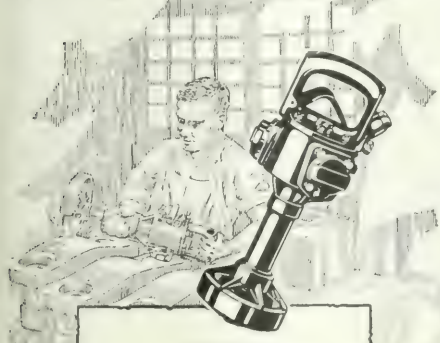


**Drills**
For drilling metal and wood, reaming, tapping and other operations.

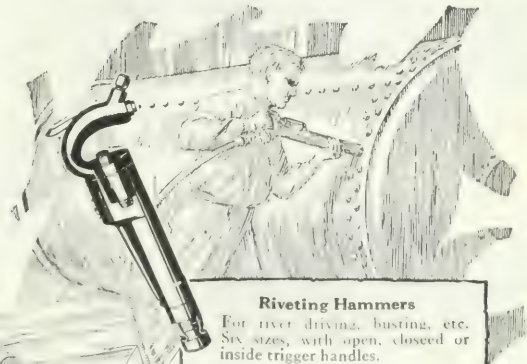
## Ingersoll-Rand Company
**General Offices: Broadway, New York**

*Offices Everywhere*

23-PT



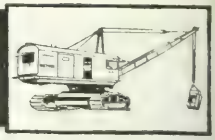
**Grinders**
Light weight, high speed machines for grinding, polishing and cleaning.



**Riveting Hammers**
For rivet driving, busting, etc. Six sizes, with open, closed or inside trigger handles.

# Ingersoll-Rand

BUCYRUS



Bucyrus electric dragline digging a 25 foot cut on a U. S. Reclamation Project. Note the neatness of the slopes.

# What will a dragline do?

The great operating range and unusual flexibility of Bucyrus Draglines adapt them to many types of work. Although the commonest use for dragline excavators is on canal and irrigation ditch excavation, there are many other kinds of work on which a dragline may be used to advantage.

Bucyrus draglines will construct levees as compact and watertight as those built by any other method. Railroad fills can also be built without rehandling, by borrowing the necessary material and dumping direct on the fill. Sand, gravel and clay pits are being successfully stripped and worked by draglines working from the surface of the ground and independent of flooded pit troubles. On canal or ditch excavation the wide reach means fewer moves of the machine, and makes it easy to overcast material far enough from the excavation to eliminate all danger of caving.

These photographs show some of the many kinds of work on which Bucyrus Draglines are operating efficiently. Under the wear and tear of the hardest digging, Bucyrus draglines will stay on the job and move the dirt. Let us figure on your requirements for your next job.

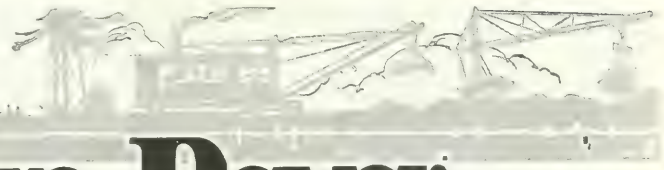
*Send for Bulletin GN*

**BUCYRUS COMPANY**

**South Milwaukee, Wis.**

New York
Los Angeles
Portland, Ore.
Minneapolis
Denver
Chicago
Salt Lake City
San Francisco
London, England

393



# Reserve Power

The Clyde Hoist was built originally for logging operations wnere the unexpected overload is the rule and not the exception.

Reserve power, which at all times gives to the operator a sense of security and satisfaction, becomes a vital necessity in handling logs from stump to mill.

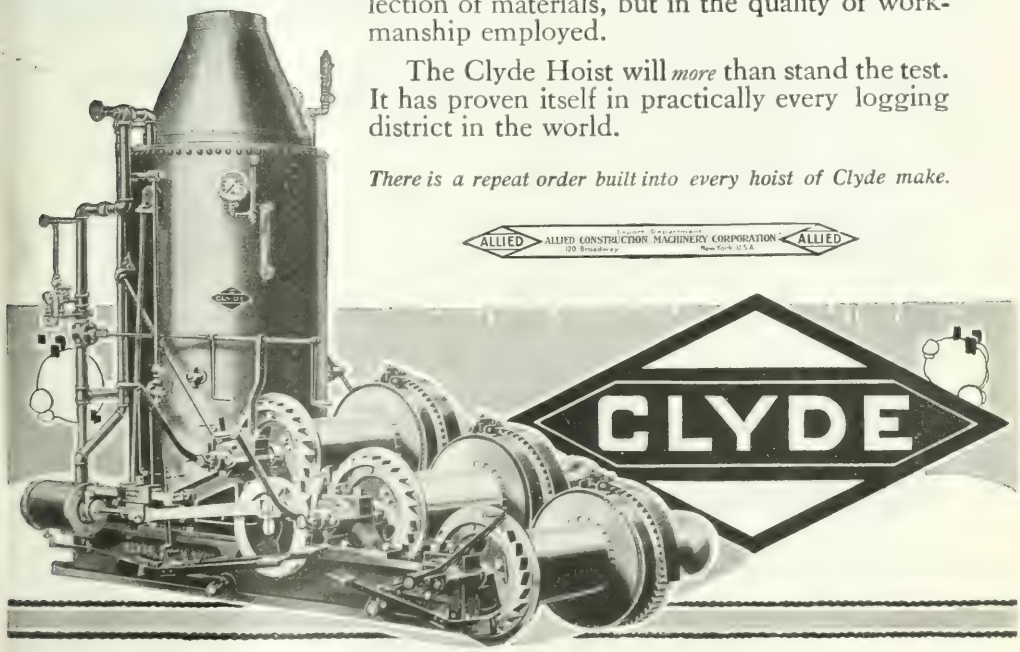
And it is not enough to meet these frequent emergencies.

The location of such operations is usually miles from the source of supply of replacement parts in case of accident. The engine that gives uninterrupted service under adverse conditions must necessarily be built with the utmost care, not only in the selection of materials, but in the quality of workmanship employed.

The Clyde Hoist will *more* than stand the test. It has proven itself in practically every logging district in the world.

*There is a repeat order built into every hoist of Clyde make.*

ALLIED — ALLIED CONSTRUCTION MACHINERY CORPORATION — ALLIED



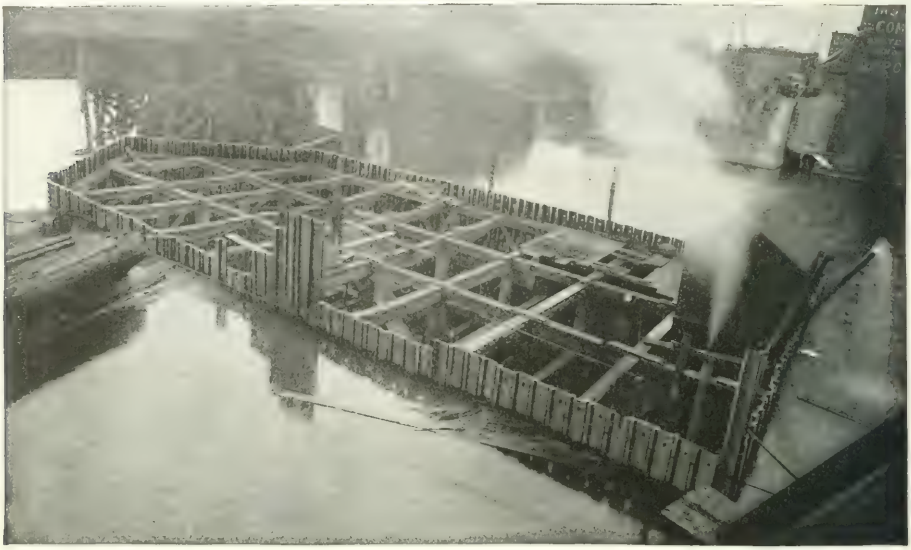

## CLYDE IRON WORKS SALES COMPANY

DULUTH, MINN., U. S. A.

**Sole Distributors for Clyde Iron Works**

*Branch Offices and Warehouses*

| NEW YORK | NEW ORLEANS | SEATTLE | CHICAGO | JACKSONVILLE | PORTLAND |
|---|---|---|---|---|---|
| 141-149 Centre St. | 309 Magazine St. | 542 First Ave. So. | 11 So. LaSalle St. | 502 Hill Bldg. | 18th and Upshur Sts. |



# Lackawanna Steel Sheet Piling

## again proves its value to the contractor

THE foundations of the Webster Street Bridge at Tonawanda, N. Y., which spans the New York State Barge Canal at this point, were constructed in cofferdams of Lackawanna 14" x 3/8" Arched-Web Steel Sheet Piling by Lathrop, Shea & Henwood Company, Contractors. The above picture shows the cofferdam for the center pier, just previous to placing the concrete, while in the background one of the completed dish abutments is seen.

The method of installing the bracing system for the pier was especially interesting. The two top tiers were constructed in crib form on skids, as shown in lower picture, then launched and floated to position. The Steel Sheet Piling was then assembled vertically around this timber cage and driven.

Although the steel sheet piles had been used in other installations they performed their work well as the appearance of the job indicates.

**Lackawanna engineers have data on a great many interesting foundation problems. Their advice is free and is cheerfully given.**

## Lackawanna Steel Company

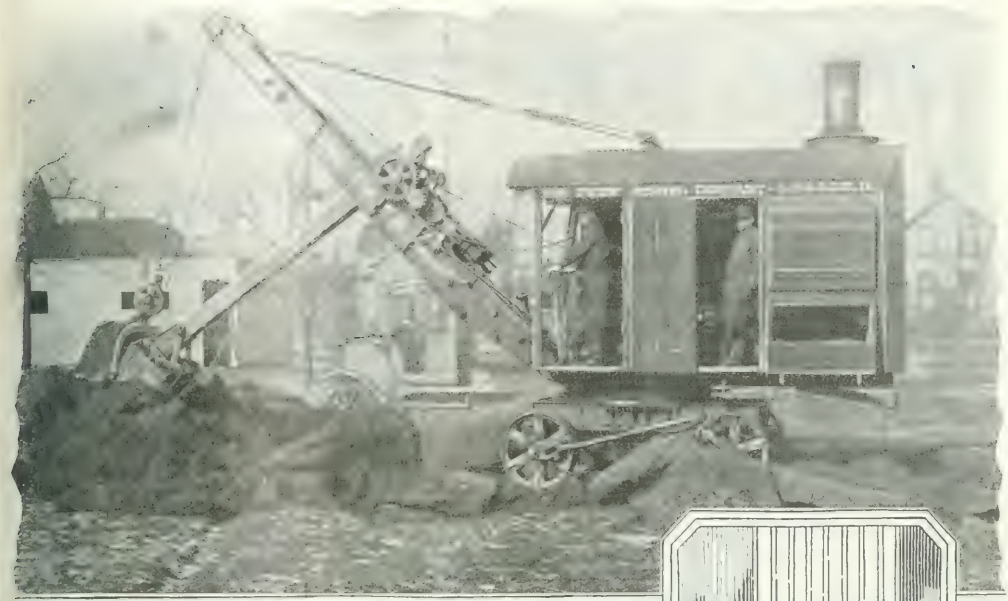
General Sales Offices and Works: Lackawanna, N. Y.

BUFFALO BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT
NEW YORK PHILADELPHIA ST. LOUIS SAN FRANCISCO

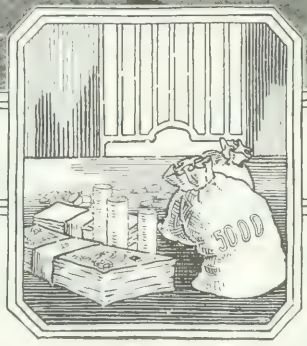
Licensees for the manufacture of Lackawanna Steel Sheet Piling:

For Great Britain and British Colonies in the Eastern Hemisphere, Cargo Fleet Iron Co., Ltd., Middlesbrough, England. For France, Italy, Spain, French Colonies and Protectorates, Italian Colonies and Spanish Colonies in the Eastern Hemisphere, Cie des Forges & Aciéries de la Marine et d'Homecourt, Paris, France.

Sole Exporter for Other Countries: CONSOLIDATED STEEL CORPORATION, 25 Broadway, New York



# Profits




HERE'S a type O Thew steadily plugging along through frozen earth.

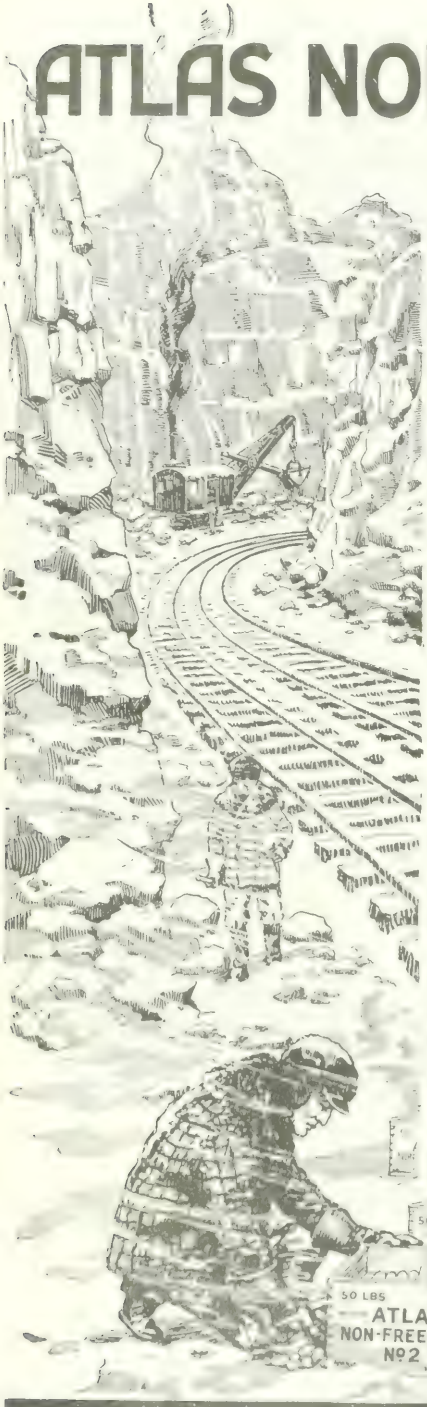
Which goes to show that the Thew keeps right on working, making profits for its owner, in any season. Extra jobs like this keep down the overhead in off months, but it takes a real shovel to stand the pace.

One more reason why you should own a Thew. Write for information.

THE THEW SHOVEL COMPANY
LORAIN, OHIO

# Thew
## Power Shovels

# ATLAS NON-FREEZING




## *will not freeze—eliminates thawing and headaches*

In the most exhaustive tests in both laboratory and field, this new explosive—Atlas Non-Freezing—has withstood the lowest temperatures known to man. It has been used for all explosive requirements and its efficiency has been fully proved in quarries, pits and mines; in rock, earth and ore—all at temperatures varying from that of torrid to the coldest found in the land of perpetual snows.

Atlas Non-Freezing has the same stability and uniformity that characterize other Atlas high explosives. It will not explode prematurely. No objectionable fumes are given off on detonation. Its use eliminates the headaches that attend the handling of ordinary explosives.

Atlas Non-Freezing is made in five grades, thus covering all blasting requirements.

Tell us what explosive you are using now and we will tell you what grade of Atlas Non-Freezing will do the work and save you the inconvenience which attends the use of explosives that are not immune from the effects of cold.

ATLAS POWDER COMPANY
Wilmington, Delaware

Branch Offices: [illegible] Boston; [illegible] Pittsburgh, Pa.; Pottsville, Pa.; St. Louis; Wilkes-Barre.

**NO thawing — NO headaches — NO objectionable fumes**

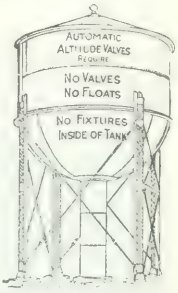
# "We have cut out water waste and we have cut out floats and fixtures!"

with

## GOLDEN-ANDERSON

**Patent Automatic Cushioned Controlling Altitude Valves**

"THERE is no reason for allowing the preventable waste of water going on down the overflows of your reservoirs, standpipes and tanks at a time when the greatest conservation of the nation's resources are imperative.



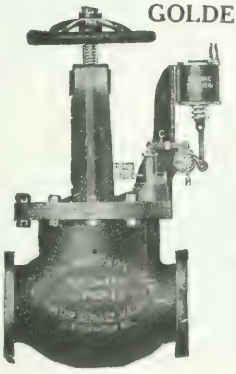

"I am ready to take up your case in detail and to point out how easily you can overcome this trouble by equipping the supply lines with these valves."

1—They keep the water level constant in reservoirs, standpipes, tanks, etc., under all conditions.
2—Very simple in design. Contain no floats or fixtures inside or outside of tanks.
3—A perfect cushion by water and air absolutely prevents water hammer surges and broken mains. No metal-to-metal seats.
4—Can be closed in three ways by hand, automatically by water if a pipe breaks and by electricity from distant points.
5—When desired can be connected to work "both ways" on a single pipe line.

Made with Stop-Starter Attachment for Centrifugal Pumps"

**Hosts of References**

**Made with Stop-Starter Attachment for Centrifugal Pumps**



## GOLDEN-ANDERSON Pat. Cushioned-Water Service Valve "For Fire Service"

1—Can be opened and closed in sturdy from distant points by electricity.
2—Current is on only a few seconds, thereby preventing waste.
3—Can be fitted with either d.c., or a.c. solenoid.
4—Perfectly cushioned by water and air. Positively no metal-to-metal seating.
5—Can be closed by hand.

Sizes to 30 in.

## GOLDEN-ANDERSON

**Automatic Double Cushioned Check Valve**

Automatically prevents disastrous reverse flow of pressure.

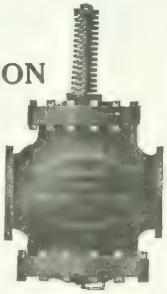
Especially adapted for use in discharge line of pump.

No water hammer or shock on reverse flow of pressure cushioned in opening and closing.

**Angle and Globe Patterns**
Sizes 3 in. to 30 in.

## GOLDEN-ANDERSON

**Pat. Automatic-Cushioned Water Pressure Reducing Valves**



1—Maintains a constant terminal water pressure under all conditions.
2—Positively cushioned by water and air at opening and closing.
3—Valve closes slowly, eliminating all shock and water hammer.
4—Can be furnished with electric regulator to open valve to full area from distant points. Sizes to 30 in.

**Golden-Anderson Pat. Automatic Float Valves**

(Angle or Straight Way) up to 20 in.

# Golden-Anderson Valve Specialty Company

**1202 Fulton Building, Pittsburgh, Pa.**

# COFFIN VALVE COMPANY

*Makers of the Largest Sluice and Gate Valves in America*

Out of 14 contracts for Valves for the Catskill Aqueduct we have been awarded six. This means more than $500,000 worth of equipment for the water supply of New York City

Check Valves
Flap Valves
Foot Valves
Sewer Gates

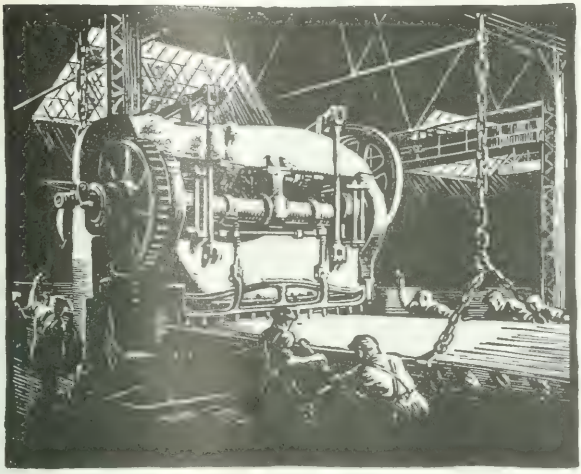
Office and Works: Neponset, Suburb of

**BOSTON, MASS.,**

Sluice Gates
Gate Valves
Butterfly Valves
Fire Hydrants

REPRESENTATIVES:

New York, Chas. C. W. Fairfax & Co., 170 Broadway. Philadelphia, Pa., DeHuff & Hopkins, Morris Building.
Cleveland, Ohio, Tomlinson Stevens Co., 1370 St. Clair Ave. San Francisco, Cal., Theo. E. Dresige, Monadnock Building.
Chicago, Ill., Wallace A. Ford, 1225 College Grove Ave.
London, Eng., Arthur S. Leitch Co., Ltd., 1001 Kent Building.



# Equipped to Serve

THE Plate shear shown in the illustration will cut plates up to 60 inches wide by $1\frac{1}{2}$ inches thick at one stroke. Ryerson saws cut the largest beams in seconds.

These machines are typical of the modern equipment in use in every department; in fact, nothing is overlooked that will make for quick service.

If you want steel in a hurry, depend upon Ryerson Steel-Service.

*Write for Ryerson Stock List the key to immediate steel*

ESTABLISHED 1842 INCORPORATED 1900

JOSEPH T. RYERSON & SON

CHICAGO ST. LOUIS DETROIT BUFFALO NEW YORK

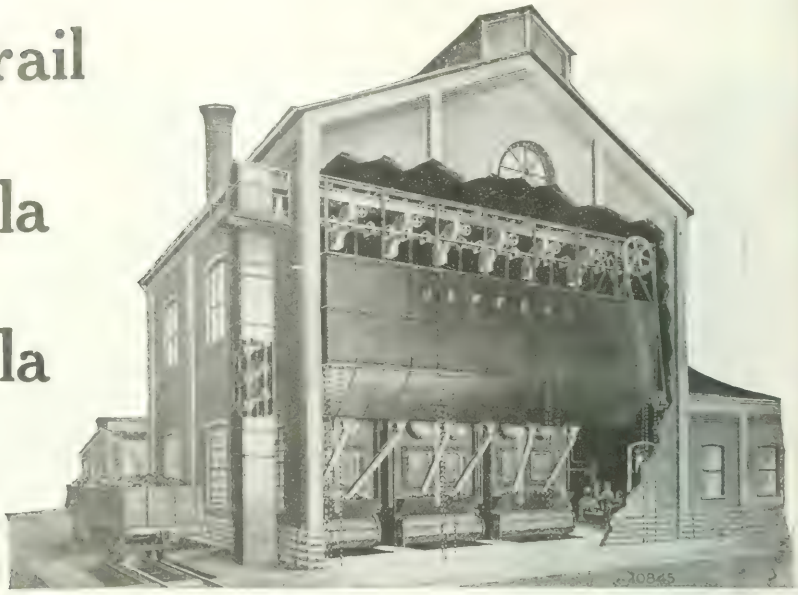
PLANTS AT LOS ANGELES DENVER HOUSTON JERSEY CITY

MT. VERNON MINNEAPOLIS NEWARK SAN FRANCISCO

RYERSON STEEL-SERVICE

39 E

# The Trail from Gondola to Gondola



At this plant coal is handled by Jeffrey Track Hopper, Single Roll Crusher and V-Bucket Elevator Conveyer to Bunkers. Ashes are handled to Skip Hoist.

## In Large or Small Power Plants

# JEFFREY EQUIPMENT

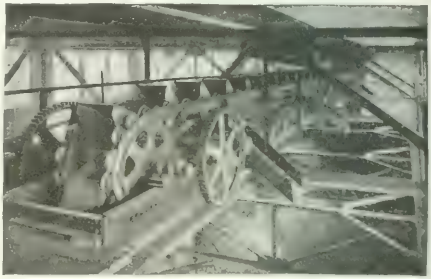
will automatically and economically handle coal and ashes.

It is so standardized and built in various types and sizes that every plant can be accommodated. The coal passes from hopper to crusher, to conveyer and bunkers, and ashes pass from pit to conveyer or skip hoist to bin or railroad car.

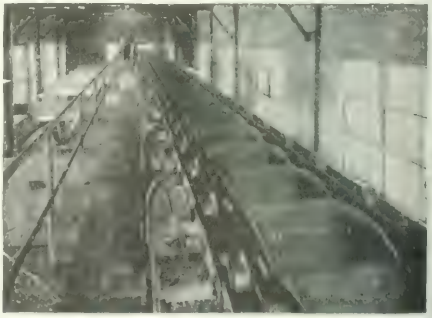
Tell our Engineering Dept. about your local conditions, and they will gladly suggest efficient equipment and assist you in the solution of your coal and ashes handling problems.

Jeffrey Coal and Ashes Handling Equipment includes Track Hoppers; Crushers; Elevators; Conveyers; Weigh Hoppers; Skip Hoists; Portable Bucket Loaders; Portable Car Unloaders for handling coal from hopper bottom cars, etc.

The Jeffrey Mfg. Co., Columbus, Ohio



V-Bucket Conveyer especially adapted for handling slack and stoker sized coal.



Pivoted Bucket Carrier for handling both coal and ashes in in large sized power plants.

# *Two miles of seamless copper tube a hundred feet underground!*

The job illustrated—that of lining two miles of the Catskill Aqueduct with copper—shows in a compelling manner the extreme portability of

## Prest-O-Lite

DISSOLVED ACETYLENE

Without gas—ideal for both welding and cutting – in such conveniently transportable containers — the oxy-acetylene process would lose much of its usefulness.

Whether the work be at the top of a sky-scraper or deep under the surface, indoors or out — Prest-O-Lite goes to the job!

A nation-wide service built around forty plants and warehouses insures a constant and prompt supply of Prest-O-Lite.

THE PREST-O-LITE COMPANY, Inc.

General Offices: Carbide and Carbon Building, 30 East 42nd Street, New York

Balfour Building San Francisco

*In Canada: Prest-O-Lite Co. of Canada, Limited, Toronto*

PW-304-21

# We are ready
# 1922
# New Models—New Prices
## Effective January 3d

### Standard 1½–2 ton Autocar

**Overall capacity, 11,000 lbs. (Chassis, body and load)**

Type F, 97-in. wheelbase, 2 cylinder motor . . . . $1950
Type G, 120-in. wheelbase, 2 cylinder motor . . . $2050

**Unladen Chassis weight: Type F, 3600 lbs.; Type G, 3700 lbs.**

### New 2 ton Heavy Duty Autocar

**Overall capacity, 14,000 lbs. (Chassis, body and load)**

Type H, 114-in. wheelbase, 4 cylinder motor . . . $2950
Type K, 138-in. wheelbase, 4 cylinder motor . . . $3075

**Unladen Chassis weight: Type H, 5200 lbs.; Type K, 5350 lbs.**

### New 5 ton Heavy Duty Autocar

**Overall capacity, 22,000 lbs. (Chassis, body and load)**

Type Y, 120-in. wheelbase, 4 cylinder motor . . . $3950
Type B, 156-in. wheelbase, 4 cylinder motor . . . $4100

**Unladen Chassis weight: Type Y, 7200 lbs.; Type B, 7400 lbs.**

THE AUTOCAR COMPANY, Ardmore, Pa., Established 1897

# Autocar

Wherever there's a road

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
*Editor*

Volume 87 — NEW YORK, DECEMBER 29, 1921 — Number 26

## What Is a Million Dollars?

IT IS EASY to read figures, even when a dollar sign is placed in front of them, without knowing quite what they mean. Take the case of bonds: this or that municipality sells without difficulty—say, as in the case of New York recently, $55,000,000 worth. What *is* $55,000,000? Perhaps your salary is $5,000 a year. Then, New York has gone in debt to the further amount of 11,000 years of your salary. But what is a mere 11,000 years! Public bond sales in 1921 exceeded one billion dollars—200,000 years of your financial life at $5,000. On the other hand, 20,000 men on this salary could pay off these bonds in ten years, if the cost of living were zero. The point is, millions of public dollars are worth watching when they are considered in terms of labor.

## A Census in 1925

HEARTY support should be given to Secretary Hoover's advocacy of a national census in 1925. While perhaps the plan will receive most widespread approval by those who are dissatisfied with the 1920 count because its results were based on a temporary and abnormal distribution of population, there are other strong arguments for a census not only in 1925 but also midway between each decennial census. A country with more than a hundred million people, with hundreds of rapidly growing cities and thousands of industrial and political interests depending largely upon reasonably exact knowledge of population change should no longer rest content with a decennial census. Population estimates carried through a period of ten years are necessarily uncertain and likely to mislead where vital interests are concerned. For the present, at least, the census in the years ending in five might well be restricted to population, and that schedule be simplified and limited to a mere count of persons, ages, sex and perhaps nationalities. With our permanent Census Bureau this should be an easy and short task and the results could be announced in detail much sooner than is done under the more elaborate decennial plan. The resulting benefits would be many and large, especially to engineers.

## The Pittsburg Road Tests

INTEREST in the tests to destruction of the reinforced-concrete road, in the form of an elliptical track, construction of which was completed recently at Pittsburg, Cal., has centered, up to the present, upon the methods employed in building the roadway and the unusually elaborate equipment installed to determine the effects of motor truck traffic, temperature and moisture. A new phase of this research work has been reached with the publication, in this week's issue, of certain preliminary observations made since traffic started its procession around the track on Nov. 9. In other words the work has passed through the planning and construction stages into that of operation. It is still too early, of course, for the real story of what the results show. Nevertheless the indications thus far made are well worth studying, for a number of significant facts were disclosed by the measuring and recording apparatus before traffic began. The California engineers have already learned some interesting things regarding the influence of temperature changes and Pittsburg has become the objective of scores of highway engineers interested in research work. In no sense are the results which will be based on the data now being collected to be considered as merely of local significance. Lessons from the Pittsburg tests will surely have a decided bearing on the future design of concrete roads, particularly with regard to reinforcement and subgrade problems.

## Litigation Yields to Irrigation

RUINOUS is none too strong a word to apply to the differences over water rights that have caused so much conflict and thwarted so much development of irrigation and water power in Western North America. It it is therefore with great pleasure that we record in two articles elsewhere in this issue (1) a working agreement as to the use of water and a postponement of all litigation in the Kings River Valley, California, and (2) an order of the International Commission interpreting the St. Mary and Milk River article in the treaty between the United States and Great Britain regarding the Canadian-United States boundary waters. In the Kings River case it was a committee of engineers that effected a temporary agreement which it is hoped will open the way to provide ample water for 400,000 acres in the Kings River valley in addition to the 800,000 already fairly supplied, and thus end thirty years of hampering litigation. The St. Mary and Milk River order is of greater import, in itself and because of its international aspect, and its promise of continued amity not only with our northern neighbor but with Great Britain as well. This international order gives permanency to the temporary working basis previously worked out and administered by engineers of the United States and Canadian reclamation and irrigation services. In both the California and the international agreements engineers and common sense have been able to overcome the barriers that the lawyers have been unable to surmount, if indeed these barriers were not largely of their own creation.

## Vision———Achievement

ANOTHER milestone in the progress of engineering was marked when President Harding's Armistice Day address over the bier of America's Unknown Soldier at the Arlington National Cemetery was heard not alone by the vast throng there gathered but also by other large assemblies in New York and San Francisco. This was made possible by the electrical amplifier and the loud-speaking device which have been perfected by telephone engineers after long and patient endeavor.

These men of vision and achievement look forward to the time when President's messages may be heard wherever the telephone reaches. Thus may a great nation be thrilled as one man, for, quick as is the daily press to spread the President's message abroad, the telephone is instantaneous and has all the many advantages of the spoken over the written or printed word. Next we may expect a simultaneous means of transmitting photographic images, so that posture, gesture and facial expression may be conveyed to the eye at the same time as words and voice inflections. Add to this a similar transmission of color as well as form and motion and how marvelous would be the whole! To do all three seems less marvelous now than would telegraphy a hundred, telephony fifty, or airplane flight twenty years ago. With each new engineering achievement one feels like changing the well known "wonders will never cease" to "when will wonders cease?" But the engineer knows that each marvel in his field only opens new and more splendid visions. It is for him not only to see the vision but to bridge the gap between vision and achievement.

### Engineering Traffic Control

IN RECOMMENDING the rerouting of numerous street railway lines in New York City last week, Daniel L. Turner, consulting engineer of the New York Transit Commission, took a very definite step forward in the engineering control of our cities. To reroute car lines in order to better rapid transit conditions is not unique, though it is uncommon to have the recommendations come from other than the companies themselves. To clear certain streets of trolleys so that through motor routes will be provided is, on the other hand, a decidedly novel procedure. It is becoming increasingly apparent that the big municipal engineering problem of the next decade is traffic control. As *Engineering News-Record* has often pointed out, it has, in our larger cities, passed beyond the province of the police, who can only exercise an arbitrary and human control, and has become a matter of street opening and clearing and of physical arrangement of the city so that traffic takes certain routes because they prove the most economical and convenient, and not because a policeman directs it there. Mr. Turner's scheme is intended to do just this, and is important because it recognizes the fundamental engineering nature of street-traffic distribution.

### Rerouting Street Cars

MR. TURNER'S suggestions are interesting for more than their specific solution of a problem in the metropolis. New York is not the only city where car tracks are on streets where they should not be today. Most of our city car lines are on routes determined in the early days of rapid transit, when every merchant wanted a street car by his door and when street traffic was hardly any problem at all. Conditions today may demand an entirely different system of routing, but franchise rights and the expense of moving act jointly to prevent any radical rerouting. In consequence, street car changes in most of our cities consist mainly in adding new routes and but rarely in a better distribution of the traffic lanes and removal of the traffic impediments fixed by car tracks. Just now few cities are provided with the legal machinery for revamping transit conditions that exist in New York, but the time is fast coming when all will have to be and when it does the city's engineers will have the responsibility of doing the work. Study of methods and results is therefore incumbent on the profession.

### Too Many Automobile Killings

WHAT traffic control means in preservation of life is strikingly indicated by the comparative mortality from typhoid and automobiles, noted on p. 1074. More people are killed by automobiles than by typhoid in the registration area, where presumably both water-supply protection and traffic control are more rigid than in the remainder of the country. It was not so long ago the big city typhoid rate was above 20 per 100,000. Millions have been spent in water-purification and sanitation to bring this figure down. And yet nearly half as many people are being killed today by automobiles, with the probabilities that in our cities the automobile killings are much higher. It will pay to spend some money to save life.

## Pressure for Economic Conference

WE HAVE urged in these columns that following the Disarmament and Far Eastern Conference there was needed an international meeting to adjust the world's economic difficulties. To our mind, land disarmament is a necessary precedent to satisfactory financial adjustment, but as to land disarmament, there is little continuous pressure, unless it is from the internal financial burden of those European countries which are supporting large armies. However, there is considerable momentum to the demand that there be an international economic conference. Just before adjournment, Senator France introduced a resolution authorizing and directing the President to call such a conference, the participants to include all recognized nations, with their colonies. In addition there are strong forces in both the American and European press advocating such a meeting.

It seems inevitable that these demands will result in such a conference, provided that on final adjournment the conference now under way in Washington will have proved a distinct success. With that example before it an economic conference might be able to make considerable headway in working out a solution for the present knotty international economic problems.

## Open-Price Association Decision

NOTE was made in these columns last week that the U. S. Supreme Court had handed down its decision in the Hardwood Manufacturers' case—a decision long awaited with interest, because it involved the legitimacy of the "open-price" form of trade association. The decision is an affirmation of that of the lower court and, accordingly, enjoins the American Hardwood Manufacturers Association from distributing stock, production and sales reports, prohibits the discussion of prices at meetings and the giving of advice as to future production and prices. The court holds the association to be a combination in restraint of trade within the meaning of the Sherman (Anti-Trust) law. The court divided on the case six to three.

It might be inferred from the full confirmation of the lower court's decree that the decision may be taken as final on all the activities of open-price associations. From our reading of the opinion, however, we do not take that to be the case. We judge it to be final as to

one activity only—advising on future action. On other activities, as we see it, the subject still calls for the broad consideration of the court.

In the usual form of open-price associations the activities extend only to the exchange of information regarding production, stocks and shipments, and, as to prices, to current lists and figures on closed transactions. No attempt is made to estimate future price trends or to suggest the effect of future production on prices. But just this the Hardwood Manufacturers did do, and it is this that distinguishes their practice from that of other open-price associations. Around this point the whole opinion of the court is made to revolve. The argument is on the evidence that the association repeatedly suggested that curtailment of production would result in higher prices. Higher prices did follow, and the court connected the rise with the advisory work of the association.

With the whole opinion swinging on this feature of the case, then, we do not believe that the decision can be held as final on purely statistical activities. Obviously, though, the conduct of these activities *in combination* with suggestion as to future functioning is now under the ban of the law.

The decision has all the more interest because on Nov. 1 the U. S. District Court of the Northern District of Illinois held that the dissemination of data on prices, sales, stocks, etc., by the linseed-oil crushers did not contravene the law. This case will undoubtedly reach the Supreme Court and thus occasion a ruling on an association which limits its activities to the exchange of data on facts and closed transactions.

* * *

Among business men the decision in the Hardwood Manufacturers' case was not unexpected. There was a feeling that the advisory work of the association was "a step too far." On the other hand, the feeling is strong that the reporting of past transactions is within the law and will be so held by the courts—a view thus far confirmed in the linseed-oil case. In the latter view, also, this journal has concurred, as the readers will recall.

While, however, we have inclined to the belief that the exchange of information upon closed transactions would be lawful, we have not held that, as practiced, the exchange is good policy. In fact, we believe it would be better for business if full publicity were given to the figures collected by open-price and trade associations. To send them to the Department of Justice and to the Federal Trade Commission avails nothing for the purpose we have in mind; it does not take the public into the industry's confidence, and the public, kept in ignorance of the association's functioning but keenly realizing its potential power, becomes suspicious.

We cannot agree with the view expressed in the linseed-oil argument that the exchange of information between association members is on a par with the activities of open exchanges, such as the Cotton Exchange, the Chicago Board of Trade, etc. It distinctly is not. The very essence of the confidence enjoyed by exchanges is their full publicity. The transactions and prices are open to everyone, are published daily in the public prints. Would the New York Stock Exchange be able to survive public suspicion if its operations were held secret to its members; would the Chicago Live Stock Market be able to survive?

This matter of publicity is emphasized by the opinion on the hardwood case. In the next to last paragraph we find these words:

"In the presence of this record it is futile to argue that the purpose of the 'Plan' was simply to furnish those engaged in this industry, with widely scattered units, the equivalent of such information as is contained in the newspaper and Government publications with respect to the market for commodities sold on boards of trade or stock exchanges. One distinguishing and sufficient difference is that the published reports go to both seller and buyer, but these reports go to the seller only."

In this view, we believe, there is hearty public concurrence.

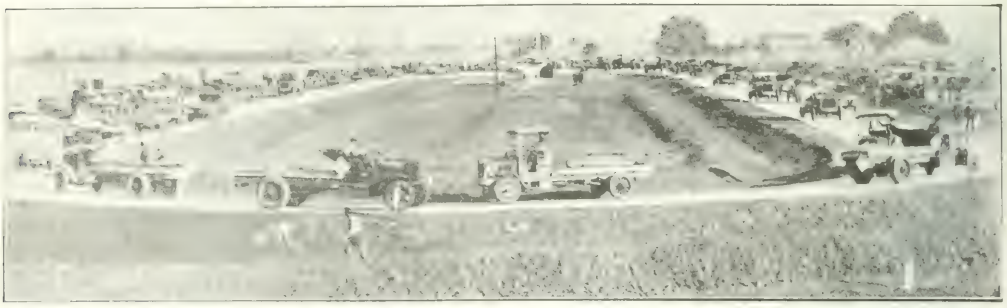
Moreover, even if the present method of exchange of price information should be found lawful, we are not convinced that it will always, or even for long, remain so. The public is firm in its determination to protect the records of individual businesses but it has not the same feeling toward associations, particularly toward those that are known to deal with prices. The war increases were, in part, responsible for this; but the suspicion and condemnation have become more serious on account of disclosures of collusive acts of trade associations in the building-materials field. Is it not possible that this feeling will make itself felt in legislative halls, with the result that the publication of all figures collected by associations may be forced by law? In fact, will it not be fortunate if the people do not go to severely restrictive measures? The railroads followed a "public be damned" policy, and the public put them under drastic regulation.

As an instance of the displeasure caused by lack of frankness, take the cement industry. As we have stated before, we believe that a majority of engineers and contractors believe that the cement companies agree on prices; many believe that they restrict territories. If the industry were frank about its statistics—and had been frank about them for many years—the feeling toward the industry would be much better. The surprising fact is that the attitude of the industry has not changed. As far back as 1913, before there was an open-price association in the cement or in any other industry, *Engineering Record* sought to publish the statistics on production, stocks and shipments of the Association of American Portland Cement Manufacturers (the predecessor of the Portland Cement Association) but was refused permission. That was at least understandable then. But the request has been made since upon the officers of the Portland Cement Association, but without avail. Even the publication of these figures, which do not involve prices, would have tended to prevent the development of the present unfavorable feeling.

The policy, in our judgment, is shortsighted not only on the part of the Portland Cement Association, but of other trade associations, whether of the open-price form or not, which keep their statistics secret. In reference to the cement industry, it is of interest to note that an influential group of consumers recently discussed means by which an open cement exchange could be established—another direction in which public pressure may be exerted on industries which are mistrusted.

* * *

On the main question, however, of the legitimacy of trade associations which exchange information only on closed transactions, we have not yet had, it would seem to us, the last word of the court.



GENERAL VIEW OF TEST HIGHWAY AT PITTSBURG, CAL.
(Note embankment to be used later for shoulder. The two lines of traffic move in opposite directions.)

# Variety of Movements Occur In Concrete Test Highway

## Cracks In Pavement Come On Crests of Longitudinal Waves—Edges Curve Up In Daytime and Down At Night—Test Continuing

DEFINITE results have become apparent even since Nov. 9, when motor truck traffic started tests to destruction of the reinforced concrete roadway built near Pittsburg, Cal. A statement of the types of pavement built and the scope of the tests was published in *Engineering News-Record* Aug. 18, 1921, p. 276 and a note announcing the beginning of traffic appeared Nov. 24, p. 873. Although new information is being added continually, records made prior to Dec. 1 consistently indicate the following: (1) Irregular longitudinal buckling or wave movement in the slabs, with "contraction cracks" occurring at the crests of the waves; (2) warping of the pavement cross-section, varying with the

[illegible]

time of day, the edges cupping up at night and curving down in the daytime; (3) temperature differences of 6 or 7 deg. F. between top and bottom of pavement, the top being about 6 deg. colder in the morning and 7 deg. warmer in the afternoon. Another unexpected develop[illegible] after the pavement was finished, the adobe subgrade under the center of the slab was found to have a greater [illegible]

Laboratory tests showed this content to average 13 to 14 per cent by weight, and in one instance 27 per cent.

After two weeks of continuous and intermittent traffic a total of about 730,000 tons, chiefly in the form of solid-tired trucks, each with a gross weight of 14,500 lb., had passed over the pavement. Numerous transverse cracks had occurred before traffic started and after traffic began triangular breaks appeared at the shoulders on either side of some of the construction joints. There had been also some vertical movement between the corners of slabs where longitudinal and transverse joints met. All broken spots were being repaired so that tests might continue without subjecting adjacent paving to undue shocks because of the broken sections. For the most part the pavement was withstanding the heavy traffic satisfactorily. After the first heavy rainfall on Nov. 22 and 23 threatened breaks developed more rapidly.

Records of slab and subgrade deflections are being compiled by means of rods imbedded in the pavement and subgrade, as shown in the accompanying drawing, and extending down into tunnels underneath the pavement where measurements are made. Four tunnels were put in, each under a different type of pavement. The tunnels are electrically lighted, ventilated by fans and have two-ply plank linings calked and tarred to make them watertight. When special tests are to be made, such as measurements of deflection under static or impact loads, observers in the tunnels make direct readings on dial micrometer gages, which are graduated to thousandths of an inch and can be estimated to ten-thousandths.

For continuous traffic, a recording pen on each of the nine rods marks on a moving paper the deflections of the slab caused by the procession of trucks. The paper is mounted vertically on the side wall, extends the full tunnel length and is rolled continuously from one drum to another by an electric motor. The arrangement of the direct reading and recording devices is such that either or both can be used without interference. The rods used to measure the subgrade deflection come into the tunnel on the opposite side from the pavement rods and movements of the subgrade are measured by direct reading gauges only.

The diagrams, four of which are reproduced on p. 1050,

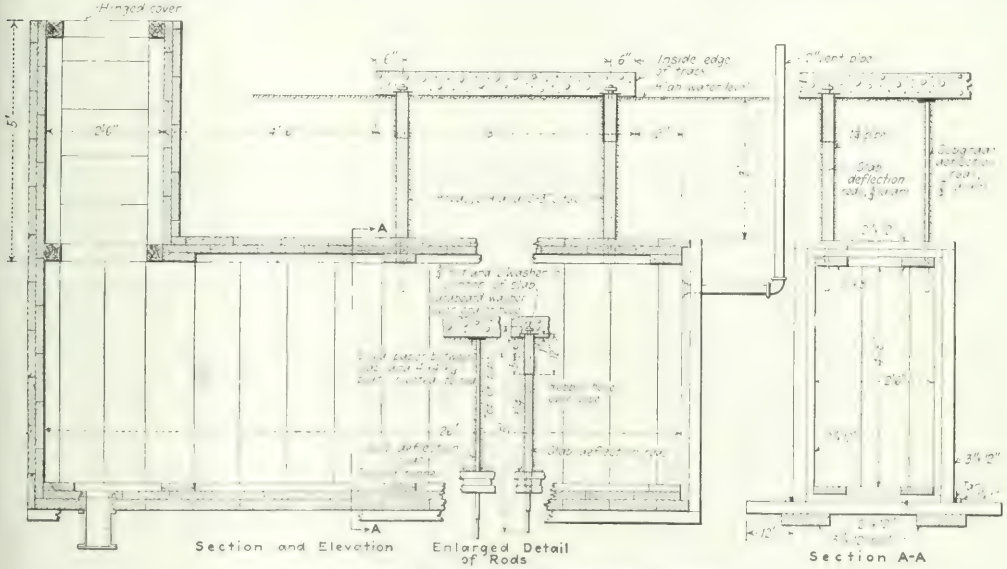
show deflections caused by 5-ton trucks in various positions on the pavement, the position of the truck wheels being indicated on each diagram. The deflections are plotted in two groups and on two different scales, a single representation of the nine rod positions with respect to the pavement serving both groups of records. The line A-B is taken as the center line of the rods and also as a line of zero deflection of the slab. Deflections for 12-mile speeds are plotted in the direction A-B. The position of the front wheels of the truck with respect to the rods is indicated in feet on the extreme right of the diagram. The maximum deflections occur as the rear wheels pass over the rods, i.e., when the front wheels are in position + 13 ft., 4 in., or the length of the wheel-base past the rods.

These deflections increased as the traffic continued. That is, with loads, speeds and all conditions, including weather, just the same as at the outset of the test, the maximum deflections increased in the first week of 5-ton truck traffic from 0.019 in. to 0.030 in. The diagrams represent the conditions observed after six days of traffic, when the tonnage over the pavement had reached a total of 326,000 tons. This increased deflection, it is suggested, might have been due to the compacting of the subgrade which would give the slab more

INTERIOR OF INSPECTION TUNNEL SHOWING ARRANGEMENT OF APPARATUS

(A—At lower ends of rods whose tops are imbedded in pavement. B—adjustable sleeve. C—dial for direct readings. D—recording pens for registering deflections on paper. E—one of the two drums on which paper is rolled. F—deflection rods from subgrade.)

results on different types of pavement. Section G, on which the measurements shown in the diagram were made, is 6 in. thick, reinforced on top and bottom with $\frac{3}{8}$-in. transverse bars placed on $7\frac{1}{2}$-in. centers. Longi-




ARRANGEMENT OF RODS AND INSPECTION TUNNEL

freedom of movement within the elastic limit. It was noted that the slow rate of return of the slab to normal position was about the same after long continued traffic as at the beginning of the test.

In the second group of deflections X-Y is taken as a line of zero deflection of the slab and for each truck position indicated, maximum deflections, as recorded by each of the nine rods, are plotted normal to X-Y. Atmospheric temperatures were recorded during all of the tests to permit of any corrections and comparisons on that basis which might be desirable.

Similar series of plottings are being made in each of the four tunnels, thus giving a comparison of similar

tudinal bars, $\frac{1}{2}$ in. in diameter, were used on top and bottom near each edge.

The longitudinal waves in the pavement were discovered by making micrometer measurements of the surface elevations along both edges at 6 ft. intervals. This was done before traffic commenced, a series of observations being made daily for several weeks. Measurements were made by means of gages mounted so the surface elevations of the slab could be read with respect to the tops of rods driven into the earth close to the concrete. The waves varied in amplitude up to a maximum of about 1 in., this variation recurring daily at approximately the same time and place. The full

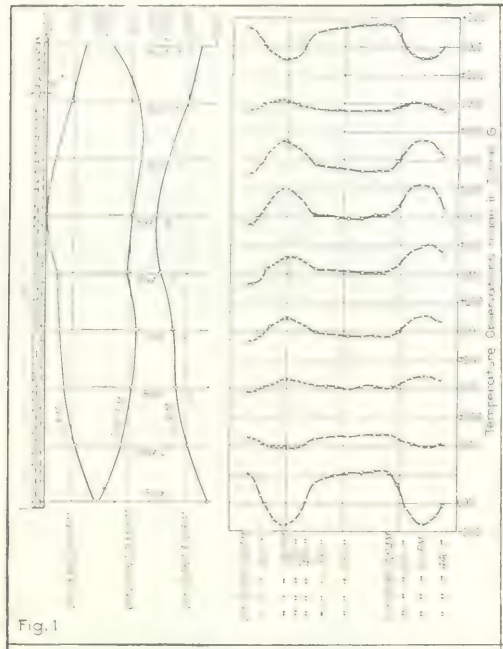


Fig. 1

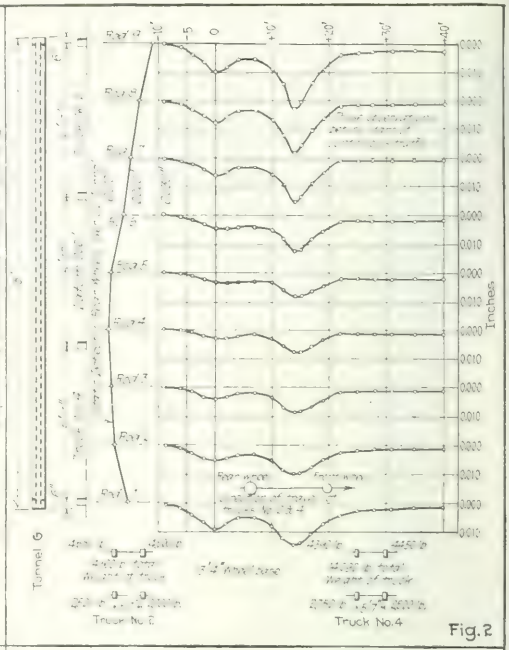


Fig. 2

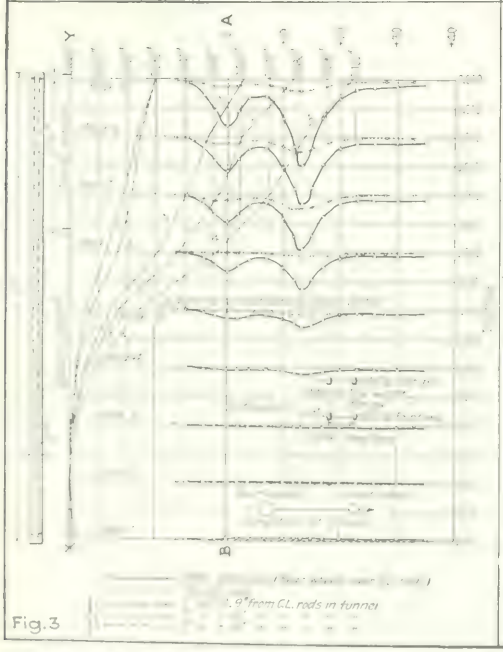


Fig. 3

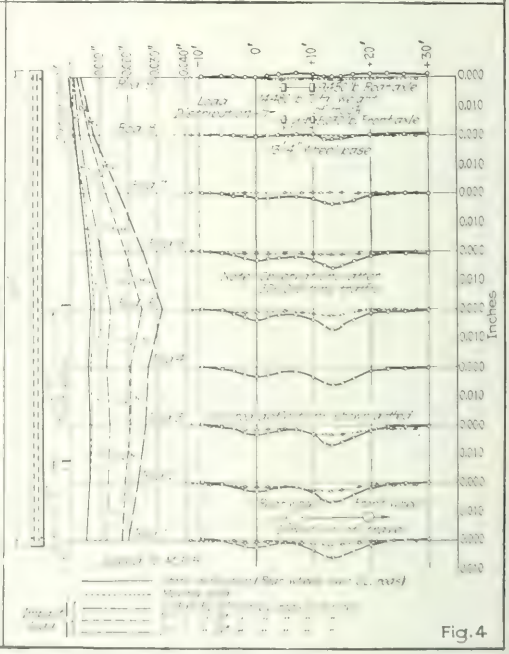


Fig. 4

DUE TO TEMPERATURE AND TO IMPACT, STATIC AND MOVING LOADS

Moving Load Impact Tests.

(2) maximum

range was covered within a period of about 7 hours, which was the time in which atmospheric temperatures varied from least to greatest. The amplitude of the waves was less in the middle of the sections than at the ends where construction joints occurred. This was believed to be due to the reinforcing which would tend

to resist bending within the section where it was continuous.

In practically every case where contraction cracks occurred on sections measured for longitudinal waves, the cracks were found at the crests of waves. In one case where the wave was not exactly at right angles to the center line, as shown by measurements on opposite sides of the slab, a small crack not previously discovered but which extended half way across the pavement to meet a crack already recorded, was found when careful search was made at the crest of the wave.

Temperature readings on the slab were also made in the weeks prior to the beginning of traffic. For this purpose two holes were drilled in the concrete for each temperature station, one ½ in. deep and the other to within ½ in. of the bottom of the slab. A small quantity of mercury was placed in each hole and the tops were closed with corks. To make readings the corks were removed and thermometers were dipped in the mercury for 1 minute, which was found to be long enough to give correct values.

Extensometer measurements were made, chiefly on the center line of the deflection rods, so that the deflections of the slab could later be expressed in terms of stresses. To facilitate accurate readings brass spuds were imbedded in the concrete in pairs, spaced convenient to the range of the instruments to be used. Because of the delicacy of these instruments and in order to avoid the personal equation involved in two separate readings, these measurements were taken first with the truck standing over the spuds and the observer with extensometer under the truck. After the reading the truck moved off, and the instrument was read again without the load.

A notation affecting construction or expansion joints has been made by observers as follows: When the rear wheels of a truck stood close to a construction joint consisting of a ½-in. board used as a transverse header between two successive concrete pours, some deflection was caused in the adjoining slab due to the shear transmitted through the joint. At times of highest temperature enough shear was transmitted to cause the adjoining slab to deflect 90 per cent of the amount found in the loaded slab. At times of minimum temperature the unloaded slab deflected only 10 per cent as much as did the slab carrying the truck.

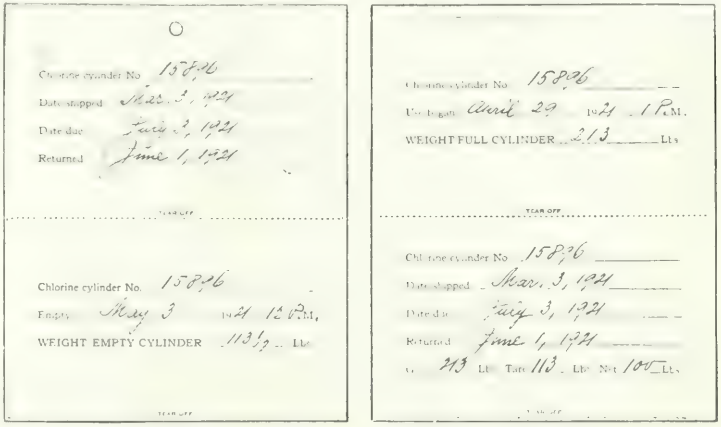
After the first rain laboratory tests on adobe taken from the subgrade under the slab showed the moisture content to have increased to 46 per cent. Simultaneously with this change the slab was found to have a better bearing on the subgrade and the deflections recorded were less.

The tests are being carried on under a co-operative plan, the major cost and the initiative being undertaken by the Columbia Steel Co. and aid being given by the U. S. Bureau of Public Roads, the California Highway Commission, the Automobile Club of Southern California and other interests. The engineering and field work are in the hands of Lloyd Aldrich and John B. Leonard. Harold Hammill has had charge of observations and records.

## Keeping Track of Chlorine Cylinders

TO keep chlorine cylinders moving in their correct order through the plant of the Indianapolis Water Co., five 3x5-in. cards have been devised. They are made up in a long strip with perforations so that they may be detached and accompany the cylinder or be placed in the various files of the employees who may be concerned with the cylinder as it progresses from the freight station through storage to use and back to empty storage, thence to the freight station for return to the manufacturers. H. E. Jordan, superintendent of filtration, explains the use of the cards as follows:

Card 1, with 2 and 3 attached, is fastened to the cylinder upon arrival at the plant. It remains there until the empty cylinder passes into the freight house for return shipment.


Chlorine cylinder No. 15826
Date shipped Mar. 3, 1921
Date due July 3, 1921
Returned June 1, 1921
Chlorine cylinder No. 15826
Empty May 3 1921 12 P.M.
WEIGHT EMPTY CYLINDER 113½ Lbs.
Chlorine cylinder No. 15826
Date began April 29 1921 1 P.M.
WEIGHT FULL CYLINDER 213 Lbs.
Chlorine cylinder No. 15826
Date shipped Mar. 3, 1921
Date due July 3, 1921
Returned June 1, 1921
213 Lbs. Tare 113 Lbs. Net 100 Lbs.

DETACHABLE CARDS FOR CHLORINE CYLINDERS

One continuous strip; card 1 is upper left, card 2 lower left, card 3, upper right, 4 lower right; card 5 same as card 1.

Card 2 is filled out by the filter operator as soon as the tank is empty when it is sent to the superintendent's office where it is checked against the billed weight and then placed in the empty file, thus providing constantly data as to the number of empties on hand.

Card 3 is filled out by the filter operator when the tank is put into service and immediately sent to the superintendent's office, where it is checked against the billed weight and put into the "in use" file with card number next below.

Card 4 remains in the superintendent's "active" file from date of arrival of the cylinder at the plant until the empty is returned. It is first used for instant reference regarding reserve stock of chlorine. When the cylinder is delivering chlorine it is held in the "in use" file, but when the cylinder is empty the card is placed in the "inactive" file for reference until receipt is obtained from the chlorine manufacturer.

Card 5 is identical with Card 1. It is the purchasing agent's copy and is used by him to check the receipt of full and the return of empty cylinders.

# International Division of St. Mary and Milk Rivers

## Order of Joint Commission Alloting Waters for Irrigation and Power to United States and Canada—With Comment

AFTER hearings and postponements extending through more than six years the International Joint Commission on Oct. 5 adopted an order and rules for the measurement and apportionment of the St. Mary and Milk rivers and their tributaries in the State of Montana and the province of Alberta and Saskatchewan. The action was taken under and is an interpretation of a provision of the treaty between the United States and Great Britain dated Jan. 11, 1909. The interpretation and rules are in substantial accord with the way the water has been divided and measured by engineers of the U. S. Reclamation and the Canadian Irrigation services, under an interim order, as described in detail by Benjamin F. Jones, hydraulic engineer, United States Geological Survey, in *Engineering News-Record*, Dec. 30, 1920, p. 1277.

Article VI of the treaty provided that the two rivers named should be treated as one stream for irrigation and power purposes and that the waters should be divided equally between the United States and Canada, but that more than half might be taken from one stream and less than half from the other "by either country so as to afford a more beneficial use of each." It was also provided that between April 1 and Oct. 31 the United States should be "entitled to a prior appropriation of 500 sec.-ft. of the waters of the Milk River, or so much of it as constitutes three-fourths of its natural flow;" and that the apportionment of the water should be made jointly by the "reclamation officers of the United States" and the "irrigation officers" of Canada.

After citing the article just abstracted, and stating that the officers just named had been unable to agree as follows:

### Rules on Apportionment

*St. Mary River*—I. (a) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is 666 sec.-ft. or less Canada shall be entitled to three-fourths and the United States to one-fourth of such flow.

(b) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is more than 666 sec.-ft. Canada shall be entitled to a prior appropriation of 500 sec.-ft. and the excess over 666 sec.-ft. shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the St. Mary River at the point where it crosses the international boundary shall be divided equally between the two countries.

*Milk River*—II. (a) During the irrigation season when the natural flow of the Milk River at the point where it crosses the international boundary for the last time (commonly and hereafter called the Eastern Crossing) is 666 sec.-ft. or less the United States shall be entitled to three-fourths and Canada to one-fourth of such natural flow.

(b) During the irrigation season when the natural flow of the Milk River at the Eastern Crossing is more than 666 sec.-ft. the United States shall be entitled to a prior appropriation of 500 sec.-ft. and the excess over 666 sec.ft. shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the Milk River at the Eastern Crossing shall be divided equally between the two countries.

*Eastern Tributaries of Milk River*—III. The natural flow of the Eastern (otherwise known as the Saskatchewan or Northern) tributaries of the Milk River at the points where they cross the international boundary shall be divided equally between the two countries.

*Waters Not Naturally Crossing the Boundary*—IV. Each country shall be apportioned such waters of the said rivers and of any tributaries thereof as rise in that country but do not naturally flow across the international boundary.

V. For the purpose of carrying out the apportionment directed in I, II and III hereof the said reclamation and irrigation officers shall jointly take steps

(a) to ascertain and keep a daily record of the natural flow of the St. Mary River at the international boundary, of the Milk River at the Eastern Crossing, and of the eastern tributaries of the Milk River at the international boundary by measurement in each case: (1) At the gaging station at the international boundary; (2) at all places where any of the water which would naturally flow across the international boundary at that particular point are diverted in either country prior to such crossing; (3) at all places where any of the waters which would naturally flow across the international boundary at that particular point are stored, or the natural flow thereof increased or decreased prior to such crossing.

(b) To fix the amount of water to which each country is entitled in each case by applying the directions contained in paragraphs 1, 2 and 3 thereof to the total amount of the natural flow so ascertained in each case.

(c) To communicate the amount so fixed to all parties interested so that the apportionment of the said waters may be fully carried out by both countries in accordance with the said directions.

### Gagings Required

VI. Each country may receive its share of the said waters as so fixed at such point or points as it may desire. A gaging station shall be established and maintained by the reclamation or irrigation officers of the country in which any diversion, storage, increase or decrease of the natural flow shall be made at every point where such diversion, storage, increase or decrease takes place.

VII. International gaging stations shall be maintained at the following points: St. Mary River near international boundary; the North Branch of Milk River near international boundary; the South Branch of Milk River near International Boundary; Milk River at Eastern Crossing; Lodge Creek, Battle Creek, and Frenchman River, near international boundary and gaging stations shall be established and maintained at such other points as the commission may from time to time approve.

VIII. The said reclamation and irrigation officers are hereby further authorized and directed:

(a) To make such additional measurements and to take such further and other steps as may be necessary or advisable in order to insure the apportionment of the said waters in accordance with the directions herein set forth.

(b) To operate the irrigation works of either country in such a manner as to facilitate the use by the other country of its share of the said waters and subject hereto to secure to the two countries the greatest beneficial use thereof.

(c) To report to the commission the measurements made at all international and other gaging stations established pursuant to this order.

IX. In the event of any disagreement in respect to any matter or thing to be done under this order the said reclamation and irrigation officers shall report to the commission, setting forth fully the points of difference and the facts relating thereto.

We are informed by Mr. Jones that the only statement or figures in his article mentioned above that would be changed by the decision are in the table on p. 1279, and are that "Canada's share on Aug. 4 would be 502 instead of 500 sec.ft. and her deficiency 22 instead of 20 sec.-ft. on that date."

F. H. Newell, now consulting engineer, United States Reclamation Service, who served as one of the original

negotiators in drafting the treaty with Great Britain, has sent *Engineering News-Record* some comment on the order that promises to be of general interest. After citing the treaty provisions giving Canada 500 sec.-ft. priority in the St. Mary River during the irrigation season and the United States a like priority in the Milk River, and noting that because of natural conditions the Milk River priority granted this country is "relatively insignificant compared with that of Canada's priority in St. Mary River," Mr. Newell writes:

There is not enough water in either or both streams to supply all of the dry lands which may be economically irrigated. The growth and future prosperity of northern Montana and southern Alberta are tied up in the efficient use of the waters of these streams. A larger beneficial use can be secured by storing the waters of St. Mary River in Montana, in the natural reservoir sites in or adjacent to the Glacier National Park. It has been found possible to carry some of this water across the low divide into the Milk River drainage, supplementing the low water flow of this stream. Waters thus diverted in the United States flow, however, into Canada and then after following along north of the boundary for about 200 miles they return to the United States.

It would seem as though little difference of opinion could arise as to the methods of measurement and apportionment. The original draft of the treaty was to the effect that apportionment should be made of the waters at the international boundary. The specific designation was, however, left out of the treaty as finally signed for the reason, as asserted by the Americans, that the treaty referred wholly to such waters. The Canadians, however, attached great significance to this omission—of what the Americans regarded as surplusage—and contended that at the last moment the object of the treaty was changed so that the entire flow of both rivers should be taken into consideration, including tributaries of Milk River, which, coming from the south, have never been considered as international waters.

Moreover, the Canadians contended that the prior rights should first be measured and then the remaining waters apportioned equally. This also was considered by the Americans as practically rewriting the object of the treaty as regards equality of division, since the granting to the Canadians of a priority which was not to be measured as part of equality practically gave them the lion's share of the available supply.

The matter was argued by learned counsel at St. Paul in May, 1915, again at Detroit in May, 1917, and for the third time in Ottawa in May, 1920. By that time the members of the commission individually seemed to have got into a state of mind where agreement was impossible.

An interesting point to engineers is that when deadlock seemed certain the commission resorted to the simple expedient of declining to hear further argument, and instead of this decided to go upon the ground in person and see for themselves something of the situation, listening not to further legal discussion but finding out for themselves, through talking with the people of the country and the engineers, what are the actual facts and what are the relative merits of the various contentions made.

Accordingly the commission invited counsel to remain away and listened to the informal statements of fact made by irrigators in the Milk River Valley in Montana and in the St. Mary area in Canada. The result was a brushing aside of technicalities and an immediate reaching of an understanding.

It required only a few minutes' talk on the part of well informed farmers and ranchmen to show that the proposed consideration of the southern tributaries of Milk River in the proposed equal division was a practical absurdity. These streams shrink soon after leaving the high lands and cannot and should not be considered as part of a dependable water supply.

In the same way the contention of Canada for a priority in St. Mary River was emphasized in the minds of the commission by the plain, simple statements of men living on the ground and using the water.

The result is that although Canada may get theoretically a larger proportion of the available supply of St. Mary River, yet the people of the United States will probably receive all that can be economically stored for their use. Each party can claim a substantial victory. The ground is now clear for the development of plans for water storage in Montana for the benefit of lands in Alberta. . . .

After again remarking on the more than six years spent in discussing this problem without reaching a decision, and noting that a compromise was finally reached only after the members of the commission had become convinced that "it would be little short of a calamity not to agree," Mr. Newell says in conclusion:

If it should be said that it was impossible for six English speaking people to interpret and apply the terms of a treaty written in plain English, then it might be claimed with some show of reason that it would be impossible to carry out other treaties between nations speaking different languages. In one sense the whole world was interested in showing that two nations living side by side can agree on waters flowing across the boundary and on other matters of vital importance to their citizens.

Two days after the above order was handed down the Commission recommended to the respective governments that both countries unite in building a storage reservoir at St. Mary's Lakes in Montana but that the United States proceed with the construction of the proposed Chain-of-Lakes reservoir in Montana and Canada with the proposed Verdigris Coulee reservoir in Alberta.

## Kings River Water-Right Litigation Halted by Engineer's Plan

CLAIMANTS to water from Kings River, California, have agreed on a program drawn up by a committee of engineers under which all litigation will stop for the 1922 season and a plan be devised for utilizing more fully than heretofore the available waters of the river. The following information on the subject has been supplied to *Engineering News-Record* by J. B. Lippincott, consulting engineer, Los Angeles:

Kings River in California supplies a fair water-right to about 800,000 acres of high-grade land and a very defective water supply to about 400,000 acres more. Considering the crop values it is probably the most important irrigation stream in America. The water is distributed by twenty-two different canal systems. There has been a chronic condition of litigation over the division of this water for the past thirty years. An effort is being made to build a good storage reservoir and power plant for the purpose of conserving flood water and pumping from underground supplies so as to furnish an adequate supply for the whole 1,200,000 acres of land. A law was passed at the last session of the California legislature providing a legal method for irrigation districts, mutual water companies and privately owned canals in a given drainage basin to co-operate for such a purpose. Preliminary steps have been taken to proceed with the formation of this super-district.

In the meantime old litigation over the division of the water of the river was revived by a certain decision of the State Supreme Court and the stage was set for a renewal of the legal fight between a number of these canal companies which would interfere with, if not entirely prevent, a constructive program. A committee of engineers appointed for the super-district, composed in part of Louis Hill, George L. Swendsen and J. B. Lippincott, proposed a plan to avoid litigation and to proceed with the engineering studies looking toward construction. They proposed that the California State Water Commission, now known as the Division of Water Rights, should be called upon to prepare,

out of court, a temporary schedule for the division of the water of Kings River for the year 1922 and that all parties using water from the river should agree to accept this schedule and to permit the officers of the state to take charge of their headgates and operate them for this year. At the end of the year any one of the canal companies was given the right to withdraw from the agreement if it desired, or to petition the State Water Commission to revise the agreement for the following year. All claimants to water from Kings River have signed an agreement to desist from litigation over the water of Kings River until after the year 1922. In the meantime, the engineering committee is to proceed with its investigations and estimates, and it is believed that a plan will be developed whereby an adequate water supply will be maintained for the 1,200,000 acres which, if demonstrated, will largely relieve the tension now existing between the canal companies over the division of the water. If the program can be carried out to a successful conclusion, it will be a distinct accomplishment of a constructive nature and an avoidance of litigation which almost invariably has been destructive in its effect on irrigation development in the arid region.

# London's Rapid Transit Mail Distribution System

### Construction Now Going on—Automatic Electric Trains to be Transporting Units—Twelve Post Offices to be Linked

(LONDON CORRESPONDENCE)

*(The project for mail distribution in London herein described is similar to the automatic electric system of freight transportation proposed for the New York Metropolitan District by the New York-New Jersey Port and Harbor Development Commission, and included in the "Comprehensive Plan" of the Port of New York Authority. The commission's plan was made public Jan. 24, 1921, and a resume of its general features was contained in "Engineering News-Record" of Jan, 27, 1921, p. 183.—Editor.)*

IN ORDER to speed up the London mail services an underground electrically-operated railway is being built which will ultimately link up the chief post offices and trunk-line depots in the London district. The project is indicated on the accompanying map which shows both the present construction and the ultimate development. The plan has been worked out by the engineering department of the London post office and Mr. Dalrymple-Hay. Post office engineers are responsible for the electrical equipment and Mr. Dalrmple-Hay is taking charge of the tunnel construction.

As shown on the map the Western Central District post office, the Mount Pleasant sorting office and the general post office at King Edward building will constitute important junctions when the extensions are undertaken. Between the stations shown the railway will consist of two lines of 2-ft. gage track, one eastbound and the other westbound, and each contained in a single tube of an inside diameter of 9 ft.

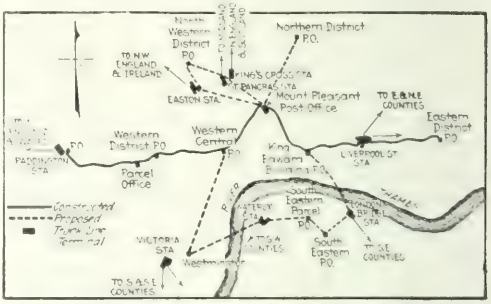
The trains running over this system will be operated without drivers on the remote-control system. It is proposed by the post office engineers to operate the trains by means of three types of electric current: high speed (HS), intermediate speed (IS); and low speed (LS). When the train is running between stations HS current will be applied. At the approach to a station the cars will pass over a short gap in the conductor rails and brakes will be applied. These brakes will be released electrically when the train is taking up the current and applied when the train is not. The next section after this of conductor rail will be normally dead and will be constructed of such a length as to allow the train to come to rest, the brake still remaining in operation.

If it is required to stop a car at a station LS current will be applied to this brake section and the train will move to the station platform where it will finally stop by the application of the brakes as it reaches that section of conducting rails rendered dead for its reception.

When a train is to skip a station IS current will be applied to the brake section and the train will pass through the station at this speed, passing over a short gap in the conductor rails and onto those sections of the line energized by HS current.

When it is possible to accept without delay a stopping train or an express the braking section or a portion of this line will be supplied with IS or LS current before the train reaches the station, in which case the train would merely be slowed up to a speed commensurate with the current supplied and would either proceed to the platform or skip the station.

Trains will be started by energizing the rails of the subsection on which they are standing with IS current




LONDON DISTRICT SHOWING RAPID TRANSIT MAIL DISTRIBUTING PLAN

Cars will be moved into sidings and stopped at certain sections in the same manner as that employed to stop them at station platforms, and a device will be supplied for automatically reversing the connections of the car motors so that they may be easily coupled up to form trains of two or more cars. When thus connected the shoes of the rear car only will pick up the current, but all of the motors will be doing part of the propulsion.

It is not intended that the control of the cars as they stop at, or pass through, a station need the continuous attention of switchmen. The position and destination of each train will be indicated to the switchman who will, with levers, set the line points for any specified route and will energize the conductor rail sections with the current needed. The operation of the line points will be interlocked with the current application and a complete interlocking system will be in force between the different routes.

Between the stations the conductor rail will be divided into sections, and while running between stations and before coming under the control of the switchman, the train will itself render each section dead as it leaves it and will energize it again upon entering the next section. This is provided to secure a dead-rail section between adjacent trains.

# Open Pier Deck To Resist Storms

By H. H. Braun
Engineer-Constructor, Manila, P. I.

IN MANILA BAY there is a concrete pier, built in an exposed location, on which it was necessary to evolve a special design of deck to resist the heavy seas. When

LOOKING ALONG THE PIER FLOOR

a typhoon escapes and runs amuck over the China Sea, as frequently happens here during the months of July and August, the waves roll in at the site to buffet the pier with incredible violence.

The pier, which carries a double-track railway, is a reinforced-concrete slab and girder deck, founded on precast concrete piles. It is built in the form of an L. A stem 400 ft. long by 21 ft. wide leads out to the pier head which is 160 x 30 ft. The water is 24 ft. deep at low tide with the deck 12 ft. higher. The bottom is good firm sand where satisfactory penetration was obtained. Batter piles were driven for side bracing.

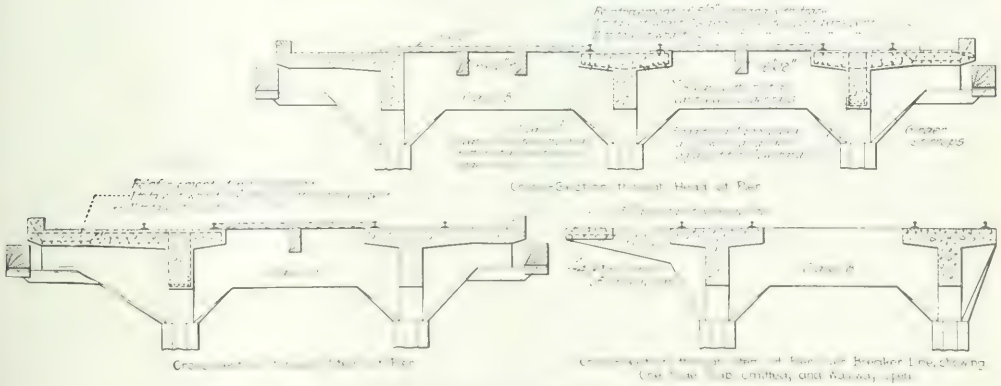
It was not deemed safe to build a solid deck. Accordingly the piles were spaced to center under the center line of each track, and are connected by heavy longitudinal T-beams, the head of each being just wide enough to carry its respective track. The longitudinal beams connect at deck level with the heavy cross girder pile caps, the space between the beams being left open The head of the pier is widened to a three pile bent, as shown in the detail drawings, the deck being left entirely open in a similar manner.

The concrete work then, practically consists of a modified trestle, with flat-slab extensions along each edge. Joists, 6 x 12 in., are placed lengthwise of these openings, supported by proper metal hangers at the pile caps. Over the openings is placed a decking of 3 x 12-in. plank, which is free to lift off and go overboard in case of severe storm.

Where the stem of the pier crosses the breakers it is peculiarly liable to damage. It was necessary to protect the shore by heavy riprap upon which the waves break and surge high above the pier with savage violence. On this section the flat slab was omitted entirely on one side, and the walkway slab on the other side provided with longitudinal openings 9 ft. x 1 ft. 6 in. wide which are covered with 3 x 12-in. panels.

The wisdom of this design has been amply demonstrated through the eight years it has firmly withstood the destructive typhoons which sometimes sweep in across the China Sea. The writer has seen many waves strike this pier and throw tons of water far above the deck. The effect under a solid deck would probably be disastrous. Many times the wooden decking has been wholly or partly heaved up and flung far overboard. To replace this decking is, of course, expensive but in ordinary rough waters such as obtain on the coasts of the United States, it would be carried away only in very exceptional storms.

It is obvious that this design would be useless where deck loads must remain on the pier during storms. It is a satisfactory construction for wharves built in exposed places, such as pleasure piers, or others where it is practicable to remove the deck load during danger.



DETAILS OF OPEN FLOOR PIER IN MANILA P. I.

## Russia's Skilled Workers

According to a survey made by the American Relief Administration among Russia's population of approximately 131,000,000, there are 4,675,400 men who are expert in mechanical and other branches of the various trades. Here are a few figures compiled by the relief workers in Russia: Electrical workers, 2,250,000; railway workers and employees, 1,215,000; transporters, 315,000; rural, 394,000, and miscellaneous, 501,400.

# Sunken Dredge Raised by Jacking From Dry Dock Pontoons

## Four Pontoons Lying on the Quarters Swing Hull in Rope Slings—Steel Truss Stiffens Dredge Against Damage

By James H. Polhemus
Chief Engineer, Port of Portland, Portland, Ore.

USING four sectional dry-dock pontoons, a dredge, displacing 1,600 tons and belonging to the Port of Portland Commission, Oregon, which had sunk in 25 to 40 ft. of water in the Willamette River, was raised in 16 hours after the salvaging equipment was in place. The entire operation of installing the equipment and raising the dredge took ten days. Some of the details of the operation were novel and all were devised and carried out by the Port engineers with available equipment. The cost of the operation was $40,000.

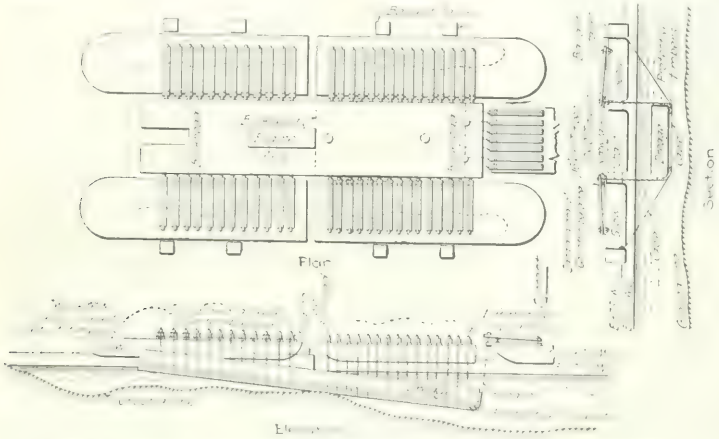



FIG. 1. ORIGINAL PLAN OF RAISING BY BARGES, JACKS AND SLINGS

At the time of the accident, March 4, 1921, the dredge was excavating gravel and pumping through 1,060 ft. of floating pipe and 1,520 ft. of shore pipe, with a lift of 18½ ft. above the surface of the river. The direct cause of the sinking was a break in a cast-iron 45-deg. bend in the discharge pipe in the hold, while the dredging pump was running. Excessive pressure broke out bodily an opening of oval form, about 15 x 28 in. measured along the axes. This pressure was caused by a plug at the far end of the floating pipe. Enough water had leaked out of the pipe during the time that the pump was previously shut down to permit the water in the pipe to gain momentum when the pump was started and the sudden check of this moving water caused hammer sufficient to break the pipe. To prevent plugs in the pipe line the invariable practice had been to pump clear water just before stopping the pump. For some unexplainable reason in this instance this method had failed to produce the desired effect.

Just previous to the accident, manganese steel bends had been ordered and were to be installed. The Port's more recently constructed dredges are so equipped and also have hydraulically operated gate valves on the suction pipe at the entrance into the hold. The bend which broke is probably the one most subject to wear and is inspected and replaced at regular intervals, but probably, due to the unusually eroding character of the material, the wear had been greatly in excess of the average.

*Conditions of the Accident.*—The hull of the dredge is 34 x 206 ft. x 10 ft. 6 in. deep with a displacement of 1,600 tons. The skin is of ⅜-in. steel plate, the deck beams and ribs are steel, the decks and house are wood and the whole structure is stiffened by a riveted steel truss extending out on the bow to carry the tackle for lowering and raising the suction pipe. The stiffness of the hull is much greater than in a river steamer, but considerably less than in an ocean-going ship. Little deformation of the hull and trusses was observed at any time after the sinking and during the salvaging operations.

After sinking, the forward part of the dredge rested on the level area which it had dredged to a depth of about 25 ft., and about one-third of its after length was unsupported, and overhung ground about 40 ft. below the water surface. The forward end of the main deck was about the level of the water and the after end about 10 ft. below.

*Flood Upsets Original Plans.*—Various plans for salvaging were considered and discarded. Cofferdamming was not feasible on account of the depth of water at the stern of the dredge and because of the expected spring freshet. Its great cost also caused other methods to be preferred. Lifting by the aid of the tides was not possible as the variation of tidal heights was not ever 1 ft. Construction of a bulkhead extending all around the outer line of the main deck and raising by pumping out was also tentatively planned but was discarded because of doubt whether the hull was intact. The plan adopted consisted of building a bulkhead around the engine-room hatch and pumping out this compartment and, at the same time raising by barges, using jacks, with slings under the dredge.

After pumping out the compartment it was estimated that buoyancy would leave not over 600 or 800 tons to be lifted by the barges. These were rated at 1,000 tons and it was estimated that by the use of counterweights each would lift 250 tons at its edge where the slings would be attached. Five barges were used as shown by Fig. 1.

As indicated, the barges were equipped with timbers extending across-deck, fastened down at one end and overhanging about 2 ft. on the side nearest the dredge. House-moving jacks were placed as shown to lift the ends of the slings under the dredge. The slings consisted of wire ropes to which chains were attached at the ends for use with the lifting gear. At the turn of the bilge of the hull, wooden pads 6 in. thick were fastened under the slings. The general plan was to raise the dredge so that it could be moved into shallow water and be beached and if the main deck could not

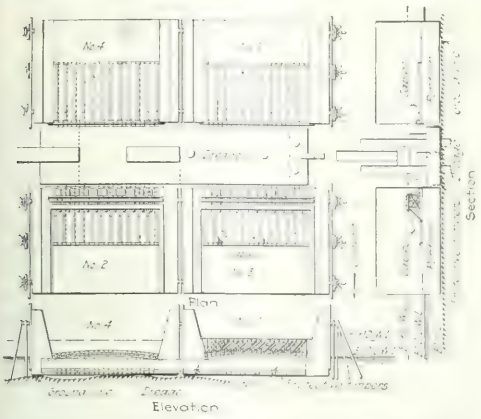



FIG. 2. SUCCESSFUL PLAN OF RAISING BY DRY-DOCK PONTOONS

be brought above the water by this means, at least the compartment could be bulkheaded and pumped out. The method of raising with the house-moving jacks was to lift a small distance and hold the distance gained by a pin through a link of the chain or by a U-bar holding against a link. Five days' time was taken in preparation for raising by this means.

The barges were in place and a heavy strain had been placed on the slings and the operation appeared to be on the eve of success, when there was an unexpected and rapid rise in the river. The total rise was about 10 ft. In one night the rise was so great as to cause the barges to careen and require the chains to be unfastened to prevent overturning or shifting the ballast. A freshet of this height was not to be expected and seldom has occurred at this date so it had not been prepared for in the plans for salvaging.

When the barges were cut loose the forward end of the dredge sank and the bow compartment filled, leaving the keel almost level or about 3 ft. down by the stern which hung unsupported for a distance of about 90 ft.

*Successful Salvaging Operation.*—With the failure of the first plan, it was decided to make use of four of the five sectional pontoons composing the port's 10,000-ton dry dock. These pontoons are 80 x 112 ft. over all and 80 x 82 ft. on deck, with wings extending about 40 ft. above the deck. To permit the pontoons to rest on an even bottom at, or lower than, the ground supporting the sunken dredge, the bottom of the river was dredged on both sides of the hull to an elevation of 14 ft. below low water. Pile clusters and connecting wales were placed as shown by Fig. 2 to hold the pontoons in position, at the same time wire rope slings were placed under the dredge, by pulling and sawing the bights from both bow and stern. Pads of 6-in. lumber were placed under the slings at the turn of the bilge as in the first operation. In the meantime the timber structures, Fig. 3, for attaching the wire rope slings to the pontoons were being erected at the port's dry dock and repair plant.

For the pontoons (4 and 5, Fig. 2) placed upstream from the dredge, the structures consisted of cross-sills to hold the loops of wire rope slings, which were held in place by sills attached to the deck beams of the pontoons by pairs of screw bolts passing through 1-in. steel plates against the lower side of the deck beams. At the end of the pontoon next to the dredge a timber was placed to protect the pontoon and to distribute the pressure transmitted by the wire ropes.

On the pontoons, 2 and 3, on the downstream side, heavy trusses were constructed extending across the length of the deck and to an elevation of 14 ft. above deck. The design of these trusses provided for: (1)

FIG. 4. TENSION ON SLINGS EQUALIZED BY WEDGING

Distribution of the strains on the deck of the pontoons; (2) possible concentration of loads at one point and movement of trusses in the direction of their length and change in direction of strains. An inclined strut was placed at the angle of the resultant pull of the wire ropes and additional inclined struts were placed to take strains which might occur otherwise than in the direction computed. The vertical resultant of the inclined pull of the wire ropes on the timber, back of the truss, was considered to require the wire rope ties under the deck connecting the upper and lower chords of the pontoon trusses.

When the pontoons were towed into position the wire rope slings were attached to the upstream pontoons and these pontoons were sunk. One end of the double slings was then carried around the back timber and both ends brought to the top of the truss and the downstream

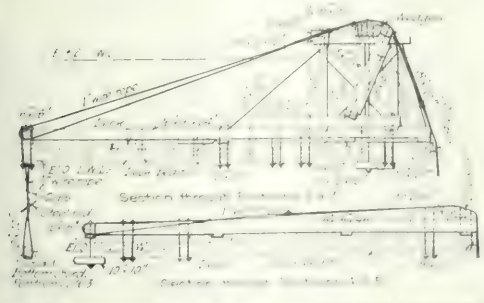


FIG. 3. SUPPORTS FOR SLINGS ERECTED ON PONTOONS

pontoons were sunk. Final adjustments of the wire rope slings consisted in pulling taut with a 8½ x 10-in. donkey engine and attaching clips. When all the ropes were brought up tight, the pontoons were partly pumped out so as to raise them about one foot. They were then sunk in place and the resulting slack was taken up by driving wedges under the wire ropes on the top timbers of the trusses, Fig. 4, thus equalizing the strain on all the wires. Not less than five malleable iron clips were used on each connection. The height of the trusses was such as to permit all final connections and adjustments to be made above water.

The weight of the dredge was estimated at 1,600 tons, as computed by displacement afloat. The number of

FIG. 7. SLINGS UNDER STRESS BITE INTO SUPPORTING TIMBERS

slings of 1-in. wire rope was 112, the average working strain of wire rope thus being about 7 tons. A strain of double this amount could be carried. The total lifting capacity of each pontoon was estimated at 2,200 tons.

By pumping out the compartments nearest the dredge and keeping the farther compartments filled, it was computed that each pontoon would lift approximately 400 tons and would then raise the dredge so that its main deck would be well above the water surface, both of which assumptions proved to be correct.

Raising was accomplished by pumping out all four pontoons simultaneously, the pumping being stopped at times on one pontoon, or water admitted, in order to keep the dredge level. The main deck of the dredge at the bow emerged in about 3½ hours and the dredge was finally floated at its normal draft about 16 hours after operations began. About ten days were consumed from time of beginning operations until they were successfully completed. Examination of the hull and working parts of the salvaged dredge showed little damage by the sinking and subsequent days of immersion.

The entire salvaging operation was conducted by the Port's regular organization under the direction of James H. Polhemus, general manager and chief engineer. The many engineering details, the computations and the preparation of the pontoons were carried out under the direct supervision of assistant engineer, H. L. Gilbert. The Port's Repair and Dry Dock Department under James Healy, master mechanic, did all of the field work and was directly responsible for the operation of raising. Much credit is due these men and the dockmaster, J. A. Stephens, who directed the actual operation of raising.

# Erection of Steel Building and 150-Ft. Truss

## Special Methods for Huge Truss—Derrick on First Floor with Long Boom Places Framing for Six Stories and Roof

By W. J. Howard
Engineer, Kelly-Atkinson Construction Co., Chicago

ERECTING THE LARGEST TRUSS ever used in a building was the major problem in the erection of the structural steel framing of the U. S. Mail Terminal at Chicago. The truss is of 150-ft. span and weighs 365 tons complete, with field rivets. All material for the structure was placed by two derricks traveling on the center line of the building at the first floor level. The building, which is a unit of the Union Station project, is 792 x 72 ft., paralleling the approach tracks and with its ends fronting on Van Buren and Harrison Sts. (See *Engineering News-Record*, Dec. 15, 1921.) It comprises a track or train floor, six upper floors and roof, with a total of 7,650 tons of structural steel, of which 2,800 tons is in the track floor and first floor.

Owing to the very limited space available, a material storage yard was established about half a mile south of the site. All steel was unloaded, checked and sorted at this yard, and then reloaded on cars for movement to the work as required for erection. This yard handling was done by derrick cars.

Two steel stiff-leg derricks mounted on platforms traveling on a single track of 36 ft. 7½ in. gage on the first floor framing performed practically all the erection work. The first two-panel section, 56 ft. in all, of the south end of the building up to and including the first floor, was erected by a stationary 15-ton wood stiff-leg

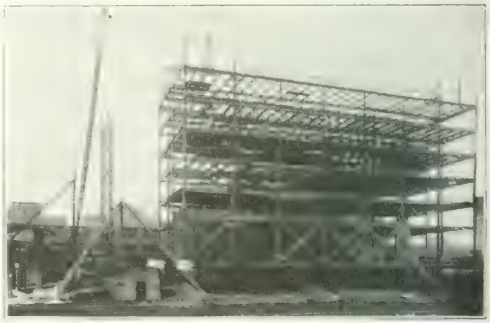


FIG. 1. ERECTION OF STEEL TRUSS AND SUPERSTRUCTURE OF U. S. MAIL TERMINAL, CHICAGO

derrick placed in the excavation and pointing south. After it had erected the first traveling derrick on the first floor this stationary derrick was removed. Traveling derrick No. 1, with its 90-ft. boom pointing north, then worked north and erected the remainder of the steel of the track floor and first floor. As soon as it had passed off the south end panels, traveling derrick No. 2 was erected on the same track with its 130-ft. boom pointing south. This derrick then moved backward or northward, erecting one 28-ft. panel for all upper stories and roof at each move. This derrick was kept 28 ft. beyond the nearest line of columns being erected. Fig. 1 shows the steel erected on the truss near the

south end of the building, with the tall derrick at the left.

Traveler No. 1 has completed its work and has been removed. When No. 2 reaches Van Buren St. to finish the end of the building, it probably will be run out into the street, as this thoroughfare is now closed to traffic during the erection of the new approach to the Van Buren St. bridge. If the street should have been opened at that time, the erection scheme shown in Fig. 2 will be used. The derrick will be dismantled within the building line by a 75-ft. wood boom placed in a special swivel boom seat casting which will be attached to a column on one side of the center line of the building, at about the third-floor level, utilizing the column as a mast. This boom will then erect the steel for the remaining end panels of the building.

A special problem in erection was presented by the 150-ft. truss, with its two 37-ton columns. This truss

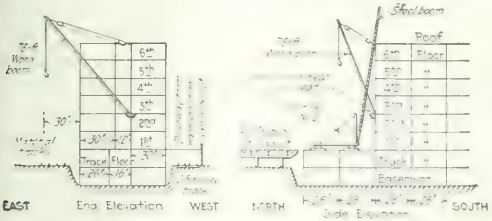



FIG. 2. ERECTION SCHEME FOR END PANELS OF BUILDING

is in the west wall, spanning an opening for a cross-over track which leads into the building. It is 25 ft. deep c. to c. of chords, with its bottom chord below the first floor and its top chord above the second floor. As shown in Fig. 3, when the two columns are held at base and track floor, the bottom chord draws each column $\frac{5}{8}$-in. inward while the top chord pushes it $\frac{3}{8}$-in. outward from the vertical center line. Thus the combined movement is $\frac{1}{2}$-in. in each direction.

It was proposed originally to place $\frac{3}{4}$-in. pins in the top and bottom chord connections to the columns, following these with pins increasing by $\frac{1}{8}$ in. in diameter until the connection was made finally with $1\frac{3}{4}$-in. pins, after which the rivets could be placed in the $1\frac{7}{8}$-in. reamed holes. This plan was simplified, however, by the unusually favorable conditions of frosty mornings and hot afternoons, which made it possible to take advantage of the expansion and contraction of the steel. Thus the $\frac{3}{4}$-in. pins in the bottom chord connections were replaced with $1\frac{3}{4}$-in. pins on a hot afternoon, and on the following cool morning $1\frac{5}{8}$-in. pins were placed in the top chord connection.

With the $1\frac{5}{8}$-in. pins replacing the $\frac{3}{4}$-in. pins in the bottom chord during a hot afternoon, the only effect of the stresses due to contraction and expansion on the following cold morning would be to bend the columns, which was what we were trying to do. The column was free to move at the bottom chord line, as it is connected to the frame of the building by slotted expansion holes, and probably it did lean away from the truss due to expansion of the bottom chord. When the full load is applied and the bottom chord lengthens either the columns will move or the chord will be crushed or the rivets attaching the chord to the columns will be sheared. It is to be presumed that the designers took this force into account.

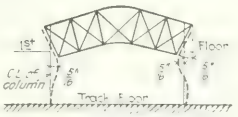



FIG. 3. CAMBER EFFECT IN TRUSS ERECTION

In the falsework for the truss erection the double bottom sills of the bents were of white oak, with white oak wedges set half way through the opening between the sills to allow of raising or lowering the falsework if required. The camber blocking on the bents was of soft fir and was of twice the camber called for in the riveted truss, so that while the truss would be amply supported, it could be crushed into place as the connections were pinned. At one bent the cap itself was crushed by the pinning of the diagonal members.

In a double-intersection truss like this, there would not be ordinarily enough flexibility for any camber beyond the reamed camber. But we did not make the diagonal connection to the top chord until the truss was erected complete and had settled, so that there was very little drifting required to force the truss to the reamed camber. The original plan required the center section of the top chord to be erected before the end sections, but this method was changed to enable the diagonal connections to be left until the last.

In shop assembly, the truss connections were reamed in the unstressed condition. This did not cause trouble nor distort the columns in making the field connections, since the truss was not connected to the columns (except for some few $\frac{3}{4}$-in. bolts) until after the truss had been riveted, with the exception of its top-chord splices. The reamed holes matched perfectly so that there was no such excessive dirfting as might be inferred from the crushing of the cap, mentioned above. This cap had been reduced in section by splitting portions away, for the reason that the camber blocking on top of the cap was hard to get at for splitting. Therefore the cutting away of the cap to cause it to crush was the easiest method of allowing the necessary settlement.

Since the whole truss had been assembled and reamed at the shop, it was bound to take its assembled position in the field. The erector's problem was to guess the amount of settlement, to camber the truss as high as possible to assist in making the top-chord connection, then to pin the truss down and crush the camber blocking, and finally on a hot day to make the bottom chord connection. This plan was followed successfully. The truss as erected had $2\frac{3}{4}$-in. camber, but $\frac{3}{4}$-in. of this was lost when the steel superstructure was erected on it. It is expected that 1 in. more will be lost under the full dead load of the concrete floors and the walls, leaving 1 in. camber in the truss when the building is completed.

By cambering the truss as high as possible we were aided in making the top-chord connections. It will be realized that $\frac{1}{8}$-in. is sometimes a great assistance in such connections. It may be noted that in the erection of the Mississippi River bridge of the St. Louis-San Francisco Ry. at Memphis, Tenn., one of the closing sections of the top chord was brought to the traveler packed in ice, and the bottom chord was surrounded by hot steam pipes.

Cambering the truss higher than called for was done partly to allow for settlement of falsework and because it is easier to lower than raise camber. Although, as stated above, it was necessary to pin one point until the cap crushed, this did not necessitate any excessive amount of pinning that would distort the metal, because

if one point was higher than those on either side of it, it must have more weight on it and all the pinning would do would be to help this excessive weight crush the camber blocking until all three points had an equal bearing against the bottom chord.

The center section of the bottom chord weighed 42 tons and the center section of the top chord 40 tons. It was necessary to keep the first or small derrick 55 ft. from the farthest necessary reach of the 70-ft. boom and we were unwilling to subject the derrick to this overload. For making these two lifts, therefore, a 15-ton wood derrick with 70-ft. boom was placed on the track floor and used to take 12 tons of the load by calculating the point of lift on the chord for each derrick. The steel derrick was hooked to the chord at a point 19 ft. 3 in. from one end and the wood derrick at a point 12 ft. 3 in. from the other end, the chord being lifted in a vertical position and then lowered into its horizontal position in the truss.

There were over 11,000 tapered field rivets of 1⅛-in. diameter in this truss, and some of these were 11¾ in. long. They were all driven by an air hammer and bucked up by air jams. These tapered rivets were adopted by the fabricator. For 1⅛-in. holes, the rivets were 1-in. in diameter from the point to within about two inches of the head, then tapering to 1⅛-in. to fill the hole. This is for the reason that a long rivet upsets from the driven end, fills the hole and plugs it so as to leave the head end with little or no upset. If the driven end is left cold or not heated so much as the head, the reverse takes place. If the middle is hot and the ends are cool, the rivet is upset at the middle. Of hundreds of long non-tapered rivets, both shop and fields, which I have examined after they were cut out, very few if any hand completely filled the holes. The shop work and design of the truss, which is the largest and heaviest ever erected for a building, was exceptionally good, and the McClintic Marshall Co. is to be congratulated on its work.

In the erection the building is riveted up complete from top to bottom for one panel at a time, as the work proceeds, the eight gangs of riveters being two panels behind the erectors. An air pressure of 100 lb. per square inch was maintained for riveting the truss, but the balance is being done with 95-lb. pressure.

The erection derricks are reeved with ⅝-in. wire rope, 13 parts to the topping lift and varying for the load lift. The topping-lift blocks are tandem six-sheave blocks designed and built by the erectors, the large sheaves being 18 in. and the small ones 16 in. in diameter. Each derrick has a 12-ft. bull wheel operated by a separate swinging engine of the steam turbine type. The double-drum hoists have 8¼ x 10-in. cylinders and four spools.

Progress averages 100 tons of steel erected per day per traveler and 3,400 rivets per eight-gang day. It is expected to complete the erection by Jan. 1, 1922. The Kelly-Atkinson Construction Co. has the contract for this erection, and the work is in charge of the writer as engineer for that company.

### House Ownership in the U. S.

The number of homes in the United States as enumerated by the census of 1920, was 24,351,676. Of these 54.4 per cent were rented, 28.2 per cent were owned by the occupants and were free from encumbrances, while 17.5 per cent were owned but mortgaged.

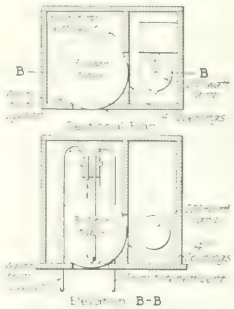
# Loss of Head as a Criterion for Washing Filters

## Arbitrary Time Interval Between Washes Replaced by a Rational Standard Obtained by a New Turbidity Detector

By James W. Armstrong
Filtration Engineer, Montebello Filters, Baltimore, Md.

During the course of the last six years many things have happened at the Montebello filter plant to upset the ordinary accepted theory of things. One of these is the value of loss of head as a criterion for washing filters. Turbidity has replaced loss of head, and a new turbidity detector has been developed.

It was noticed that, with water coming to the plant under normal conditions and with filters being washed on an 8-ft. loss of head, the lengths of run would vary from about 48 to more than 100 hours with apparently good results. Occasions arose when the combined filter effluent would show cloudy water when the loss of head was as low as 3 or 4 ft. At such times loss of head was valueless as an indication of the proper time for washing filters, and an arbitrary method of washing based on the time of service was adopted.



TURBIDITY DETECTOR USED AT BALTIMORE FILTERS

As a means of determining the clarity of the combined filter effluent, a device similar to that used at several other plants was installed at the outlet of the filtered water basins. It consisted of a 60-watt electric lamp, with waterproof connections, which was lowered to the bottom of the basin. A piece of opalite glass was anchored on the floor under the lamp for the purpose of reflecting the light. This device enabled the filter attendant to detect the slightest turbidity in the water when it was from 6 to 8 ft. deep.

For judging the quality of the water leaving the plant it proved very helpful, but with a water not up to standard it failed to point to the guilty filter. It was thought that if such a device could be provided for each of the filters, it would establish a rational instead of an arbitrary standard for indicating the proper time for washing filters.

In at attempt to prove the practicability of the plan, several filters were equipped with 3-in. steel tubes, which were placed in the pipe gallery and provided with an inlet pipe at the bottom and an overflow pipe 5 ft. higher up. The filter effluent was kept flowing slowly through the tube and a light was placed under its glass bottom to permit observation of the water. The lighting conditions were changed from time to time, but the experiment was not a success because the small diameter of the tube interfered with the proper distribution of light, to such an extent that slight differences in turbidity could not be distinguished.

Next, experiments were made with what is virtually a Tyndall meter. A 3-liter flask was equipped with copper tubes for siphoning the filter effluent through it. The flask was set on one of the operating tables and beside it was a 200-watt electric lamp. Both were cov-

ered with a black wooden box with a partition separating the lamp from the flask. A small round hole in the partition permitted the light rays to pass through the flask at right angles to the line of sight, which was obtained through a similar round hole in the front of the box. At first some trouble was experienced with air, but after that had been overcome, even a very slight turbidity could be detected in the water. The results were so satisfactory that sixteen filters were equipped with similar devices.

So far, the personal judgment of the observer is the only means devised for comparing the effluent of one filter with another, and as this cannot be reported in definite terms, the objection might be raised against the appartus that it affords no definite standard of comparison. An attendant can, however, soon learn to detect the slightest difference in filter performance, and as this turbidity detector is more satisfactory than a loss-of-head gage, the remaining 16 filters are soon to be equipped with them.

## Concrete Armored Piles in Wharf At Port Orford, Ore.

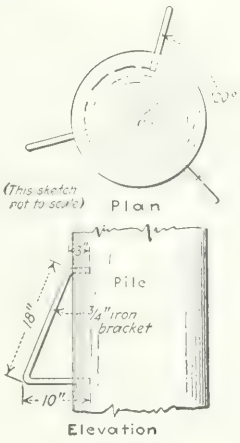
### Metal Pipe Driven To Serve as Forms—Brackets in Piles Insure Desired Thickness of Concrete at Ground Line

A SMALL wharf recently constructed at Port Orford, Ore., is supported on piles which are protected from teredo action by a coating of concrete placed in forms of corrugated iron pipe slipped down over the pile. About 125 fir piles were driven in bents 20 ft. apart and protected in this way. Features of the work were the method of centering the piles in the form at

PORT ORFORD WHARF WITH PILE CASINGS IN PLACE
Concrete not yet poured or piles centered in casings

the ground line and the follower used for driving the pipes. The need for some form of pile protection was decided upon after it had been found that on account of borer action unprotected piles in this port required renewal after about one year of service.

Before starting the work of pile driving, small dynamite charges were used to blast potholes at the point where each pile was to be located. After driving a pile to refusal the driver would back away while a section




ARRANGEMENT OF BRACKETS

of 2-ft., 14-gage corrugated pipe, previously cut to desired length, was slipped over the pile and allowed to slide down to the bottom.

*Penetration of the Casings.*—The pile driver was then moved back into place and if the weight of the 3,400-lb. hammer resting on top of the follower was not sufficient to secure the desired penetration of the corrugated pipe casing, it was given a light blow, such as would be delivered by the hammer falling not more than 1½ ft. The depth of water ranged from 16 to 30 ft. and the maximum length of casings was about 34 feet.

The casings were ordered from the factory in lengths to fit every bent. They were allowed to extend 2 to 3 ft. above high water level and as the bottom at this location apparently does not change, the casings were driven only 10 in. to 2 ft. below the ground line. Because of the potholes blasted this penetration was considered to be of considerably greater effective depth than if driven without the aid of blasting. The lower limit of teredo action in this region is reported to be about 6 in. below the ground line.

The follower with which the casings were driven consisted of a short section of the casing with timber fittings or cushions on top and bottom. The one used on the bottom was a square frame of 10 x 10-in. fir in which a groove about 1½ in. deep had been cut to fit the top of the casing below. The section of casing used as a follower had to be long enough to extend above the pile top at least the amount of the penetration desired.

*Method of Centering.*—To center the pile in the casing three brackets were attached to each pile before driving at a point which would be about 3 or 4 ft. above the ground line. The penetration of the piles on this job ranged from 10 to 17 ft., but the change occurred at a fairly uniform rate so the penetration could be predicted with sufficient accuracy for placing the brackets. Each bracket was made of a piece of ¾-in. iron, 31 in. long, having right-angled bends 3 in. and 10 in. respectively, from the ends. By driving the 3-in. leg into the pile with the 18-in. side of the bracket extending toward the lower end of the pile, the lower right-angle bend would be 10 in. from the pile. This was greater than the thickness of concrete desired and the 10-in. leg was accordingly driven into the pile until the projection plus half the diameter of the pile at this point was slightly less than half the diameter of the casing.

The three brackets were spaced around the pile about 120 deg. apart. The upper end of the 18-in. side of the bracket was thus flush with the surface of the pile and sloped away from it in a downward direction. The brackets so arranged would guide the casing into place and hold it centered around the pile while the concrete was setting.

Concrete was mixed in the proportion of 1:2:3 and placed by means of tremies. No reinforcing was used.

The casings were dipped in asphalt before leaving the factory and although joints were not water-tight the leakage was so small that its effect on the concrete was disregarded. The piles varied from 10 to 14 in. in diameter at the larger ends and 24-in. casing was used for all alike.

S. P. Pierce of Sixes, Ore., under whose direction the design and construction were carried out, states that handling the tremies would have been easier if 30-in. casing had been used instead of the 24-in. Also he suggests that it would be better to make the 2 or 3 ft. of casing at the bottom plain instead of corrugated to facilitate getting the desired penetration. If this type of construction were to be used where shifting bottom was encountered, he suggested that greater penetration of the casing would be advisable.

# Utilizing Gas from Sewage Sludge as Motive Power

By John D. Watson

[illegible]

A paper read before the Institution of Municipal and County Engineers, Birmingham, England, Nov. 12, 1921

THE ever increasing need for power on sewage-works, the present cost of fuel, the persistent demands for economy and the salvage of waste products are all influences which compel exhaustive inquiries into every possible source of power. The object of this paper is to suggest a source of power hitherto overlooked or minimized, and to describe experiments and experiences which are calculated to stimulate further inquiries into the possibilities of utilizing the marsh gas which is formed by organisms acting upon decaying vegetable and other organic substances.

When this Institution met in Birmingham two years ago, I described in some detail the intensive fermentation process adopted on the Birmingham sewage-works to render the vast quantities of sludge inoffensive without destroying its fertilizing properties, or lessening its calorific value. In that paper comparatively little was said about the gas evolved by the fermentation process beyond making reference to the marked differences between crude sewage sludge before and after it enters upon the septic or putrefactive stage. Illustrations were given to show that sludge during the digestion process is lighter than water, but what at first sight appeared to be a reversal of the law of gravitation is a delusion; it is merely an instance of solid matter being held up by gas formed in the course of the putrefactive change which takes place when organic matter is acted upon by bacteria and their enzymes. It was shown how sludge in this condition was more easily pumped than fresh sludge; friction in the process of forcing it through a cast-iron main five miles in length was lessened. When the main referred to was first laid difficulties were anticipated which were not realized in practice; it was assumed, therefore, that the comparatively frictionless propulsion of solids through the main was probably due to the reduced density of sludge and to an innumerable number of gas bubbles acting like so many ball bearings between particles of solids thus tending to reduce the viscosity of the sludge.

It is now proposed to refer to the nature and power of this gas, and to give illustrations of what it can be made to do when under control, for it is possible to harness this veritable will-o'-th'-wisp if the conditions are understood and taken advantage of in a scientific manner.

More than a quarter of a century ago gas generated in [illegible] in the Exeter sewage works. In the beginning of 1920, I visited the Matunga Leper Asylum at Bombay, where a small engine had been driven by sewage gas by Mr. James as far back as 1907. In both these cases the gas was generated in closed septic tanks which favored the cultivation of the anaerobic organisms, and at Bombay the climate was specially favorable. But the work done more recently by Mr. Walshaw at Parramatta in Australia, under what he terms aerobic conditions, are much more remarkable; indeed, it was knowledge of this case coming immediately after his Indian experiences which induced me to try whether it was possible to obtain equally successful results in the changeable, unreliable climate of England

The opportunity for making a test at Cole Hall presented itself to me and the Birmingham Drainage Board, which had some years previously approved plans for driving the pump there by a suction gas engine, consented to the scheme being varied to admit of a sewage gas plant being substituted for the suction gas plant. Very little alteration was required to meet the changed conditions and little expense was incurred in defraying the cost of the experiment.

The plant is designed to give 25 B. hp. for a working period of 6 hr. per day. It comprises a 34 (max.) hp. horizontal gas engine of the ordinary suction type, a 5-in. centrifugal "unchokable" sludge pump, a small sludge pump well, and a sludge digestion tank in two sections. There yet remains to be erected a small gasholder, without which it is impossible to keep the engine running for more than 1½ to 2 hr. consecutively.

The 9-in. exhaust pipes for the engine pass through the digestion or generating tanks with the object of imparting heat to the sludge and so promoting fermentation, thus benefiting from the experience gained at Saltley where for a dozen years it has been customary to inject live steam into the sludge during extremely cold weather. Provision is made for effecting an occasional disturbance of the mass by injecting compressed air, but this is not altogether satisfactory, as it interferes to a certain extent with the regulation of the mixtures supplied to the engine, and arrangements will shortly be made to effect the desired disturbance by means of compressed gas drawn from the top of the sludge digestion tanks. This will also serve to mix the fresh charges of sludge.

TABLE I PERCENTAGE VOLUME OF MARSH GAS IN SEPTIC SEWAGES

| | Per Cent |
|---|---|
| Exeter (Donald Cameron) | 20 18 |
| Exeter (Donald Cameron) | 24 4 |
| Matunga (C. C. James) | 21 25 |
| Matunga (C. C. James) | 23 9 |
| [illegible] | |
| Septic Tank A | 79 0 |
| Septic Tank B | 57 5 |
| Septic Tank F | 75 9 |
| [illegible] Septic [illegible] f Australia) | 60 0 |
| [illegible] | 60 1 |
| [illegible] | 77 0 |
| [illegible] | 67 5 |

The principal constituents of sewage gas are methane ($CH_4$) hydrogen (H) nitrogen (N) and carbon dioxide ($CO_2$) and it is upon the marsh gas or methane we chiefly rely.

Table I gives the percentage by volume of marsh gas found in various septic sewages in England, America, Australia and India and Table II gives analyses of the sewage gas at Birmingham in September and October.

TABLE II ANALYSIS OF BIRMINGHAM SEPTIC TANK GAS, SEPTEMBER AND NOVEMBER, 1921

| | Per Cent | Per Cent |
|---|---|---|
| Carbon dioxide $CO_2$ | 18 1 | 25 2 |
| Hydro carbon HC | 0 2 | |
| Oxygen $O_2$ | 0 4 | 0 3 |
| Carbon monoxide CO | 1 1 | |
| Methane $CH_4$ | 77 0 | 67 5 |
| Hydrogen H | [illegible] | 2 8 |
| Nitrogen N | 3 2 | 4 2 |
| | 100 0 | 100 0 |
| [illegible] | 700 | 850 |

Results from such a wide selection of places in different parts of the world seem to indicate that marsh gas is evolved from organic matter as readily in one climate as in another, but in fact it is not so, and the results of the analyses show the need for more definite information and

caution in their application. Results obtained by Mr. Rhead, chief chemist to the Birmingham Gas Department, in his analyses of the Cole Hall gas emphase this statement.

The amount of gas from the total volume of available sludge which can be relied upon at Cole Hall is greater than the power demand there, but it is certain to vary with the seasons, and it is as sure to vary with the age, the volume, and the condition of the organic matter in the sludge. Steps are therefore being taken to investigate the facts with a view to preparing graphs which will show (1) the volume of gas to be obtained from a given volume of average sludge (10 per cent dry solid matter) in a given time (2) and one which will show at what time the sludge gives off the maximum quantity of gas, and what time is needed to change that maximum into a minimum.

Probably the majority of the results given in Table I were obtained from septic sewage, but I think it is from sludge and not from liquid sewage that gas can be obtained in sufficient volume to render its use economical. This statement is contrary to that put forward by Australian observers, who claim that the best results can be obtained from aerobic treatment of sewage.

Up till now the sludge available at Cole Hall has been very watery (containing only 3 per cent dry solid matter.) This was owing to the fact that the supply was temporarily

TABLE III. ANNUAL COST OF SEWAGE GAS PLANT COMPARED WITH STANDARD SUCTION GAS PLANT

Duty—25 B.hp. for [illegible] per [illegible] of gas to engine house, pump and power will [illegible] engine, producer, [illegible] The cost of labor, lubrication, and repairs is also approximately equal, and does not appear in the comparison.

| | | | | | | |
|---|---|---|---|---|---|---|
| *Suction Gas Plant* | | | | | | |
| Capital cost, £300. | | | | | | |
| Annual charges on £300 for [illegible] | £30 | 0 | 0 | | | |
| 30 tons of anthracite at £3 per ton, using 1¼ lb per B.hp.hr. | 45 | 0 | 0 | | | |
| | | | | 75 | 0 | 0 |
| *Sewage Gas Plant* | | | | | | |
| Generating tanks, with complete equipment of [illegible] and [illegible] (repayable in 25 yr.), £42 | | | | | | |
| Provision for gasholder £500 at 10% (repayable in 14 yr.), £50 | | | | 92 | 0 | 0 |
| Net annual saving in favor of [illegible] plant | | | | £29 | 10 | 0 |

* Probably the sewage gas plant can be cheapened when more exact knowledge of the principles of working have been obtained.

dependent upon the ability of a land irrigation pipe laid on a very flat grade to convey it from the outfall works to the engine house. By a new sludge main which will soon be completed a denser sludge (at least 10 per cent dry solid matter) will be conveyed to the tanks, thus reducing the volume of water which has hitherto entered the tanks, persistently lowering the temperature of the mass and taking up space which should be occupied by organic matter which is capable of yielding gas. With a more concentrated sludge, it is evident that the gas forming material temporarily confined in the limited space should produce a greatly increased volume of gas (a matter of prime importance until a gasholder is provided as part of the installation), for it is necessary to impound surplus gas to be drawn upon when the demand by the engine exceeds the volume available in the digestion or generating tank.

Notwithstanding existing weaknesses in the experimental plant, the fact remains that the engine has worked successfully and has given out the power required to drive the pump.

At Cole Hall, where the gas engine has been installed, the method of disposing of sludge has hitherto been quite different from that obtaining in the main works in the Tame Valley. At the latter works the sludge is subjected to the fermentation process, but at Cole Hall farmers buy it for agricultural purposes, and it is obvious that so long as it can be got rid of in this, the most satisfactory way, there is no need to employ intensive fermentation. At Cole Hall, therefore, only sludge required to give off gas for power will be subjected to fermentation, and judging from the limited experience available it is estimated that about two tons of wet sludge (10 per cent dry solid matter) per day will be required to provide an explosive gas capable of generating 25 B.h.p. for a working period of 6 hr. per day. The amount of available sludge at Cole Hall is approximately 80 tons per day (10 per cent dry solid matter).

The sludge after it has been discarded will probably be freer of fat and grease than it was before fermentation, and to that extent it will be more valuable to farmers than it was in its initial stage; moreover it will still retain about 2 per cent of nitrogen after it has given off its methane, so that its fertilizing properties are not thereby exhausted, if indeed they are materially lessened.

Before emphasizing the fact that we have in marsh gas a useful power for driving an internal combustion engine, and that we have great volumes of this gas in sewage sludge, there is the all important question—is it economical to use it?

It is obviously the business of the engineer to determine this, and he will require to take into account comparative costs of fuels, probable fluctuations in prices, the location of the works, transport facilities, effect of strikes on the supply of fuel, etc.

It was originally intended to put in a suction gas plant, and although it is hardly time to make a comparison which can be relied upon, the figures given in Table III are interesting and may be helpful.

The following notes should be pondered by those who think of developing the Cole Hall experiment. Success in designing an installation is dependent on accurate information regarding (a) the percentage of sludge (dry solid matter) which is capable of gasification, (b) the rate of evolution of the gas at various temperatures, and (c) the proportion of methane in the composition of the gas.

(a) Sludge, like sewage, is of diverse composition; much of its value as a gas producing substance depends upon the efficiency of the grit chambers and the amount of organic matter left in the sludge. There can be no doubt that the gas comes from the decomposition of organic matter, and an inordinate proportion of inorganic matter would be a distinct hindrance; so would large doses of tarry and oily substances mixed up with the sludge lessen, if they did not entirely inhibit, the gas producing power of the putrefactive organisms.

Again, a modern sewage system is designed to convey to a place of disposal almost every form of trade as well as domestic wastes, and water is the vehicle by which it is conveyed. That the fouled water contains organic matter is true, but obviously it is the sludge which is brought down with the water that contains the material from which gas is produced, so that the less liquid there is in sludge which is set aside for gasification the better. This, however, leads to a position where one may go wrong very readily. It is most difficult to obtain fresh sludge which contains more than 10 per cent of dry solid matter, but the author has found to his cost that you may keep such sludge in a tank for a whole year without its undergoing the putrefactive change so essential to the production of gas. It is not enough, therefore, to set aside great volumes of organic matter—that matter must be introduced into a tank which has already been inoculated by the right organism, and it should not be introduced so rapidly that the organisms are smothered.

On the Saltley works, where sludge is treated in order to deprive it of smell and its emulsive character, it is found to be advisable to mix the fresh material with about 20 per cent of "ripe" sludge when it is first transferred into a digestion tank; it is desirable also to maintain its temperature as high as possible with the view of providing those conditions which favor putrefactive change. Probably Dr. Travis' hydrolytic tank was the direct result of the desirability of doing this work efficiently. Dr. Imhoff, the German engineer, improved on Travis' tank and boomed it in America, where it has proved to be a very efficient instrument for separating fresh sewage from sludge which is kept designedly for months in order to convert it into an inodorous mass. The Birmingham method is better adapted to local circumstances, but the results are similar except that the Birmingham method is so arranged that it is possible to isolate sudden rushes of anti-septic liquor, a matter of considerable importance at times.

Another line of investigation essential to ascertaining the

volume of gas which may be evolved from a given quantity of sludge is the influence of agitation. We know as a fact that disturbance of the mass is beneficial, but we are ignorant of the extent to which it should be carried. When a silt tank at Saltley fails to ferment, its contents are passed through the pump and distributed amongst what are termed ripe or healthy tanks. The breaking up of the sludge as it passes through the direct-acting pumps effects a considerable change, but this side of the question requires further investigation, and what has already been done in Australia in this regard should not be overlooked.

(b) Temperature plays a very important part in the rate of evolution of gas, and the volume extracted from a given quantity of sludge. In a sewerage district of 115 sq.mi. it takes so long for some sewage to travel to the outfall that it is mildly septic before it arrives there, but when the district is small the liquid portion of the sewage is for the time being almost free of putrefactive tendencies and will probably remain so throughout its treatment. The sludge, too, may take longer to septicize but if treated under anaerobic conditions should be converted into gas in the quickest and most favorable way. We do not know the temperature at which the organisms will cease to act altogether, nor the temperature at which they will act most efficiently; investigation is required, therefore, if we would ascertain this one of the essential factors of the problem

TABLE IV. DATA REGARDING BIRMINGHAM SEWAGE GAS INSTALLATION

| | |
|---|---|
| Ordinary [illegible] engine | 54 [illegible] B.h.p. |
| [illegible] | 25 [illegible] per 60 hr. per day |
| [illegible] | 20 [illegible] |
| Estimated quantity of gas required per day | 5,000 cu.ft. |
| Maximum [illegible] of "unchokable" pump | 450 [illegible] gal. per min. against a head of [illegible] at about 1200 r.p.m. |
| Rising main | 12 in. diameter |
| Storage capacity of generating tank | 80 [illegible] |
| Proposed capacity of gasholder | 2,000 [illegible] |
| Average percentage of methane in gas | 60 to 77 |

The composition of the sludge also should be considered when endeavoring to find out the rate of evolution of gas. Domestic sewage *per se* is probably better than any other for gas production, and some sewages, so far from containing putrefactive organisms, possess qualities which sterilize those that emanate from domestic sources. Rushes of acid water, for example, affect whatever they come in contact with. One of the Birmingham outfalls is so bad in this respect that in five months a new-cast iron centrifugal pump impeller is pitted all over and the extremities worn to fine points.

(c) The analytical constituents of the gas emanating from the available sewage sludge should be determined with accuracy. The figures in our possession are limited; so far they lead us to say that the gas contains from 60 to 77 per cent of methane, but with frequent determinations taken over a longer period it will be possible to give a more reliable figure.

Table IV gives some of the main figures regarding the sewage-gas installation.

The following observations on the working of the plant between Sept. 6 and Nov. 3, 1921, although varying in some respects with our original estimate, are considerably importance: Total amount of dry solid matter passed through tanks, 4 long tons; average period of retention, 6.4 weeks; average percentage of dry solid matter in wet sludge, 3; (the plant now contains sludge having a proportion of 10 per cent dry solid matter); estimated amount of gas consumed by engine, 25,000 cubic feet.

The total gas yield is, of course, in excess of this amount, but it will only be possible to measure it when a gasholder is available. Under present circumstances a considerable quantity of gas is lost each time a recharge of sludge is made. A certain amount of gas has also been lost in making tests and minor alterations. A gas production of 25,000 cu.ft. from four long tons dry solid matter is equivalent to 1 cu.ft. gas from 0.36 lb. dry solid matter, or a gasification of 18 per cent of the total dry solid matter. This is only 60 per cent [illegible] tanks in the Tame Valley.

In conclusion, it is worthy of remark that the fact which has influenced the author more than any other in following up this experiment consists in this: that 400,000 long tons of wet sludge containing 27,000 long tons of dry solid matter is dealt with on the main works at Birmingham every year, and that as much as 9 000 long tons of dry solid matter is gasified. This is equivalent to 320,000,000 cu.ft.

# Rectangular Enginehouse with Interior Turntable

## Two Canadian Railways Adopt Novel Plan To Reduce Winter Trouble at Terminal by Putting Turntable Under Cover

A TURNTABLE placed inside a rectangular enginehouse and serving sixteen radial tracks with repair pits is the very unusual arrangement adopted at the new engine terminal of the Canadian National Railways at Hornepayne, Ont. Its purpose is to facilitate work under severe conditions due to prolonged low temperatures reaching 60 deg. F. below zero, when turntable work is very hard on the men. It also eliminates snow troubles, although at this place the snowfall is not very heavy as a rule and owing to the extreme cold the snow is usually fine and hard, so that it is not difficult to handle. But at many points snow troubles would make an inclosed turntable very desirable. The general plan is shown in Fig. 1.

This unusual arrangement was adapted from a similar enginehouse built in 1912 at Sault Ste. Marie, Ont.,

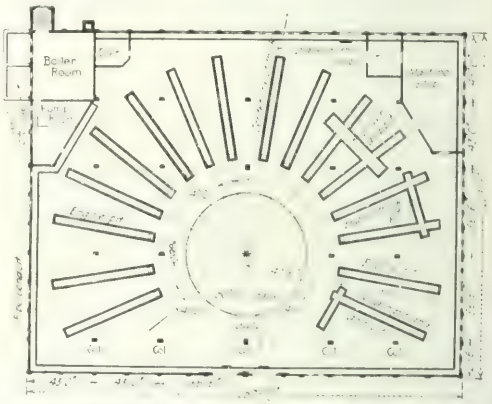



FIG. 1. ENGINEHOUSE WITH INTERIOR TURNTABLE AT HORNEPAYNE, CANADIAN NATIONAL RAILWAYS

for the Algoma Central & Hudson Bay Ry. and designed jointly by R. S. McCormick, chief engineer of the railway, and P. L. Battey, then chief engineer of the Arnold Co., Chicago. In the older building, Fig. 2, 179 x 266 ft., there is a two-track entrance and two tracks extend through the machine-shop at the rear. Steel roof trusses are carried by columns spaced 44 ft. in each direction, except that at the turntable there is a span of 88 ft. A special feature is that the repair pits are served by a circular industrial track of 24 in. gage, this line being connected by turntables with lateral tracks to the drop pits and into the machine shop.

Where the rectangular form of enginehouse has been adopted by American railways it has been the usual practice to have a layout of parallel tracks served by a

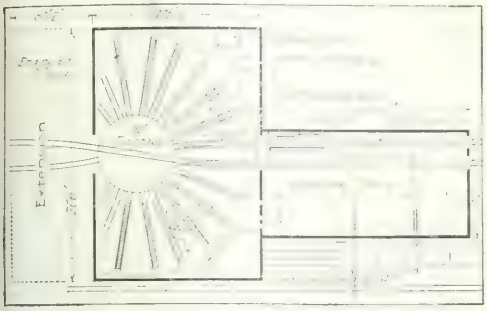


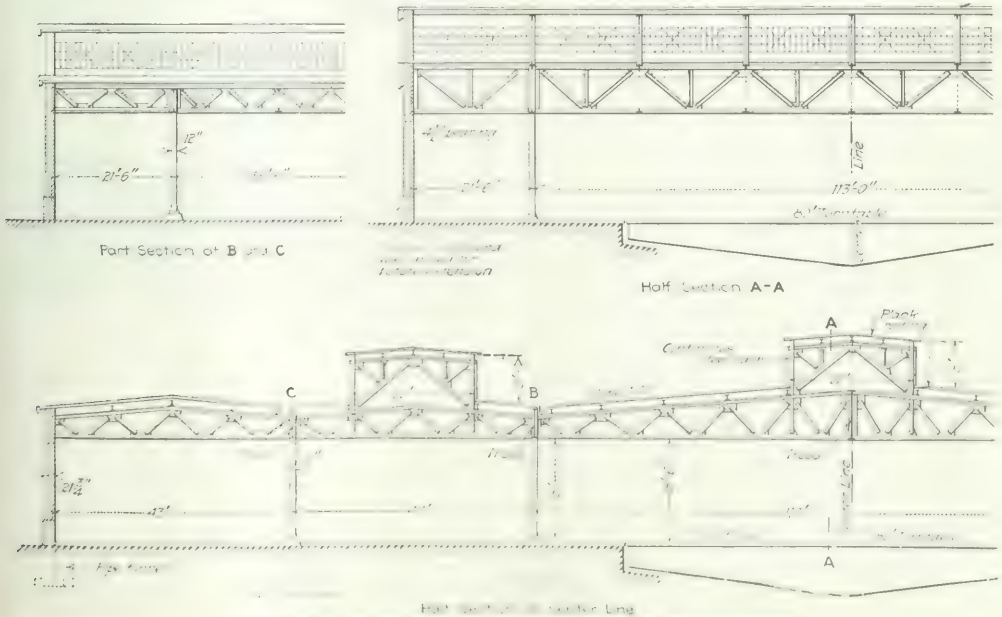
FIG. 2. ENGINEHOUSE WITH INTERIOR TURNTABLE ON ALGOMA CENTRAL & HUDSON BAY RY.

transfer table or by a ladder track on the outside, as in the enginehouse of the Denver & Rio Grande R.R. at Soldier Summit, described in *Engineering News-Record* of May 27 and June 10, 1920, pp. 1069 and 1159. Rectangular structures with inclosed turntables have been used in England. An enginehouse of this type on the Great Western Ry., 440 x 360 ft. has four 65-ft. turntables, each serving 28 radial tracks of different lengths, six of these tracks forming entrances (see *Engineering News*, June 13, 1907, p. 642).

From the plan, Fig. 1, it will be seen that the Hornepayne enginehouse is 287½ x 223¾ ft., with two entrance tracks leading to a turntable near the front of the building, and with another track passing out at the rear. This arrangement provides for a future extension, the turntable being then at the center of the building. This 80-ft turntable is of the center bearing type, operated by a compressed-air tractor which rides on the circle rail. The walls of the building are of brick on concrete foundations which are carried to a depth of 7 ft. A water-bearing mixture of sand and clay makes a top soil difficult to deal with, and quicksand is found at 4 ft. below the foundations. A considerable proportion of the wall area is of steel sash and the track entrances have wooden swinging doors. A cinder floor is laid, except that concrete is placed in the machine shop and boiler room.

Steel roof trusses form a rectangular framing with spans of 21½ to 56½ ft., except that at the center the span is 113 ft. in both directions in order to clear the turntable, as shown in Figs. 1 and 3. The interior columns, built up of H-beams and plates, rest on concrete pedestals whose tops are 11 in. above base of rail. Three monitors 8 ft. high and 22 ft. wide, extending the full length of the building, have their sides formed of steel sash with ventilating panels. This roof is designed for a total load of 10 lb. per sq.ft. and has 3-in. plank sheathing covered with tar and gravel.

Radial tracks laid with 80-lb. rails are spaced at an angle of 14 deg. 12 min. between center lines, except that where columns intervene the angle is increased to 19 deg. All the repair pits are 80 ft. long. Two are connected by a transverse drop pit for handling driving wheels and two others have a similar but smaller pit for handling truck wheels. One of the end pits is reserved for tenders and has a lateral drop pit for handling the truck wheels. A hot water plant for washing out boilers is provided, and all pits have convenient connections to pipe lines for steam, compressed air and hot and cold water. Electric lighting is provided, with portable drop lights for use in the pits. Wood smokejacks are used, of a standard type designed and built by the railway. It is stated that none of them have ever caught fire, as they are protected by fire-resistant paint and soon accumulate a protective coating of soot. These smokejacks are placed 119½ ft. from the center of the



turntable. Six exhaust ventilators with 36-in. openings are placed over the turntable at 30 ft. from its center.

Concrete repair pits are employed, these pits and the turntable pit being all drained to a sewer. No crane is provided, but all raising of the engines is done by jacks. For this purpose a rather unusual floor and track construction is used, as shown in Fig. 4. Each pit wall is covered with transverse timbers 6 x 10-in. laid close together; these timbers are 3 ft. 3 in. long, with one end projecting 5 in. over the pit and the other end spiked to a 6 x 10-in. timber embedded in the soil. At the pilot end of the pit there is on each side a jacking block of concrete instead of the wooden blocks, which arrangement has been found very satisfactory. Track

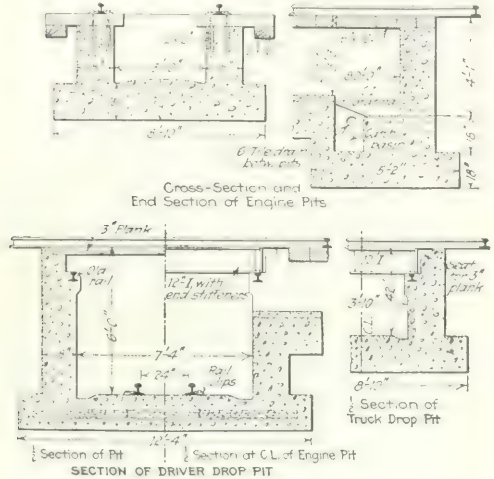



FIG. 4. ENGINE REPAIR PITS AND DROP PITS

rails of 80-lb. per yd. laid upon the transverse timbers are secured by clamps with long drift bolts driven into vertical 2 x 2-in. sticks embedded in the concrete.

Track rails are carried across the drop pits on 12-in. I-beams, the ends of which, fitted with stiffeners, are seated on old 56-lb. rails embedded in the walls of the drop pits. The large drop pit has rails secured to the concrete floor by anchor bolts and clamps, forming a track of 24 in. gage for a truck carrying the hydraulic jack which handles driving wheels. No track is provided in the two smaller drop pits. These three drop pits are covered by loose 3-in. planks when not in use.

A machine shop and blacksmith shop are located in one corner of the building. At the opposite corner are a toilet room, pump room and boiler room, this last having an outside 150-ton coal bin served by an incline track on a trestle. A pipe conduit 3 ft. wide extends around the inside of the wall. Other facilities at this terminal include a 70,000-gal. elevated steel tank, a 200-ton coaling station and an ashpit of the depressed track type. Ashes are shoveled from the pit into cars, except that a locomotive crane with grab bucket is used when available. Steam pipes are carried up through the vertical water supply pipe into the tank and are also laid at the base of the water columns and along the coach tracks.

This enginehouse and the layout of the new terminal at Hornepayne were designed under the direction of A. F. Stewart, then chief engineer. The work has been carried out by railway forces under H. T. Hazen, acting chief engineer of eastern lines, Canadian National Railways; W. V. Appleton, general superintendent of rolling stock, and G. C. Briggs, architect.

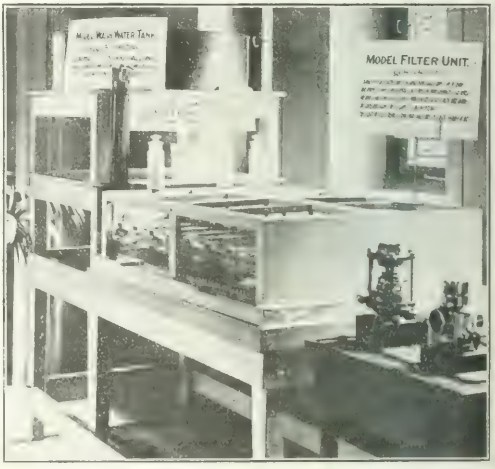
## Water-Works Shares in Exhibit of St. Louis City Activities

By T. Chivvis
Engineer-in-Charge, Distribution Section, Water Division, St. Louis, Mo.

THE various city departments of St. Louis, Mo., were recently requested by the Municipal Reference Library to place on exhibition such apparatus, models, maps and photographs as would show to advantage the activities of the city. The city engineers, among many others, have responded in a manner which has attracted wide attention.

The Water Division constructed a model filter unit on a $\frac{1}{4}$ scale, which was connected to the $\frac{3}{8}$ in. supply of a bubbling fountain and drained into the bowl of this fixture. Head is supplied to the wash water by a circular copper tank supported several feet above the bed. On account of the greatly reduced depth of sand and other difficulties, no attempt was made to filter turbid water. The usual washing rate cannot be obtained on account of the restricted capacity of the bubbler drain, but with these two exceptions the model operates exactly as the real filters.

Two $\frac{5}{8}$-in. glass-case water meters are installed in the




MODEL FILTER UNIT IN EXHIBIT OF ACTIVITIES OF CITY DEPARTMENTS OF ST. LOUIS, MO.

supply line to the filter, not primarily to measure the rate, but rather to illustrate the interior construction of a disc meter and its manner of recording water consumption. Two tapping machines, one for corporation cocks and the other for cast-iron connections, are shown in action on short sections of main. A length of pipe badly eaten by electrolysis, and a couple of pieces of badly corroded pipe, together with photographic evidence of the improvement wrought by cleaning, completed the physical side of the exhibit.

The graphic exhibits consist of maps showing proposed extension work being planned and executed.

# The Probable Frequency of Given Rates of Rainfall

## Average-Rate Method More Economical for Design of Public Works than Uniform-Intensity Method—Data Reviewed

By Adolph F. Meyer
Consulting Engineer, Minneapolis, Minn.

From time to time articles have appeared in *Engineering News-Record* and other technical magazines relating to the probable frequency with which certain rates of intense rainfall may be expected in various parts of the country. In these studies of rainfall a procedure has been adopted which leads to erroneous conclusions respecting the frequency with which given amounts of precipitation may be expected in periods of from about 30 to 120 min. Conclusions regarding the frequency of downpours of shorter duration, as a rule, are not materially affected.

My criticism is directed to the failure to consider rainfalls occurring within 50 min., for example, in determining the frequency with which 60-min. downpours of certain magnitude will probably recur. In the design of engineering works, the fact really used is the amount of rain that falls within a given time, rather than the rate of rainfall in inches per hour for that time. Most runoff formulas use the term "rate of rainfall" merely as a matter of convenience, because this is substantially equivalent to the run-off from an impervious area in cubic feet per second per acre. The rainfall rates commonly used in these formulas are derived from the amount of precipitation registered by rain gages and therefore represent *average* rates for the given time intervals. Hufeland, in his article, "Long-Time New York Rainfall as Basis for Sewer Design—II" (*Engineering News*, Sept. 7, 1916), objects to the use of these average rates and advocates the use of only those downpours having rates of uniform intensity. Notwithstanding his criticism, however, I believe the use of the "average-rate" method leads to safer and, all factors considered, more economical public works than the "uniform-intensity" method which he advocates. If we had 500 or 1,000 years of rainfall records, the latter method would be preferable. After all, "uniform intensity" is but a relative term; it represents the *average* rate for a certain time interval. The measure of uniformity adopted will determine the number of rainfall observations which will be available for use. Until a great many more intense rainfalls have been observed, averaging rates over considerable periods of time is necessary to secure a reasonable record of the frequency of given downpours. The resulting average rate of rainfall undoubtedly is as dependable a basis for a conclusion respecting the required sewer, drain or ditch capacity as the other factor entering into this problem. Hufeland further criticizes the "average-rate" method because he finds that the excessive rates, for a given time interval, are not uniformly distributed through the period of observation. Assuming the records referred to as dependable, the fact stated does not in itself form ground for criticism of the "average-rate" method, but rather of the irregular manner in which given rates of precipitation recur with respect to both time and place.

The 50-year record at New York City, in my judgment, does not form as satisfactory a basis for determining the probable frequency with which given rainfalls will recur as the combined 15- or 20-year records of considerable number of observation stations in this region.

Intense rainstorms usually cover only a few square miles. Observation stations only 5 or 10 miles apart often show as much dissimilarity in the rates of excessive precipitation during intense rainstorms as stations 50 or 100 miles apart. As there are only about two hundred Weather Bureau Stations in the United States at which continuous records of precipitation are being secured, it is apparent that only a few of the downpours which actually occur are being recorded. In some of the larger cities, municipal organizations are maintaining a number of observation stations and are thus obtaining more complete data.

It is safe to say that, taking the country as a whole, doubling the number of observation stations would double the number of records of excessive precipitation obtained in any given number of years. For the same reason, the records of several stations in one region are virtually equivalent to a longer record at a single station. One record supplements the other, making a combined record which is far more representative of the frequency with which given rates of precipitation may be expected than the records of a single station.

The extent to which the records of one station supplement those of another in the same part of the country is well illustrated by a study of Table 11 in my

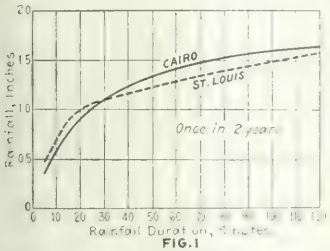


FIG. 1

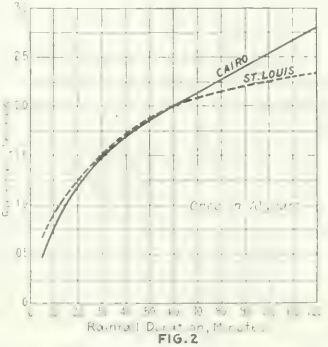


FIG. 2

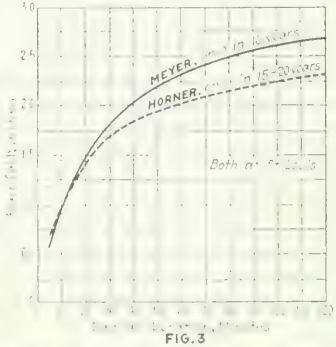


FIG. 3

FIGS. 1 AND 2. MAXIMUM RAINFALL TO BE EXPECTED AT ST. LOUIS, MO., AND CAIRO, ILL., ONCE IN TWO YEARS AND ONCE IN TEN YEARS. FIG. 3. MAXIMUM RAINFALL TO BE EXPECTED AT ST. LOUIS Determined from records of individual stations.

"Elements of Hydrology" (John Wiley & Son, New York City) which gives a summary of 1,962 rainstorms in the United States. Stations with a disproportionate number of very excessive storms usually have a deficiency of ordinary storms. Other stations that have experienced many short storms have had comparatively few long ones, and vice versa.

These same facts are brought out by the curves of Figs. 1 and 2. The data from which these curves are plotted are taken from Table 14 of my "Elements of Hydrology," which in turn is based upon the United States Weather Bureau records for the 19-year period, 1896-1914, inclusive. These curves clearly show that during the 19-year period, St. Louis, Mo., had a large number of exceptionally heavy 5-, 10- and 15-min. downpours and a defficiency of heavy 1-hr. and 2-hr. storms. Cairo, Ill., on the other hand, had a deficiency of short downpours and an excess of storms of long duration. Cairo had a few extremely heavy long storms. At St. Louis these were lacking. Neither experience is representative of the average frequency of recurrence of such storms.

The effect of estimating the probable frequency of recurrence of intense rainstorms from the records of a single station is well illustrated by the curves of Fig. 3. The St. Louis (Mo.) standard intensity curve as given by Horner, in my judgment, shows rates which are too high for 5-min. downpours and decidedly too low for storms lasting from 45 to 120 minutes. (Run-off computations for 70,000-acre storm water drainage area, St. Louis, *Eng. News*, Mar. 22, 1917, p. 470.)

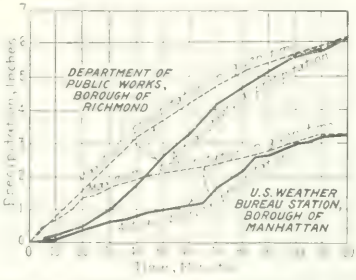



FIG. 4. DIFFERENCES IN RAINFALL AT NEAR BY STATIONS

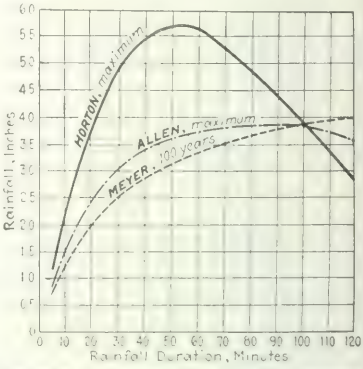



FIG. 5. MAXIMUM RAINFALL TO BE EXPECTED IN A GIVEN TIME-INTERVAL, NEW YORK CITY

During the 19-yr. period above referred to, St. Louis had four 5-min. downpours within which more than 0.6 in. of rain fell. This is equal to the number of similar downpours observed at Jacksonville, Fla., during the same period and one more than the number observed at Galveston, Texas. Or, to put it another way, at St. Louis, during the 19-yr. period, as many or more heavy 5-min. downpours occurred as at any other one of 43 stations in the United States included in the rainfall studies summarized in Table 11 of my "Elements of Hydrology." On the other hand, during the same time interval, only two storms occurred at St. Louis within which more than 1.8 in. of rain fell in one hour. This is less than fell in one hour at any one of the 18 stations located in regions of comparably heavy precipitation, for which data are given in my Table 11, previously referred to.

The difference between intense rainfalls at near-by stations is well illustrated by Fig. 4, which is a record of the New York City storm of Oct. 1, 1913, as observed in the boroughs of Richmond and Manhattan. There is practically no similarity between coincident rates of rainfall at these two stations, only five miles apart.

Assuming now that for most purposes engineers will continue to use the "average-rate" method as against the "uniform-intensity" method in the analysis of rainfall records, I contend that if a downpour ends in 25 min., for example, the amount of rain which fell in that time should also be used in determining the average rate of rainfall for 30 min., etc. A mere statement of the case would appear to carry conviction with it. It is not apparent that there is any material difference between the effect on a sewerage or drainage system of a storm lasting 60 min., for example, during which there is an interval of very light rainfall for 10 min., and another storm within which the same amount of rain falls during 50 continuous minutes.

As an illustration of the inconsistency of grouping storms exclusively by duration in minutes rather than by amount of precipitation in inches, the storm at Buffalo, New York, March 20, 1897, may be cited. During this storm, 0.79 in. of rain fell in 5 min. This amount of precipitation was equal to a 10-min. downpour to be expected only once in about 15 yr. Therefore, in determining the frequency of given rainfalls in Buffalo, this storm should clearly be considered also as a 10-min. storm, even though the rain all fell within 5 minutes.

On Aug. 20, 1901, 1.77 in. of rain fell at Cleveland, Ohio, in 20 min. During the next 5 min., only 0.01 in. fell, or 1.78 in. in 25 min. This storm did not last 30 min.; nevertheless, 1.78 in. may be expected at Cleveland in 30 minutes only once in about 25 years.

Another storm of this character is that of Aug. 12, 1910, at Duluth, Minn., when 1.38 in. fell in 20 min. and 0.02 in. during the next 5 min. Although this storm lasted only 25 min., yet the amount of rain which fell is to be expected in 30 min. only once in about 12 yr. at Duluth.

Another illustration is the 20-min. storm of Sept. 30, 1902, at Indianapolis, Ind., when 1.08 in. fell in 10 min., and only 0.01 in. in each of the succeeding 5-min. periods. There is no more reason for including this storm among the 15- and 20-min. downpours because 0.01 in. fell during each of the last two 5-min. intervals than if the storm had ended completely in 10 minutes.

Hundreds of examples of this kind could be cited. It is not at all unusual for the rate of rainfall to become very small just before the end of the storm. For this reason, it is just as logical to consider a 45-min. downpour as a 60-min. storm as if a few hundredths of an inch of rain had fallen during the last 15 min. The basis for grouping should be the amount of precipitation; and the average rate of rainfall to which this

amount is equivalent should receive consideration for all time intervals within which it appears excessive.

The amount of rain that fell during most of the 100 typical intense rainstorms for which detailed data are given in Table 12 of my "Elements of Hydrology" (pp. 161 to 172), was equivalent to excessive rainfall rates over time intervals considerably longer than the actual duration of the storm. Some of these rainstorms yielded very little precipitation at the beginning of the storm, others near the middle of the storm, and still others near the end. The determination and use of intense rainfall rates for time intervals beyond the actual duration of the storm is but a reasonable interpretation and extension of the "average-rate" method of analysis.

How illogical it is to group downpours only with respect to time is well illustrated by Allen's Table No. 1, in "The Prediction of Probable Rainfall Intensities," *Engineering News-Record*, April 7, 1921, p. 588. Allen has no record of rainfall exceeding 1½ in. per hour for 120 min. (equivalent to 3 in. of rainfall) even though 3.14 in. actually fell at the Central Park Observatory in New York in 100 min. on Oct. 1, 1913; 3.60 in. fell in 80 min. on Sept. 4, 1913, and 3.02 in. fell in 60 min. on July 28, 1902.

A similar error appears in Horton's Table No. 3, in his article "Some Broader Aspects of Rain Intensities in Relation to Storm Sewer Design," published in *Municipal and County Engineering*, June and July, 1919. According to this table, a rate of 1.33 in. per hour for 120 min. or 2.66 in. of rain, is the maximum to be expected in New York City once every 45 yr. Nevertheless, the same table shows that 3.40 in. of rain is to be expected within one hour once every 45 yr. It is not conceivable that a rainfall of 3.40 in. in one hour may be totally disregarded when estimating the probable frequency of 2-hr. rainfalls. The fact that once during the period of record 3.40 in. of rain fell in 60 min. is no good reason for assuming that the next time a similar storm passes over this territory the same amount of rain may not be distributed over 80, 100 or 120 min. As a matter of fact, 3.60 in. did actually fall in 80 min. during this same storm.

Hufeland's Table II, (*Engineering News*, Aug. 31, 1916, p. 396) is similarly in error. This table shows only eight storms in New York City of 120 min. duration giving more than 2 in. precipitation, yet there was one storm lasting 100 min. during which 3.14 in. fell; two other storms lasting 80 min., which yielded 2.94 in. and 3.60 in. each, and two storms of 60 min. duration, which yielded 2.66 in. and 3.02 in. each. In other words, the record shows that 2 in. of precipitation may be expected in 120 min. once in about three years instead of once in nearly six years, as given in Hufeland's table.

In order to clarify this matter further, Fig. 5 has been prepared. The curve labeled "Horton-Maximum" is plotted from data given in Horton's paper, *Municipal and County Engineering*, July, 1919; and that labeled "Allen-Maximum" is plotted from Allen's paper in *Engineering News-Record*, April 7, 1921, both previously mentioned. The curve labeled "Meyer-100 yrs." is plotted from the weighted average of data given in Table 15 of my "Elements of Hydrology." New York City is in "Group 2" (p. 151, "Elements of Hydrology") but lies so near the borderline of this group of stations that the data in Table 15 for Group 2 are given a weight of 2, and those for Group 3 are given a weight of 1, in computing points for the "Meyer-100 yrs." curve.

It seems self-evident that the longer the time interval, the greater the amount of precipitation which may be expected with given frequency. It would not appear to require any argument to disprove the contention that 5.75 in. of rain may be expected in New York City in one hour as frequently as 3 in. may be expected in two hours.

# Breakwaters of Three Types in One Lake Harbor

## Rubble Mounds, Concrete Caissons and Rock Filled Pile Cribs for U. S. Naval Station at Great Lakes, Ill.

THREE types of breakwater construction are to be used for the protection of the new harbor for the U. S. Naval Training Station at Great Lakes, Ill., thus affording an interesting comparison of respective costs under similar conditions. These three types are as follows: (1) Rock fill between two lines of closely driven round piles, with a heavy concrete cap or superstructure poured in place; (2) stone rubble mound; (3) hollow concrete caissons sunk on a bed of broken stone, filled with stone and capped with concrete poured in place. The first type will be used in water from 4 to 14 ft. deep; the others will be in depths of 14 to 21

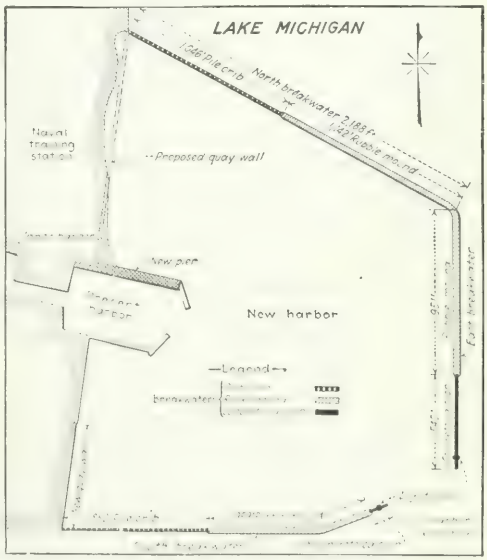



FIG. 1 BREAKWATERS OF DIFFERENT TYPES FORM LAKE HARBOR

ft. A plan of the harbor, showing the positions of the different types of breakwater which are to be built, is given in Fig. 1.

Reasons for this combination of breakwater types at one harbor may be summarized as follows from a statement furnished by the engineers:

A. For shallow water, the rock-filled pile crib construction was considered to be the cheapest and to serve the purpose adequately, since there will be no heavy seas in such shallow depths. Further, experience indicates that these depths will be reduced by shoaling

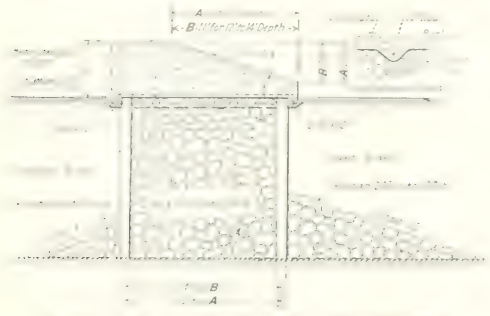


FIG. 2. PILE AND ROCK-FILL BREAKWATER

along the breakwater, particularly on the north side of the harbor.

B. For deep water, the high cost of timber made rock-filled crib construction prohibitive. The rough stone rubble mound has been found sufficient on the lakes in breaking up the waves and not allowing the passage of solid volumes of water such as would be carried over a smooth-faced breakwater. As a concrete caisson breakwater presents a smooth face to wave action is was not considered so efficient as the rubble mound.

C. For the harbor entrance, two factors governed the selection of concrete caisson construction: (1) With their nearly vertical sides they permit of the widest navigable opening for a given width of entrance, as compared with the slope of a rock mound; (2) a solid foundation was required for the lighthouses which mark the entrance.

*Pile and Rock Fill Breakwater*—For this construction, shown in Fig. 2, two rows of closely driven piles will retain a fill of loose rock in sizes weighing from 10 lb. to 2,000 lb. each. The distance between the two rows varies uniformly from 8 ft. at the shore end to 14 ft. at the outer end. A minimum penetration of 10 ft. is required, with, if possible, at least 2 ft. in hardpan. Each row of piles will have an outside wale composed of two 6 x 12-in. timbers bolted to every pile. Tie rods 8 ft. apart will pass between the piles and through the wales, the rock fill being hollowed out to form a trough under each rod, so that the rods will be embedded later in the concrete cap. Riprap will be placed outside of the piling, as shown. Experience has shown this to be important, as a number of piles not thus protected were thrown over in a recent storm, apparently due to scour along the toe of the piling.

On the lake side every third pile is to extend 15 in. above the water level and on the harbor side every fourth pile will extend 24 in. above this level, these pile heads being gained or grooved horizontally to form a bond with the concrete cap. Burlap will be laid over the rock fill to prevent the concrete for the superstructure or cap from escaping between the stones. The outer side of the superstructure will have a slope of 1 on 3.12. Piling and filling will be completed this season, but concreting will be left until the spring of 1922, thus allowing ample time for the fill to settle and become stable. The concrete superstructure will be constructed with joints at 50-ft. intervals, these joints being filled with four layers of felt.

*Dense Concrete*—In order to obtain as dense a concrete as possible for marine work, the specifications provide for a mixture of 1 part cement to 4 parts of coarse aggregate and a variable amount of sand. The coarse aggregate consists of stone passed by a 2-in. screen and retained on a ¾-in. screen. The amount of sand will be determined experimentally as follows: To a representative sample of the dry stone having a fixed volume (not less than 5 cu.ft.) will be added a fixed volume of dry sand, and after thorough mixing, the weight and volume will be determined. After repeating this process several times the proportion of sand that gives the heaviest mixture per unit of volume can be determined and this proportion used in mixing the concrete. These tests will be conducted every 24 hours, or as often as the characteristics of the stand or stone vary.

Forms are to be smooth and water-tight, and of such height as to protect the concrete from wave action while setting. Surfaces not in contact with forms must be brought up slightly above the edge of the forms, struck off with a long straight edge and thoroughly compacted and smoothed by working and trowelling. These sur-

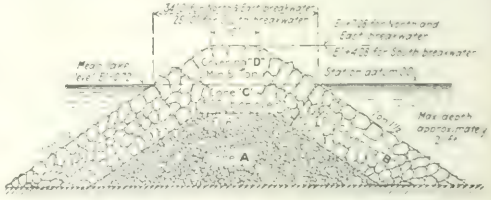


FIG. 3. ROCK RUBBLE MOUND BREAKWATER

faces will then be protected from the sun, rain or spray until they have attained their final set. Forms will not be removed sooner than 36 hours after the concrete has been poured, and the surface will be kept wet and protected from the sun for a period not exceeding five days after pouring. The object is to obtain a dense concrete having a smooth surface without sharp edges or projections.

*Rock Rubble Mound Breakwater*—In this construction, shown in section in Fig. 3, the core is of well graded quarry run stone with not to exceed 5 per cent of dust and having side slopes not exceeding 1 on 1½. Below the water level the slopes of the core are to be covered with stones weighing one ton or more, 85 per cent to weigh two tons or more. These will be deposited by derricks to a thickness of not less than 10 ft. On the top of the mound will be laid stones weighing 5 tons or more, with their long axes as far as possible perpendicular to the face of the breakwater, and with no surfaces projecting more than 10 in. outside or inside of the theoretical cross-section. These stones will be carefully set by derrick and will be wedged and blocked on the core by stones weighing not less than 500 lb. The covering stone above the water line is a hard dense and non-absorbent granite from Lohrville, Wis.; all other rock is a dense limestone from Lemont, Ill.

*Concrete Caisson Breakwater*—This construction is used only at the harbor entrance, where the rubble mound breakwater would greatly decrease the navigable opening of the harbor due to the long subsurface slopes of rough stones. Hollow reinforced-concrete caissons 54 ft. long, of the form shown in Fig. 4, will be floated into place and sunk on a bed of rock deposited in a dredged trench. This trench will be dredged to a depth

of 4 ft. unless hardpan is encountered at a depth of less than 3 ft. below lake bottom, in which case the trench will extend only 1 ft. into the hardpan.

In the trench will be deposited rock varying in size up to 500 lb. to within 2 ft. of the lower surface of the caissons. On this will be 2 ft. of rock from 10 to 100 lb., well graded and leveled to uniform elevation. The subfoundation will be laid this season and the foundation and caissons placed next spring. The caisson foundation will be protected by rip-rap.

The caissons will be sunk by filling them with water and will then be filled with rock varying from ordinary minimum run-of-crusher size to 500 lb. stone, to within 3½ ft. of the top. After 30 days, the filling will be covered with 6 in. of lean concrete, on which will be the cap or superstructure of concrete, conforming to the specification described above for the superstructure of the pile and rock fill breakwater. These caissons will be built at the plant of the U. S. Army Engineers at Milwaukee, Wis., in accordance with the War Department standard design as prepared originally by Col. W. V. Judson, U. S. Corps of Engineers (see *Engineering News-Record*, Aug. 8, 1918, pp. 258 and 287). They will be delivered to the contractor in the harbor of Waukegan, Ill.

*Unit Cost of Breakwaters*—This combination design of harbor protection at Great Lakes affords an interesting comparison of the costs of the three types of breakwaters. The contract has been awarded on the lump sum basis, but the following is an estimate of the average cost per linear foot.

Type 1. Rock Filled Pile Crib—Piling, timber, rods, etc., $35.82; rock fill, $24.08; concrete cap, $43.35; total, $102.25.

Type 2. Rock Rubble Mound—Core stone A, $37,84; core stone C, $23.92; cover stone B, $91.24; cover stone D, $71.50; total, $224.50.

Type 3. Concrete Caisson—Dredging, $6.90; foundation, $31.98; rip rap, $17.84; filling, $28.70; placing, $11.30; concrete cap, $34.78; caisson (furnished by U. S. Government), $90.75; total, $222.25.

Studies for the harbor design at Great Lakes, the determination of the most suitable types of breakwater and plans and specifications for the work were prepared by Commander Walter H. Allen, Civil Engineer Corps, U. S. Navy, public works officer of the Naval Training Station, and were approved by Rear-Admiral C. W. Parks, chief of the Bureau of Yards and Docks, U. S. Navy Department. In May, 1921, the contract was awarded to the Great Lakes Dredge & Dock Co., Chicago, at a lump sum price of $967,326. The concrete caissons are estimated to cost $4,900 each. The cost of the breakwater complete will approximate $1,026,126.

Construction work is under the direction of Commander Allen, public works officer of the training station, whose assistant is Lieutenant Henry Niemann, civil engineer corps, U. S. Navy.

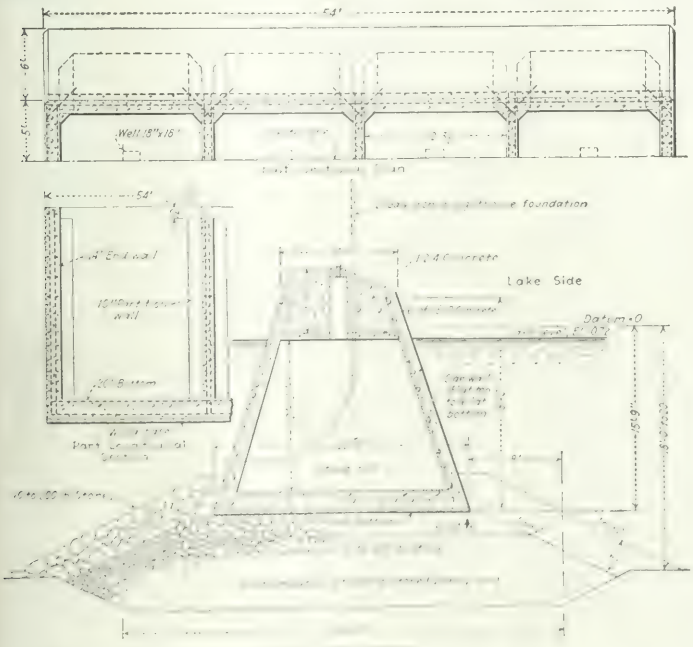



FIG. 1. CONCRETE CAISSONS FOR HARBOR BREAKWATER AND LIGHTHOUSE SUPPORTS

## Highway Bridge Fire Protection Under Study

Fire protection principles for highway bridge floors are being studied by a joint committee formed under the auspices of the American Wood Preservers' Association. George W. Booth, chief engineer of the National Board of Fire Underwriters, 76 Williams St., New York, is chairman of the committee, and E. F. Kelley, bridge engineer, U. S. Bureau of Public Roads, Washington, is secretary. At the initial meeting, held at New York on Dec. 13, bridge-floor fire experiences and various means of protection were canvassed. A study of current floor designs from the fire-protection standpoint was decided upon, to reveal the principal points of weakness of floors from the fire standpoint. In connection herewith the committee desires information and opinions from engineers connected with the design and maintenance of highway bridges as to start and spread of floor fires. It is expected that the influence of creosoting practice on the fire risk will be taken up later. The work to be done will, in the committee's opinion, bear mainly on long bridges, in which the spread of fire is an important factor in the result, but it is thought that the principles developed will also prove of value in application to smaller bridges. The committee includes C. M. Taylor and L. T. Ericson of the American Wood Preservers' Association, F. E. Schmitt, *Engineering News-Record*, and D. F. Holtman, National Lumber Manufacturers' Assn.

# LETTERS TO THE EDITOR

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## One Example of Wage Reduction

Sir—With our publications full of the questions of lower wages and lower building costs it seems that the question of a living wage for the construction engineer has been put in the background.

These men, always underpaid, are now forced to accept cuts in salary out of all proportion to the increases, however slight, which they received during the war.

The writer, like many others, served in the Engineer Corps abroad during the war, returned in 1919, located in a new job, only to be laid off when the depression came, and accepted an offer to go into the field at a cut of about 40 per cent, being told that "the war is over" and that wages had returned to a pre-war status. Imagine then our chagrin to see the weekly pay rolls still carrying carpenters at $60 a week, bricklayers, masons and foremen running anywhere from that figure up to $70 per week and getting it steadily. Is it justice to hold a man who has given four or five years of his life to the study of his profession and as many more to preparing himself in experience, to a salary of $40 or $50 a week because he is not backed by a labor union? And on top of this to hold him responsible for the acts of omission and commission of the various foremen whose weekly envelopes put his to shame.

The woods are full of good men out of work but that is no reason that those who are fortunate enough to be working should not receive a salary commensurate with their ability and responsibilities. The contractor of today is pointing an accusing finger at the labor unions as the cause of the high building costs and on the other hand is giving a pretty good indication of what he would do to them if they had no union by the way in which his engineering forces are cut to the bone.

The older and wiser heads of the great engineering societies frown on any suggestion of their giving support to a demand for a living wage for the younger members of the profession and intimate that we are becoming too commercial and losing sight of the definition of a true engineer. And yet the pot must boil and without stirring the broth is certainly mighty thin. "EX SERVICE."

## Brooklyn Theater Roof Trusses Criticized

Sir—The collapse of the roof of the theater building in Brooklyn, on Nov. 29, as reported in your issue of Dec. 8, p. 9, is—contrary to the opinions expressed—rather due to faulty design than to poor erection work.

The roof trusses were not of the regular type with straight bottom chords, but of one of those many forms that appear occasionally, when triangular, rectangular or trapezoidal trusses do not suit the purpose and arched trusses are found to be too difficult to design. In the form chosen for the trusses the elastic nature of the material seems to have been entirely overlooked. The construction as well as the result point to this.

When trusses of such forms are laid up on brick walls, one end is preferably placed on a roller bearing on the wall to allow the changes in length of the truss for the various loads to take place without undue resistance. If one end of such roof trusses rests on a girder which can yield laterally between its points of support, while the other end rests on a brick wall, the changes in length will probably lead to a lateral deflection of the girder at the top, and it surely will if the other end of the roof trusses are anchored to an unyielding brick wall.

Had the column on which one end of the girder rested, been [illegible] by means of a longitudinal pin, and had the roof trusses been anchored to the wall, the structure would probably still be standing, but as the column rested squarely on its foundation a considerable resisting moment due to the load was developed at the foot when the lateral deflection of the top of the girder took place. This resisting moment caused stresses in the column and its extension, a strut rigidly connected to the column and serving as support for the roof truss. Anchor bolts at the foot of the column could not have prevented the development of such stresses.

The starting point of the failure seems to have been at this vertical strut. Its buckling under the combined stresses from the load of one-half of the end truss and from the aforesaid bending moments let the end of the truss down, and this truss pulled the column and the end of the girder along in its fall and inward, the latter rotating about the support at the other end. The damage to the brick wall at this point is rather due to the reaction from the heavy blow when the end of the girder struck the ground than to anything else. The damage to the piers elsewhere is probably entirely due to the pulling down of the trusses. Such piers are not ordinarily expected to stand abuse of this sort. The diagrams shown in connection with your description of the wreck suggest a mode of failure as indicated above. Had there been a kneebrace at the end truss, or had the column been carried up to the top of the longitudinal truss, the failure would probably have been avoided.

Apparently there are several errors in the design. They are easily enough spotted when one's attention is drawn to their presence, but somehow they seem to have a chance to slip by unnoticed here and there occasionally for one reason or another.

New York, Dec. 17. E. R. T. BERGGREN.

## Must Cover Reinforcement Well

Sir—I read the article in *Engineering News-Record*, Dec. 8, 1921, p. 924, regarding the deterioration of concrete bridges in Nashville and as I was passing through that city recently I stopped off and took a good look at these structures. It seems to me that your correspondents have not placed sufficient emphasis upon the principal lessons to be learned from the condition of these structures.

The most glaring defect is the insufficient covering of reinforcing steel. In hundreds of cases of spalling observed by the writer, the very apparent cause was the fact that the reinforcing members were placed from ¾ in. to 1 in. from the surface of the concrete. Such a condition as this is sufficient explanation of all the troubles although there may be contributing factors. There was not a single instance that the writer could find in the course of his superficial investigation where spalling occurred due to any other cause.

The lessons to be learned from this fact are lessons that have been taught for years by many such defects in various structures, of various materials in various places, i.e., the disigner must so proportion the members as to allow sufficient room for reinforcing members to be properly placed without coming nearer than 1½ to 2 in. from the concrete surface at any point. The engineers responsible for construction must make sure that no steel, whether main reinforcing members, secondary members such as stirrup and ties, or construction members such as wire ties, is allowed to be placed nearer to the surface than the distance specified.

The concrete railing of these bridges was composed of crushed limestone aggregates of a somewhat flaky shape, and the surfaces were scrubbed while green in order to remove the cement film. The writer believes that this is bad practice, that it is permissible to use the washed surfaces only when an aggregate of hard rounded pebbles or particles is usual so as not to form small pockets over the surface which holds water. In general, when using a limestone aggregate it is better to specify a rubbed surface finish.

These two points are the main lessons to be learned from this particular case but perhaps it may be well also to call attention of concrete designers to the great difficulty of

obtaining waterproof concrete in field operations, and the necessity of getting plenty of good concrete around all reinforcing members, especially between reinforcing members and surfaces exposed to an atmosphere charged with corrosive gases.

There is one more point well illustrated by this case as well as by many others examined by the writer; that is the necessity of covering properly all secondary members. I have seen instances where the end of a ¾-in. tie, for column rods, came so close to the concrete surface that rust started at this exposed end, causing a very small piece of concrete to be spalled off by the expanding rust; then the rusting pentrated deeper and deeper, spalling off larger and larger pieces until the main reinforcing was reached and corrosion started on it, spalling off the protecting concrete regardless of its thickness or its physical condition. The only way to prevent this progressive corrosion is to make sure that it don't start. WILBUR J. WATSON.

Cleveland, Ohio, Dec. 15.

## Technical Supervision of Construction Required on Public Work

Sir—In your editorial on "Engineers or Builders," Dec. 8, p. 923, I note the sentence, "At any rate, as yet no community, no city or state, has made professional supervision of building a legal requirement." I would call your attention to Section 19 of the Michigan registration act, which reads as follows:

> Sec. 19. After the first day of March, 1920, neither the state, nor any county, township, municipality or village, shall engage in the construction or maintenance of any public work of an architectural or engineering character, for which construction or maintenance, the plans, specifications and estimates shall not have been prepared by a registered architect or a registered engineer under this act with qualifications appertaining to such work, *and the construction of which is not supervised by such a registered architect or registered engineer;* provided, That nothing in this section shall be held to apply to items of maintenance, repair or construction wherein the contemplated expenditure for the completed project does not exceed two thousand dollars.

This does not wholly vitiate the correctness of your statement, but it goes a little way toward showing a tendency toward better things. GARDNER S. WILLIAMS,

Ann Arbor, Mich., Dec. 19. Consulting Engineer.

Sir—Your editorial in the issue of Dec. 8, p. 923, under the caption "Engineers or Builders?", states—"as yet no community, no city or state has made professional supervision of building a legal requirement." Alas! this appears too true, in spite of the fact that engineers' registration laws have been enacted in a number of states.. The general intent of licensing engineers undoubtedly is to protect the public from accidents and bad construction by legally requiring the services of competent engineers. Drafts of registration bills have been drawn, particularly by the American Association of Engineers, in which design and supervision of construction by registered engineers were requirements. But when the bills were entered, the proponents evidently lost nerve, cut out the essential part, and generally provided only that no one should call himself a registered engineer unless he was one. Thus the chief purpose of registering engineers is lost and the result has simply been to force other states to register engineers, first for reciprocity to protect their own engineers from being discriminated against, and second to keep out incompetents leaving states that have registration laws. Nothing is worth doing unless fearlessly done right. May we not hear from engineers from the different states the history of this important point: the legal requirements of professional design and professional supervision of construction?

The same article states that some building officials are advocating licensed builders but that no practical trial has been made. The city of Boston requires that no construction work shall be done unless a man is on the job who is licensed to take personal charge or control of the work. John F. Hickey is chairman of the board of examiners. Licenses are issued to builders to construct different classes of buildings as stated in the license, and as determined in each case by the board after considering a written statement of experience and work done and an oral examination. Licenses may be revoked on account of complaints against a man for failure to perform his duties properly, and are renewable each year after an examination as to what the licensee has done and any complaints against him. A hardship has developed in the requirement that the licensed master builder must remain continually on the job, even though it were a small job in some one branch of the work that could be left in charge of a competent foreman. To obviate this, licenses are now granted also for different trades.

While it is as advisable to retain an engineer or architect to supervise construction and design as it is to retain a doctor for an operation on the body, so also it is the same advantage to have tried and licensed builders (and even foremen) as to have a trained nurse to carry out the doctor's orders. The engineer may give instructions and advice, and condemn bad workmanship, but undoubtedly good workmanship rather than making good the bad workmanship is most economical and is essential and can be best attained by the experienced workman under the control of an experienced foreman.

Yet engineering is required for construction as well as good and proper workmanship. Your advocating compulsory supervision of building work by the engineer or architect is sound policy. Massachusetts (including Boston) lacks that. Boston's licensed builders undoubtedly get good workmanship and the work is duly inspected by city building inspectors. Besides the designs are inspected by engineers of the building department. But compulsory supervision of construction by an engineer or architect is not required and is often neglected by an ignorant owner who is penny-wise and pound-foolish and employs an engineer or architect only to design the work, and that simply because of the requirement of the building department for satisfactory plans.

Failures in buildings occur generally during construction, and more often are chargeable to the lack of a competent construction engineer, than to poor workmanship. Therefore, for the safety of the public the laws should enforce employing the services of a competent engineer or architect for the supervision of construction as well as for the designing.

After all is done, accidents will happen in the best regulated families. Often designs are made without a view to the practical operation of construction. The deflecting of a long truss when the load is being applied may throw an eccentric stress on a column and cause the column to kick out and throw the whole structure, unless it has been designed for this stress. And yet such a design may be passed by a building department engineer as satisfactory to hold, if the building were completed.

But who has to pay the cost of examinations, and registrations? The poor engineer! FREDERICK O. LEWIS,

Boston, Consulting Architect and

Dec. 17. Construction Engineer.

## Actual Stresses In British Impact Tests

Sir—Referring to your extremely interesting report on certain impact tests for British bridges, Oct. 20, pp. 642-645, the writer would like to point out one or two features suggested by a study of the table of results.

Because of the fact that in our bridge specifications and practice the increment for impact, etc., is added to the *calculated static* live-load stress and not to any recorded stress, the attached supplementary column A has been figured to show the ratio between column 14 of the original table, which gives the maximum recorded live-load stress, and column 12, the calculated static live-load stress. This is the only set of figures which, strictly speaking, can be compared with the results obtained from any of our actual formulas. Examining this table we find at once the effect of the phenomenon noted in the text of your article, that the live-loads as figured, even from definite concentrations, very seldom occurred in the

members. Out of 59 cases, 43 show the sum of live-load plus increment to be less than the calculated static live-load. One case is obviously a freak; it is a web measurement, and a great deal more information would be required in order to properly appraise its significance. One other case shows an increase of 92%, two show about 50%, two show about 35%, and the remaining ten are between 5% and 20%. Plotting these figures on your Fig. 2, p. 644,

LIVE-LOAD STRESS RATIOS AND UNIT STRESSES IN BRITISH IMPACT TESTS

| A | B | C |
|---|---|---|
| Col. 13 ÷ Col. 12 Actual calc't'd | Col. 11 + Col. 14 Total Actual Unit, Lbs. per Sq. In. | Col. 11 ÷ Col. 12 × Imp. = 300/300 + I Live-load Unit, Lbs. per Sq. In. |
| 0.64 | 6,500 | 15,100 |
| 0.84 | 2,500 | 6,100 |
| 0.66 | 7,400 | 18,900 |
| 0.64 | 6,700 | 17,800 |
| 1.02 | 7,400 | 7,600 |
| 1.36 | 5,300 | 7,600 |
| 0.62 | 5,600 | 14,900 |
| 0.40 | 4,200 | 17,600 |
| 0.61 | 4,200 | 11,900 |
| 0.55 | 3,800 | 11,900 |
| 1.31 | 5,300 | 7,500 |
| 0.82 | 6,700 | 14,600 |
| 0.61 | 3,900 | 8,000 |
| 0.75 | 7,200 | 18,100 |
| 0.72 | 6,500 | 16,500 |
| 0.58 | 11,400 | 30,600 |
| 1.35 | 8,800 | 11,400 |
| 0.94 | 8,400 | 15,900 |
| 1.07 | 7,600 | 13,300 |
| 1.05 | 5,800 | 9,500 |
| 1.18 | 5,400 | 8,400 |
| 0.75 | 5,800 | 11,800 |
| 1.12 | 4,300 | 6,400 |
| 0.79 | 6,200 | 12,800 |
| 0.83 | 10,400 | 14,200 |
| 0.96 | 2,500 | 4,400 |
| 0.89 | 6,700 | 11,800 |
| 0.83 | 4,700 | 9,800 |
| 0.96 | 5,500 | 9,400 |
| 1.04 | 4,700 | 7,300 |
| 0.66 | 7,600 | 14,700 |
| 0.80 | 4,900 | 10,700 |
| 0.17 | 4,700 | 21,260 |
| 0.34 | 6,700 | 14,300 |
| 0.61 | 5,500 | 8,900 |
| *3.37 | 4,000 | 2,500 |
| 0.66 | 5,300 | 8,200 |
| 0.68 | 8,800 | 17,300 |
| 1.04 | 10,300 | 16,100 |
| 0.78 | 9,900 | 19,000 |
| 0.59 | 9,200 | 13,600 |
| 1.02 | 8,700 | 11,100 |
| 0.63 | 6,600 | 12,700 |
| 0.48 | 3,700 | 8,200 |
| 1.05 | 5,900 | 8,300 |
| 0.75 | 2,700 | 4,500 |
| 1.31 | 7,100 | 7,400 |
| 0.73 | 9,700 | 15,700 |
| 1.18 | 9,800 | 12,500 |
| 1.12 | 12,400 | 17,400 |
| 0.66 | 6,600 | 12,900 |
| 0.82 | 6,900 | 11,300 |
| 0.50 | 5,400 | 11,300 |
| 0.50 | 8,300 | 18,800 |
| 0.40 | 6,500 | 16,400 |
| 0.75 | 7,400 | 11,800 |
| 0.57 | 7,600 | 14,400 |
| 0.96 | 7,900 | 11,400 |
| 0.48 | 6,900 | 14,100 |

gives quite an uninterpretable series of points, palpably insufficient for the derivation of any formula.

Another interesting point is provided in the determination of the actual total unit stresses, using the calculated dead-load unit and the maximum recorded live-load, including increment. Column B of the table herewith shows these units in pounds per square inch. They seem distinctly safe.

An examination was also made of the unit stresses as they would appear on a stress sheet, using the calculated dead-load unit, calculated live-load unit, and an increment for impact given by the Schneider formula—300/300+I. Column C shows these resulting "working" or "designing" stresses, and reveals a remarkable range, running from 4,500, excluding the freak case before mentioned, to 30,600 lb. per sq.in. As these live-loads are supposed to be produced by "one or two locomotives, typical 2-cylinder passenger type, chosen from approximately the heaviest on each system" they must be reasonably close to the specified loading for which the bridges are figured, and the units in column C would indicate a very wide difference in practice, and would serve to strengthen any argument for a certain measure of standardization in design, or at least standardization in calculation methods.

If there is one result more outstanding than any other from a study of this article and the accompanying table it is that, until we know a great deal better than we would seem to know at present how our live-loads are actually taken up, it is mis-spent zeal to keep continually revising and refining our impact allowance.

Montreal. P. L. PRATLEY,
Oct. 26. Consulting Engineer.

## Assisting the Geological Survey

Sir—I would like to call the attention of all railway engineers to the article by Geo. W. White, in the *Engineering News-Record*, for Nov. 10, p. 764, regarding the methods adopted by the Southern Ry. for its resurveys, particularly the statement that all lines were referred to true north as determined by observations on Polaris.

For some time past, the U. S. Geological Survey has been conducting an educational campaign in its endeavor to induce railway and highway engineers to refer all survey lines to true north rather than to magnetic north. If true bearings for railway and highway alignment surveys were available the Geological Survey could, without further field traverses, compute accurate geographic positions from them and use them for the control of topographic maps, thereby saving from 5 to 10 per cent in the cost of completing the topographic mapping of the United States. This is, therefore, a matter of no little importance especially in view of the insistent demand for economy and the small appropriation made by Congress for map work.

The Geological Survey has prepared instructions for azimuth observations on the sun and on Polaris, which it is glad to send free to engineers, engaged in railway or highway surveys. If engineers generally knew how easy it is to make such observations when proper methods are employed, more would attempt it. When the air is reasonably clear Polaris can be seen with a good transit telescope for several hours before sunset and by taking advantage of this fact one objection to the measurement of true azimuths can be removed. C. H. BIRDSEYE,

Chief Topographic Engineer,
Nov. 14, Washington. United States Geological Survey.

## Automobiles Kill More Than Typhoid Census Figures Show

Automobiles caused more deaths than did typhoid fever or railways in the registration area of the United States in 1920, according to the Bureau of the Census. The 1920 figures are: Automobiles, 9,103; typhoid fever, 6,805; railways, 6,426. The respective mortality rates per 100,000 are 10.4, 7.8 and 7.3. The registration area in 1920 included 34 states, the District of Columbia and 16 cities in non-registration states, with an estimated mid-year population of 87,486,713 or 82.2 per cent of that of the whole United States. Nebraska, with an estimated mid-year population of 1,301,737 was added to the area in 1920. It is also interesting to note that the registration-area typhoid mortality in 1919, despite the lower population, was 7,860, a rate of 9.2 per 100,000 as against the 6,805 and 7.8 rate for 1920, which is noted above.

# HINTS FOR THE CONTRACTOR

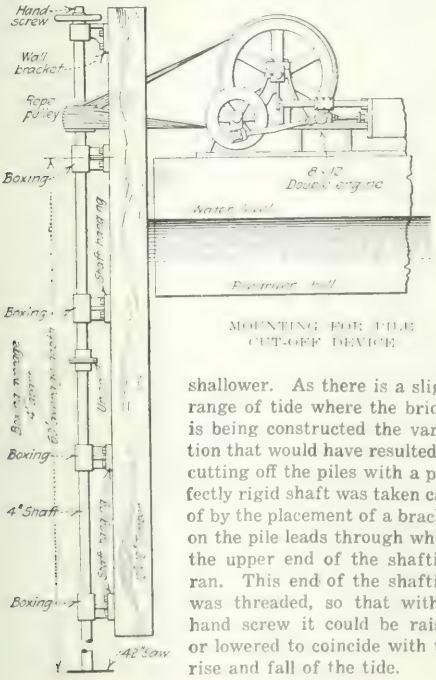
## Hoe With Straightened Blade Spaces Paving Brick

USING lugless brick, in paving in Scott County, Iowa, even joints and proper spacing, to get full penetration of the bituminous filler, were secured by laying the bricks rather loosely and then spacing them by eye, using a hoe with a straightened blade. An ordinary hoe was used, with its blade bent by a blacksmith, straight out in line with the handle. The McCarthy Improvement Co., Davenport, Iowa, were the contractors.

## Footing Piles Cut Off 60 Ft. Below Water Surface

BY FASTENING a 12 x 12-in. timber between the leads of a piledriver and attaching to it at intervals of about 4 ft. boxing which carried a 4-in. shafting, the McLean Contracting Co., of Baltimore, who are building the Long Beach bridge which connects Wreck Lead with Long Beach, Long Island, were able to cut off the footing piles for one of the central piers 60 ft. below the surface of the water.

The device used is shown in the accompanying sketch. It is not particularly new expect in that an unusual depth was necessary at which the piles were to be cut off. Piles of a length of 85 ft. were used and inasmuch as the penetration was around 25 ft. the piles could be used again on pier footings where the water was much




MOUNTING FOR PILE CUT-OFF DEVICE

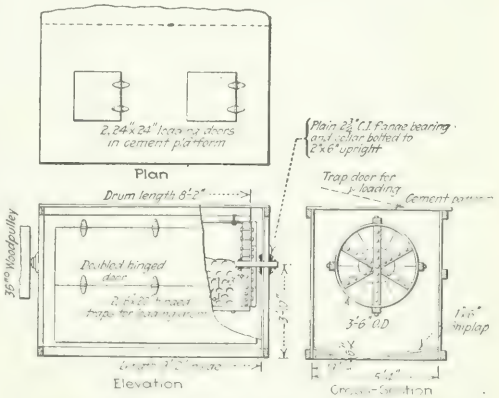
shallower. As there is a slight range of tide where the bridge is being constructed the variation that would have resulted in cutting off the piles with a perfectly rigid shaft was taken care of by the placement of a bracket on the pile leads through which the upper end of the shafting ran. This end of the shafting was threaded, so that with a hand screw it could be raised or lowered to coincide with the rise and fall of the tide.

At about the mid-point of the shafting was placed a union so that sections could be taken out or put in as desired.

The Long Beach bridge is being constructed by Nassau County, N. Y., under the supervision of W. Fred Starks, county superintendent of highways.

## Homemade Sack Shaker Saves Cement

A MOTOR-OPERATED rotary rock screen salvaged from other work was recently adapted by engineers of the San Joaquin Light & Power Corporation to serve as a cement sack shaker. One laborer operated the device, dividing his time between loading and unloading the shaker, tieing up the sacks and gathering up the cement recovered. Ordinarily he handled about 800 sacks per day. The sacks were put in the screen in lots of 50 and each lot was turned about 30 minutes at the rate of 50 r.p.m.




ARRANGEMENT OF SCREEN AND HOUSING FOR SACK SHAKER

The product of this operation was 8 sacks of cement per day or twice the laborer's hire of $4 for 8 hours. Besides the cement recovery, there was a considerable saving in freight and truck haul. In putting 59,680 sacks through this shaker the value of cement recovered was $504; the freight saving was $184 and truck haulage $61.50, a total of $749.50. The cost of rebuilding and setting up the old screen so it would be useful for this purpose was $395.

## New Tests of Timber Columns in Progress

Column tests for the purpose of determining the effect of density, and defects such as knots, checks, cross-grain, etc., on the strength of structural columns of Southern pine and Douglas fir have just been started at the Forest Products Laboratory, Madison, Wis., under the direction of J. H. Newlin of the laboratory and D. F. Holtman of the National Lumber Manufacturers' Association. The experiments will cover a period of four years, and the data will be used as a basis for recommending safe working stresses for structural columns.

# NEWS OF THE WEEK

New York, December 29, 1921

## Road Builders Announce Convention Program

**Technical Papers Cover Bituminous and Concrete Types, Financing, Traffic and Research**

The American Road Builders Association has announced the following tentative program of technical papers for its twelfth annual convention to be held in the Coliseum, Chicago, Jan. 16-20:

*Bituminous Roads* — "Bituminous Foundations": Hugh W. Skidmore, Chicago Paving Laboratory; "Selection of Bituminous Wearing Course": C. M. Pinckney, chief engineer, Bureau of Highways, Borough of Manhattan, New York City; "Utilization of Local Material for Mineral Aggregate": Major W. A. Welch, chief engineer, Palisades Interstate Park Commission, New York; "Asphalt Specifications": L. M. Law, chief chemist, New Orleans Refining Co.; "Specifications of Mineral Aggregates": Roy M. Green, manager, Western Laboratories, Lincoln, Neb.; "Controversial Construction Requirements in Specifications": Bruce Aldrich, Toronto, Canada; "A Simple Graphic Method of Proportioning Sands for Sheet Asphalt Mixtures": Prevost Hubbard, chemical engineer, The Asphalt Association, New York City.

*Cement Concrete Roads*—"The Selection of the Mineral Aggregate for a Portland Cement Concrete Road": John H. Mullen, chief engineer, State Highway Department of Minnesota; "Design of Concrete Roads for Heavy Traffic": W. D. Uhler, chief engineer, Pennsylvania State Highway Department; "Inspection and Control of Materials for Concrete Roads": R. W. Crum, testing engineer, Iowa State Highway Commission; "Importance of Surface Finish and Methods of Control": H. E. Breed, consulting engineer, N. Y. City; "Single Track Concrete Roads for the Average County": P. C. McArdle, county highway superintendent, Vermilion County, Danville, Ill.; "Pavement Widths for Highways Serving Large Cities": Edward N. Hines, chairman, Board of County Road Commissioners, Wayne County, Detroit, Mich.

*Common Roads*—"Common Roads": T. J. Wasser, state highway engineer, Trenton, N. J.; "A Systematic study of Gravels for Road Purposes": Wallace F. Purrington, chemist and testing engineer, New Hampshire State Highway Department.

*Highway Financing*—"The Proposed Wisconsin Plan of Highway Finance": A. R. Hirst, chief highway engineer, Wisconsin Highway Commission; "The Minnesota Experience in Highway Financing": C. M. Babcock, commissioner of highways, Minnesota Highway Dept.

*Highway Transportation* — "Truck Overloading, Its Relation to Road Construction and Maintenance": J. G. McKay, Professor of Economics, University of Wisconsin.

*Highway Research* —"Highway Research": W. K. Hatt, Professor of Engineering, Purdue University and Director of research, National Research Council; "The Illinois Experimental Road": Clifford Older, chief highway engineer, Department of Public Works, Illinois; "Highway Researches and What the Results Indicate": A. T. Goldbeck, U. S. Bureau of Public Roads.

*Miscellaneous* — "The Highway Outlook": Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, Washington, D. C.; "Cost Keeping on Highway Construction": A. R. Losh, Bureau of Construction, U. S. Bureau of Public Roads, Washington, D. C.; "Development of Small Stream Valleys into Traffic Routes": Jay Downer, chief engineer, Bronx Parkway Commission, New York; "Uniform Legislation as Affecting Highway Traffic and Highway Transport": D. C. Fenner, Manager, Public Works Department, International Motor Co., N. Y. City; "Construction and Maintenance of Earth Roads": George E. Johnson, Secretary of Public Works, Lincoln, Neb.; "Highway Construction on the Pacific Coast": Herbert Nunn, State Highway Engineer, Salem, Ore.; "Co-operation of All Parties Interested in the Construction of a Modern Road": William Ord, manager, paving department, Lakewood Engineering Co., Cleveland; "The Business End of a State Highway Department": Charles M. Upham, state highway engineer, North Carolina State Highway Commission; "The Highway Contractor's Problems": H. H. Wilson, Winston Bros., Muncy, Pa.

## Building Code May Prohibit All Non-Fireproof Hospitals

The Wisconsin State Industrial Commission is considering an amendment to the state building code which will require all hospitals hereafter constructed to be of fireproof construction. At present only hospitals of three or more stories in height must be fireproof.

### *Hoover on Colorado River Commission*

*The President has appointed Secretary of Commerce Hoover as federal chairman of the Colorado River Commission, created by Congress and the States of California, Arizona, Nevada, Utah, Colorado, Wyoming and Montana. It is the duty of the Commission to determine a plan for the control of irrigation, power and flood protection on the Colorado River.*

## Chile Halts Public Works

Owing to the high rates in effect on Chilean railroads serious attention is being given to the construction reports in the agricultural sections of southern Chile, according to cable advices to the U. S. Department of Commerce. The same cable announces that road-building funds have been exhausted and that the Government is retrenching and will undertake no new public works.

## California Water Commission Has New Head—Moves to Sacramento

Paul Bailey formerly a deputy of the California Water Commission and more recently assistant to Austin B. Fletcher, director of the State Board of Public Works, has been named chief of the division of water rights succeeding Chas. H. Lee. The position held by Mr. Lee for two years was declared vacant by Mr. Fletcher on December 1 after a difference of opinion had arisen over the advisability of moving the headquarters of the water rights division from San Francisco to Sacramento.

The reorganization of California state departments which made the water commission a subdivision under the jurisdiction of the Board of Public Works went into effect last July and was reported in *Engineering News-Record*, July 28, p. 166. Mr. Fletcher retains his position as chief engineer of the state highway commission at the same time that he heads the Board of Public Works.

## Engineering Employment Shows Year-End Pause

A year-end pause in engineering employment is apparent from a survey of conditions made by the employment department of the American Association of Engineers Dec. 1, based on reports from 25 widely separated localities. In comparison with reports and surveys of other years a lull in the demand for engineering services is usually experienced at this time with a resumption of activities after Jan. 1. From the seasonal standpoint the greatest demand for engineers comes during the spring and summer.

During November 12 per cent fewer applicants registered for employment than during the previous month. There were 20 per cent less placements and 13 per cent less positions received in November than the previous month. The following table shows the trend:

| | Nov. 1921 | Oct. 1921 | Nov. 1920 |
|---|---|---|---|
| Applicants for employment | 1,661 | 1,877 | 1,763 |
| Positions received | 335 | 384 | 717 |
| Men referred | 1,639 | 1,731 | 3,506 |
| Men placed | 193 | 240 | 313 |

The average monthly salary of positions filled in November was $192, or $6 more than the last month. For the same month last year the average salary was $201 a month.

The greatest demand during the last month was for engineers in the industries and designing offices, including mechanical draftsmen, mechanical engineers, structural and architectural draftsmen, with a large demand for map draftsmen. The least demand was for construction engineers, superintendents and general civil engineers. This is natural, as less construction is in progress during the winter months. At this season of the year the drafting field is the most prominent with the structural lines leading, although there is a healthy demand for mechanical engineers.

## Minnesota Gets Low Prices on Winter Road Work

Notably low prices on grading, gravel surfacing and paving were received by the Minnesota State Highway Department, as announced by C. M. Babcock, commissioner, on "winter work" trunk highway projects for which bids were opened Nov. 29 and 30 Dec. 2. On the seven grading jobs advertised, a total of 76 miles, bids for excavation ran from 19 to 27c per cubic yard, with an average of 23c as compared with a range of 23 to 40c, and an average of 37c for last summer's work. On 25 graveling projects, totaling 260 miles, bids ran from 16 to 28c per cubic yard per mile haul, about one-half of the prices obtained for the summer program. On the one job of paving, a 25-mile section of concrete, the low bid was less than $24,000 a mile as against $27,000, the lowest of last summer. Final awards are awaiting rechecking.

## Move to Span Pend O'Reille River

A movement to span the Pend O'Reille River, in Eastern Washington, with a $200,000 concrete and steel bridge has been undertaken by the communities of Priest River and Sandpoint, Idaho. The Interstate Toll Bridge Co., with an authorized capital stock of $200,000, has been formed, and the bridge will be constructed at Newport. It will provide a new route for tourists who branch off the Yellowstone Trail, and will open a new route from Missoula to Spokane, carrying traffic on not less than six important highways.

The bridge will be 1,224 ft. long, having five steel spans, resting on six reinforced concrete piers. It will have a width of 20 ft. in the clear, and will give a 65-ft. clearance, allowing free passage of vessels and obviating a draw span. The plans for the structure have been drawn by the Union Bridge Co., of Seattle, the firm now building the Kennewick-Pasco bridge, and plans have been approved by the engineers of the War Department. The bridge will replace the present unsatisfactory ferry service on the river.

## Acceptance Seattle Water Bonds Brings Storm of Protest

The Seattle city council recently accepted a bid for $2,000,000 water extension revenue bonds, which has brought a storm of protect from Mayor Hugh M. Caldwell, superintendent of water L. B. Youngs and business men of the city. The bonds carry interest at 6 per cent and the bidders offer to pay par and accrued interest. The bid is alleged to have been secretly accepted by the council without the approval of the superintendent of water, or of Mayor Caldwell, and it is declared will mean a loss of $60,000 to $100,000 to the water department. Mayor Caldwell expressed the belief that a public sale of the bonds would have brought the city a premium of from one to five per cent above par value.

The bonds are part of a $6,000,000 issue authorized several years ago to finance extensions to the municipal water system, including construction of an impounding basin at Swan Lake, a pipe line from there to the city, and a proposed reservoir at Volunteer Park. It is considered likely that the sale may be declared void and the bonds placed in the open market.

## California Water Resources Board Begins Statewide Inventory

The California state legislature in June, 1921, appropriated $200,000 for a statewide survey of water resources to be made under the direction of the state department of engineering. The bill instructs the engineering department to "determine the maximum amount of water which can be delivered to the maximum area of land, the maximum control of flood waters, the maximum storage of waters, the effect of deforestation and all possible and practicable uses for such waters in the state of California."

The bill also requires the state engineering department to "determine a comprehensive plan for the accomplishment of the maximum conservation, control, storage, distribution and application of all the waters of the state and to estimate the cost of constructing dams, canals, reservoirs, or other work necessary in carrying out this plan and to report the result of such investigations with recommendations not later than the legislative sesion of 1923."

### *Queenston-Chippawa Power Plant Opened*

*On Dec. 24, water was admitted for the first time into the nine-mile canal leading around Niagara Falls to the Queenston power plant of the Hydro-Electric Power Commission of Ontario. As this was written it had reached a depth of 40 ft. on the forebay side and the ceremony of turning over the first 55,000-hp. turbine was set for 2 p.m., Dec. 28. Details of the first step in the completion of the great Niagara power development will appear in a later issue.*

### Plan Is Comprehensive

In pursuance of a provision of the bill, the Governor appointed a consulting board of citizens to serve in an advisory capacity. This board consists of H. D. McGlashan, U. S. Geological Survey, San Francisco; B. A. Etchevery, professor of irrigation engineering, University of California; H. Hawgood, consulting engineer; R. B. Marshall, Peter Cook, J. C. Forkner, and O. B. Tout. This advisory board has held public hearings in several parts of the state to permit residents to express their views with regard to the proposed study and recommendations.

Comprehensive plans are being worked out for the actual compiling of the inventory of water and power resources. All available stream flow and runoff records will first be listed. To aid in this work thirteen engineers of Sacramento, San Francisco and Los Angeles have been named to aid in gathering data in public and private offices that have a bearing on the desired records. When all existing information has been collected, it is planned to put reconnaissance survey parties in the field to gather the additional data needed. The first field party is already at work.

F. C. Scobey, hydraulic engineer, irrigation division, U. S. Bureau of Public Roads, has been "loaned" to the state department of engineering to take charge of the engineering studies involved. Paul Bailey is chief of the water rights division, state engineering department.

## New York Zoning Discussed by Am. Soc. C. E. Section

### Residence and Retail Districts Protected — Skyscrapers Curbed — Decentralization Needed

What zoning has done for New York City since its adoption in the summer of 1916 was the topic of the meeting of the New York Section, Am. Soc. C. E., in that city Dec. 21. The formal discussiong was opened by Edward M. Bassett, formerly rapid transit commissioner, and Lawson Purdy, for some years commissioner of taxes and assessments, both members of the committee that framed the New York zoning regulations.

Zoning, said Mr. Bassett, has kept industries out of residence and high class retail business districts; has kept commercial garages out of residence and business districts; and has ameliorated but not cured the skyscraper evil.

Mr. Purdy gave as one result of zoning in which he takes much pride that is excludes signs from residence districts by prohibiting all structures therein except residences. He expressed the hope that the time will come when the only outdoor signs that will be permitted will be relatively small ones advertising business conducted in the buildings on which the signs are affixed.

John B. Fox, secretary of the Murray Hill association, told of the fight that the association has had to keep up to Murray Hill residence section. He stated that, with one exception, the Board of Estimate had supported the association by not granting appeals for the admitting of business into the district.

### Use Restrictions Important

Rudolph P. Miller, superintendent of buildings in the Borough of Manhattan, sent a paper in which he said, among other things, that while height restrictions come first to mind, the restrictions as regards use are of greater importance. As to the exact benefits of the height restrictions, it is yet too early to say, Mr. Miller stated, as thus far there have been only forty buildings that have come within the set-back limitations as to the upper parts of the buildings.

Clarence S. Stein, architect, New York City, laid stress on the desirability of devising some way of providing homes for workers near their working places as a means of lessening congestion. An examination of the map of New York City, he said, would show that a very small portion of the lower end of Manhattan is occupied by residences notwithstanding the fact that many people work there. He suggested mixed residential districts with business uses in the first story and residences above. Finally, Mr. Stein said that we are approaching the time when the worker will be in touch with his industry on one hand and with green fields on the other.

### General Discussion

Among those taking part in the general discussion were H. H. Curran, president of the Board of Manhattan, and D. L. Turner, consulting engineer, Rapid Transit Commission, New York City. Mr. Curran said that to knit the five boroughs of New York City together is a problem in engineering that is unsolvable without zoning. The present

transit system he compared to a hub and spokes without a rim. He urged that instead there be a cobweb system so as to provide not only an outer circumferential, but also inner circumferential means of travel. Mr. Curran suggested fifty to seventy-five scattered districts in which the workers could live close to their industries, even though there might be short transit hauls of one-half mile to a mile, in contrast to the very long hauls between homes and workshops that exist today. Mr. Turner thought it a mistake to overemphasize the boroughs of New York City. The borough lines should be broken down, industry decentralized, and one large city made. There should be circular as well as radial lines of transit.

## Would Fill Senate with Engineers

It would reflect more favorably on the progress of our civilization if there were more statues to engineers and fewer to soldiers. This thought was expressed by Lord Riddell in the course of remarks at the annual dinner Dec. 7 of the Washington (D.C.) Society of Engineers. Senator King, another of the speakers, said that the country would be benefited if the existing United States Senate were dismissed and each place filled with an engineer. Col. E. Lester Jones, director of the Coast and Geodetic Survey, served as toastmaster.

Herbert Quick, introduced as a literary engineer, cited instances to show that engineer representation on the governing bodies of great municipalities had resulted in such efficiencies that he believes county government should make use of its engineering rather than its professional political talent. While the railroads have utilized engineering talent very extensively in subordinate capacities, one reason why the railroads, in his opinion, are the most inefficiently managed great properties in the country is due to the fact that engineers have not had a voice in the broader questions of their conduct.

## Completion of San Pablo Dam Adds to Oakland Water

Construction on the San Pablo water supply project for the city of Oakland, Cal., was started in August, 1916, by the East Bay Water Co. and the dam was advanced far enough to be used for storage in 1920. The dam has recently been finished and is to be used for storing the runoff this winter. It was built by the hydraulic sluicing method, is 110 ft. high, has a base width of 1,300 ft., a crest length of 1,250 ft. and contains about 2,200,000 cu.yd. of material.

In addition to the dam the project as a whole includes a 115-ft. concrete intake control tower, a 14,000-ft. concrete-lined tunnel with a capacity of 100,000,000 gal. per day and a rapid sand filtration plant with a normal capacity of 12,000,000 gal. per day.

William Mulholland of Los Angeles has acted as consulting engineer since the inception of the work. In the early stages Allen Hazen and John R. Freeman were also called in as consulting engineers. More recently J. M. Howells has been acting in this capacity. Geo. H. Wilhelm is vice-president and general manager of the East Bay Water Company and Geo. W. Hawley is engineer in charge of the San Pablo project.

## May Purchase Cape Cod Canal

The purchase by the federal government of the Cape Cod canal has been recommended by Secretaries Weeks, Denby, and Hoover, who have informed congress that $11,500,000 would be a reasonable price for the property. Investigation of the acquisition of the canal by these three secretaries has led them to conclude that government control of it is desirable and the price reasonable.

Recommendation that the federal government acquire the property has been transmitted to Speaker Gillet and there accompanied the recommendation an agreement to be ratified by congress calling for the transfer of the canal property from the Boston Cape Cod & New York Canal Co. to the federal government.

Of the $11,500,000 purchase price, $5,500,000 would be a cash payment and the rest assumption of bonds now outstanding.

## Discuss Engineering Aspects of Malaria Control

The third annual conference of malarial control field workers was held at Hot Springs, Ark., Nov. 15 to 17. Those in attendance were largely engineers and most of the twenty papers dealt with engineering work for malaria control.

The economic aspects of the subject were given particular attention. Among the papers were: "The Effect of Large Drainage Districts in the Mississippi Delta on the Control of Malaria," by L. L. Hidinger, president, Morgan Engineering Co., Memphis, Tenn.; "Use of Dynamite and TNT in Blasting Ditches," by J. T. Clarke, sanitary engineer, International Health Board, Greenwood, Miss.; "Economic Loss Caused by Malaria," by A. W. Fuchs, associate sanitary engineer, U. S. Public Health Service, Memphis, Tenn.; "Malaria Control in Memphis, Tenn.," by W. G. Stromquist, sanitary engineer, City Health Department, Memphis.

## Alaska R.R. Nears Completion

With only 20 miles of track to be laid to close the gap in the interior section, the Alaska R.R. is rapidly approaching completion. This was the condition on Nov. 2. About 525 miles are in operation and it is expected that tracklaying gangs now working in both directions will reach Riley Creek, at Mile 347, on Dec. 1. (See *Engineering News-Record*, April 14, 1921, p. 632.)

Steel for the permanent high level bridge over Riley Creek has been shipped by the Phoenix Bridge Co. and it is expected to have this bridge completed by Feb. 1, giving a through line of rails from Seward and Anchorage to Nenana. The next work will be the permanent crossing of the Tanana River at Nenana. Connection with 85 miles of narrow-gage line north of the river is made now by means of a ferry in summer and by extending the narrow-gage track over the ice in winter. This Tenana River bridge and the widening of gage on the present track will give a through and unbroken railway line into Fairbanks. The railway is being built for the U. S. Government by the Alaskan Engineering Commission, of which Col. Frederic [illegible] is president and chief engineer.

## Civil Engineers Will Discuss National Housing Problem

Following its monthly business meeting in the Engineering Societies Building, New York City, at 8 p.m., Jan. 4, the American Society of Civil Engineers will hold a conference on that evening and the following day on "The National Housing Problem." On Jan. 4 the broad economic phases of the subject will be discussed and on Jan. 5 the program provides for the consideration of "Planning and Zoning" at 10 a.m.; "Utilities," at 2 p.m.; and "Legislation and Financing," at 8 p.m. Nineteen speakers are scheduled to address the meetings.

## Court Restores Civil Service Employee After 13 Years

Vindication of the validity of the civil service law as it pertains to employment in municipal service in Chicago is indicated by a "peremptory writ of mandamus" directed to the city, mayor, city treasurer, city clerk, city controller, each member of the city council and each member of the civil service commission to reinstate P. C. McArdle, with full back-pay allowance since 1908 as head of the testing division Bureau of Engineering. The legal battle which Mr. McArdle put up for reinstatement after being ousted started May 12, 1908, and continued through the circuit, appellate and supreme court and finally back to the circuit court which issued the writ on Nov. 21, 1921. Mr. McArdle, as construction engineer, has recently completed the building of the road system in Vermilion Co., Illinois, under a $2,000,000 bond issue and returns in person to his former position with the City of Chicago.

## Committee To Study Creosoted Bridge Floor Construction

Under the auspices of the American Wood Preservers' Association a joint committee has been formed, including representation of the wood preserving, lumber, fire protection and bridge engineering interests, to study creosoted-wood bridge floor construction. A recent bridge floor fire furnished the impetus for the formation of the committee, on the basis of the probability that improper design of the floor played a part in the spread of the fire. Recognizing that wood must continue in use for a long time as a material for bridge floors, and that, as a measure of safety and conservation, treated wood should be used to protect against decay, the committee will study the question broadly.

The committee will meet under the chairmanship of L. T. Ericson, of the Jennison-Wright Co., who has been appointed representative of the American Wood Preservers' Association. George W. Booth, chief engineer of the National Board of Fire Underwriters, will represent fire protection; E. F. Kelley, of the Bureau of Public Roads, bridge engineering; and D. F. Holtman, of the National Lumber Association, the interests of wood.

## W. C. K. Alumni Association

One hundred and forty former employees of Westinghouse, Church, Kerr & Co. met for supper on Wednesday, Nov. 30, and organized the "W. C. K. Alumni Association."

## Atlanta Invites Bids for Filters and Clear Water Reservoir

Bids for a 21,000,000-gal. mechanical filter plant, a 10,000,000-gal. covered clear water reservoir and a wash water tank, all of reinforced concrete, together with a piping system of like material and of cast iron are to be received by J. N. Landers, purchasing agent of Atlanta, Ga., on Jan. 31. P. H. Norcross, of Atlanta, is consulting engineer for the work.

## Lake Cushman Hydro-Electric Project Still in Doubt

In the superior court of Thurston County at Olympia Wash., the city of Tacoma is fighting another battle to obtain permits to proceed with its proposed development at Lake Cushman, on the north fork of the Skokomish River, of a hydro-electric plant to provide the city of Tacoma with additional electric horsepower. The newest obstacle to the city's project is an action on the part of the State Board of Fisheries, contesting the city's right to divert the waters of the Skokomish River. The city has completed its condemnation suit in the Mason county superior court, won its order of public necessity, settled damage claims, and paid out $300,000 to acquire the project site. The only detail necessary is the permit of the state hydraulic engineer to divert the waters from the river and to create an impounding reservoir, which has been checked by the move of the Fisheries Board.

The board claims that the development of the project would injure the fisheries industry of the state by destroying the spawning beds for salmon in the river. The city will make a strong fight to show that the Skokomish River has never been largely used by Salmon for spawning and that the loss to the industry would be trifling compared to the benefits accruing from the power development.

## "Public Roads" Discontinued

Publication of *Public Roads*, the monthly magazine issued by the U. S. Bureau of Public Roads, has been discontinued. By action of Congress at its last session there was a wholesale discontinuation of bureau and department journals and *Public Roads* was caught in the drag-net. It served as a means of making public the general studies and special investigations of the bureau.

## Use Opening of New Reservoir to Educate Public

A new 10,000,000-gal, reinforced-concrete reservoir to augment the storage capacity of the Indianapolis Water Co. was put into service in November and the company took this occasion to educate 272 representative business men, including the governor, mayor and heads of the Indiana Public Service Commission and City Board of Trade, into the mysteries of the water business by a 2½-hour inspection trip and set program of explanation.

C. L. Kirk, vice-president and general manager of the company, set forth the accomplishments of the company since 1913 in laying 103 miles of pipe, installing 1,000 hydrants and increasing the daily pumping capacity by 32 m.g.d. The 1920 average consumption he said was 30 m.g.d. and the maximum during summer sprinkling, 75 m.g.d. Improvements in 1921 cost $550,000. The new reservoir is the last of a series of clear-water reservoirs from which the water is pumped to the mains. It is 564½ ft. long, 258 ft. wide, 10.7 ft. deep, has 15-in. side walls and a 9-in. roof supported by 24-in. circular columns which rest on a groined arch floor, 5 to 23 in. thick, below which is a 4-in. reinforced-concrete slab. Preliminary to increasing the capacity of the present purification plant by the construction of mechanical filters an experimental filter is being constructed.

## N. J. Plans Snow Removal from State Highways

### System Divided into Sections about 12 Miles Long—Early Attack on Snow Essential

Plans for the removal of snow from the state highway system of New Jersey have been developed by the New Jersey Highway Commission. Chief Engineer Thomas J. Wasser has supplied the following information regarding the program:

The state highway system of New Jersey comprises 725 miles, including some extensions and connections not yet taken over by the Commission. The system is divided into sections for the purpose of snow removal varying from a minimum of 9 to a maximum of 17 miles, the idea being to have the sections as near 12 miles in length as practicable.

There are 31 sections in what might be called the primary system comprising a total of 402 miles. These sections are assigned to various contractors in the state who have work near these sections or who have their headquarters nearby. Trucks that were received from the United States Government of 2½- and 5-tons capacity are equipped with snow plows and distributed to the various sections before Dec. 1.

#### Weather Bureau Helps

The Trenton office of the U. S. Weather Bureau co-operates with the State Highway Department and advises as far in advance as possible of the approach of any severe snow storm. This information is immediately telephoned to the contractors in the various sections of the state and they are advised to call together their organization and to go to the garages where their equipment is stationed so as to be in readiness to proceed with the snow removal work as soon as the depth of snow warrants attempting to

### Taylorsville Detaining Dam Completed Recently Insures Dayton and Hamilton Against Flood Destruction

The largest of the five detaining dams of the Miami Conservancy District, that at Taylorsville, a few miles above Dayton, controls the main course of the Miami River. Farther north, Loramie Creek, one of the headwater streams, is controlled by the Lockington dam, completed several months ago. Two important tributaries entering at Dayton, Stillwater River and Mad River, are controlled by detaining dams at Englewood and at Huffman respectively, which are nearing completion. Finally, ten miles south of Dayton the inflowing Twin Creek is controlled by a dam at Germantown, which has been completed and in service.

The Taylorsville dam is 3,000 ft. long, has a maximum height of 78 ft., and contains about 1,200,000 cu.-yd. of earth embankment. Its outlet structure, comprising a series of four 15 by 20 ft. arched openings through a concrete spillway weir, is the largest of the concrete structures on any of the district work, containing about 50,000 cu.yd. of concrete. At extreme flood stage the outlet will discharge 50,000 sec.-ft. In a flood as large as that of 1913 the basin back of the Taylorsville dam would impound 152,000 acre-ft. of water.

Construction work at Taylorsville has been in progress three years. O. N. Floyd was in charge for the district as division engineer, assisted by H. L. Fruend, and H. M. Sherwood was construction superintendent. The embankment and concrete work is now completed, but there are odds and ends of work to be done, trimming and the like, which will keep the construction forces on the job probably into next spring.

Incidentally, the historic National Road will cross the valley along the crest of the dam, by way of a 30-ft. roadway. For this purpose the road has been shifted south about a mile, as its old location will be submerged when the dam impounds flood waters.

force it to the side of the road with the scrapers attached to the front of the motor truck, commonly called snow plows.

The success of the undertaking, Mr. Wasser points out, depends on getting out early and keeping ahead of the snow storm. The snow should not be allowed to accumulate to such an extent that it would interfere with the operation of the trucks. The trucks are operated in groups of two and three, the latter number being placed on the sections where the traffic is heavy and where there is likelihood of a heavy snow-fall. It is advisable to have at least three plows in a unit in case one should be out of commission for a time.

The trucks are manned by 3 men; one to operate the vehicle, another to operate the plow; and the third an extra man to be used in the case of emergency.

The remaining mileage of roads in the state highway system, comprising over 300 miles is taken care of by the forces of the state highway maintenance division. A comparatively small mileage in the northern part of the state is not cleared entirely of snow but is kept open for traffic. This is done because many of the vehicles in this section are on runners and there is some objection to removing the snow from the highways on that account. The sections in the southern part of the state are kept clear of snow by the maintenance forces but these roads are not the main through routes in the winter time, nor is the snow-fall as heavy as in the sections first mentioned. The maintenance forces are able to remove the snow with the equipment used for maintenance of roads.

## Definite Results of Conference on Unemployment Cited

In his report upon work accomplished and results obtained since the President's Conference on Unemployment was called, Secretary of Commerce Hoover estimates that about 1,500,000 men and women who otherwise would have been unemployed, are now working, through the activities of the conference and local and state associations stimulated by it.

Among the concrete results which Secretary Hoover cites as having come out of the conference are: (1) Public opinion has been focused on unemployment; (2) municipal committees are organized on a nation-wide scale to relieve unemployment; (3) a national clearing house is ready to assist municipalities with district representatives in the field; (4) industry is assuming a share of responsibility to the unemployed; (5) municipal bond sales for public works have broken all records; (6) important public works have been inaugurated by Congress; (7) a large appropriation for the United States Employment Service is before Congress; (8) a variety of measures have been introduced into Congress to carry out recommendations of the conference such as Senator Kenyon's bill for long-range planning of public works; (9) the construction industries are being organized nationally and locally under public direction; (10) stabilization studies are being planned for seasonal and intermittent industries; (11) an investigation of [illegible] cycle is in progress.

## To Hold Lumber Congress

The American Lumber Congress will meet in Chicago April 5 and 6. The congress is being sponsored by the National Lumber Manufacturers Association which invites every national, regional and state association to be represented. Three congresses have been held but enthusiasm has waned since the first one was held in 1919. A renewed effort is being put forth with the idea of making the congress occupy the same relative position among forest and wood-using industries as the American Iron & Steel Institute does in the iron and steel trade.

## War Department Will Approve San Francisco Bay Crossing

The chief of engineers, U. S. Army, has announced that favorable consideration will be given to a plan for bridging San Francisco Bay provided the plan conforms to certain conditions, has the necessary financial backing and the approval of the cities and counties affected. Five conditions are named, as follows: (1) no bridge of any kind north of Hunters Point will be approved, (2) no low bridge north of San Mateo will be approved, (3) a tunnel crossing the bay in any location will be approved provided the highest part of the structure is at least 50 ft. below mean low water and proper compensation is made for tidal flow, (4) a combined bridge and tunnel at a location south of the proposed Alameda naval base site will be approved provided a 3,000 ft. channel 50 ft. deep is left at the San Francisco end and proper provision is made for tidal flow, (5) not more than one crossing at any location north of San Mateo shall be approved at present.

## Seattle's Right to Restaurant Garbage Upheld

The Superior Court recently refused to grant an injunction to prevent the Pacific Meat Packing Co. from carrying out its contract with the City of Seattle, Wash., for handling garbage from restaurants. The law suit on this subject was noted in *Engineering News-Record*, Oct. 13, 1921, p. 627. The contract was made as the result of an ordinance passed by the City Council directing the Board of Public Works to advertise for bids for restaurant garbage. The best bid received was from the Pacific Meat Packing Co., which has a large hog ranch on the east side of Lake Washington. The company is now carrying out its contract, which covers kitchen and table wastes from hotels and restaurants. All other forms of garbage and refuse are collected by the city, as has been the case for years past, and disposed of by the "sanitary-fill method."

According to information from A. H. Dimock, city engineer, the three incinerators built by the city some years ago have not been in use for many years and the "sanitary-fill method" will probably continue to be used as long as available dumping sites within reasonable distance are available. Mr. Dimock adds: "When the cost of haulage becomes excessive, or more than the cost of burning we may return to the method of incineration, but in my judgment it will be many years before that happens."

## Contract Awarded on Wichita Falls Irrigation Project

The Callahan Construction Co., of Dallas, Texas, has been awarded a contract for the construction of the Wichita Falls irrigation project, on the Wichita River. The successful bid was $3,354,211. The contract, which is one of the largest let in the vicinity recently, calls for the completion of a diversion dam and a canal within a year, and a storage dam within two years. It is expected that work will be started within thirty days.

## McGill Puts Civic Subjects in Engineering Course

A new course for civil engineering students and graduates has been opened this session at McGill College, Montreal, with the object of giving more thorough and detailed instruction in highway and municipal subjects than has hitherto been available. The course is under the general direction of R. L. French, who was appointed professor of highway and municipal engineering last June.

In the fourth year the new courses offered include one in civic administration. It will cover some phases of municipal activity which are seldom touched upon in engineering education, but which should be useful to all city engineers. Among the matters discussed will be the various systems of government, municipal finance, civil service, police and fire departments, recreation, municipal relief of the needy, welfare work and the like.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN CONCRETE INSTITUTE, Detroit, Mich., Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C., Annual Meeting, Washington, D. C., Jan. 5 and 6.

**The New York Post, Society of American Military Engineers,** announces the following meetings to be held in the Engineering Societies Building, New York: Dec. 15, Col. E. E. Winslow, "Flashes of Action at the Front"; followed by a Signal Corps moving picture; March 2, Col. F. E. Humphreys, Commanding Officer, 22nd Engineers, N. Y. N. G., showing a graphical history of the Meuse-Argonne offensive; April 6, Col. George C. Marshall, "History of the A. E. F. and Lessons of the War."

**The Lansing (Mich.) Engineers' Club,** at its meeting Nov. 16, was ad-

dressed by Col. W. C. Holt, professor on civil engineering, University of Michigan, on the sewerage system of Lansing, present and future.

**The Engineering Institute of Canada, Montreal Branch,** at its opening meeting, presented Roger French with the Gzowski Medal for his paper, "Reinforced Concrete Covered Reservoirs." At the evening session A. E. Doucet presented the first of a series of papers to be given on the Montreal Aqueduct, in which he sketched the whole waterworks scheme of the city.

**The Engineers' Association of Fairfield County,** Stamford, Conn., recently appointed a committee on city planning consisting of A. S. Brower, G. H. Cavanaugh, H. A. Parsons, V. E. Wardwell and J. W. Mershon, chairman, to draw up a preliminary zoning plan which will be submitted to a citizens' committee on city planning appointed by the mayor.

**The Engineering Institute of Canada, Toronto Branch,** at its meeting Nov. 3, was addressed by A. G. Dalzell on his experiences in connection with laying 145 miles of sewers in Vancouver.

**The Indiana Engineering Society** will hold its annual meeting at Purdue University, Lafayette, Ind., Jan. 19 and 20. Among the subjects listed are the following: "The Future of the Gas and Steam Automobile," Prof. A. C. Staly, Purdue University; "Sphere of Influence of the Society," R. C. Yeoman, Indianapolis; "The Engineers' License Law," Prof. R. L. McCormick, Rose Polytechnic Institute; "Current Issues for the Engineer," H. O. Garman, Indianapolis; "Sanitary Engineering," Paul Hansen, Chicago; "The Indianapolis Sewage Plant," C. K. Calvert, assistant engineer, Indianapolis Sanitary District; "The Engineer in Politics," John Elliott, city engineer, Indianapolis. There will be a social meeting Jan. 19 and the annual dinner on Jan. 20.

**The Central Ohio Section, Am. Soc. C. E.,** at a recent meeting, elected as president W. F. Jennings, a member of the Jennings & Lawrence Engineering Co., and as secretary, H. F. Schryver, valuation engineer, Toledo & Ohio Central R.R.

**The Northeastern Section, Am. Soc. C. E.,** recently organized, has elected the following officers: Chairman, Frank B. Sanborn; vice-chairman, Walter C. Voss; secretary-treasurer, Charles W. Banks; members of the executive committee, Leonard C. Wason, James H. Manning.

**The New York Section, Am. Soc. C. E., at its Jan. 11** meeting will consider the topic, "Traffic Handling—Its Engineering as well as Regulatory Aspects." The chief addresses will be by E. P. Goodrich, consulting engineer, and Amos Schaeffer, consulting engineer to the Borough President of Manhattan.

**The Iowa Engineering Society** will hold its twenty-fourth annual meeting in the Woodbury County Court House, Sioux City, Iowa, Jan. 17-20. There will be an exhibit of equipment and material.

**A Sanitary Engineers' Dinner** will be held Jan. 17 at 7.30 p.m. at the Hotel McAlpin. Reservations should be made by Jan. 12, addressing Kenneth Allen, 1235 Municipal Building, New York City.

## Personal Notes

J. R. McDERMOTT, former assistant division engineer, West Virginia State Road Commission has been appointed resident engineer for the commission in charge of road construction and maintenance in Mineral and Hampshire counties. His headquarters will be at Keyser, W. Va.

VANCE W. BAISE, draftsman and computer with the North Carolina State Highway Commission has been promoted to assistant engineer, department of highway designs and estimates, at Raleigh.

RAY SPEER, county engineer, Keweenan County, Mich., has resigned to accept a position with the Wisconsin State Highway Department, as Madison.

MORSE B. PRINGLE, chief engineer for the Eastman Kodak Co., in charge of the construction of its chemical plant at Kingsport, Tenn., has been appointed city manager of Smyrna. Florida.

G. F. NICHOLSON, chief engineer, Port of Seattle, has been retained by the city of Cork, Ireland, to make a comprehensive plan for harbor development. He has obtained a six months' leave of absence and is now en route to Europe. Before returning to this country he expects to visit the important ports of Europe, particularly those which have extensive mechanical equipment.

E. W. RICE, JR., president of the General Electric Co., has been elected to membership in Tau Beta Pi, the national honorary engineering society.

ALBERT W. SMITH, formerly dean of Sibley College, Cornell University, is now connected with the firm of Henry R. Kent & Co., engineers and constructors, of New York and Boston, as consulting engineer. Dean Smith's work will relate particularly to thermodynamics and mechanical engineering of chemical plants. During the interval between the resignation of President Schurman and the recent inauguration of President Farraud—about a year and a half—Dean Smith was acting president of Cornell.

HOWARD R. FULLERTON, formerly in the sanitary engineering division, U. S. Public Health Service, has been appointed assistant sanitary engineer for the Tennessee State Department of Health on sewage disposal and water supply work.

P. C. McARDLE, superintending engineer, Vermilion Co., Ill., having completed the $2,000,000 county bond road system, has tendered his resignation effective Dec. 15.

H. O. GARMAN, chief engineer, Indiana Public Service Commission and Railroad Commission for 14 years, has entered private practice in Indianapolis as a consulting engineer. He will handle the management and operation of public utilities. Mr. Garman is president of the American Association of Engineers.

HOWARD C. PHILLIPS, whose resignation as chairman, Western group, engineering committee, Railway Presidents Conference Committee on Valuation, was noted in *Engineering News-Record* of Dec. 8, has taken up consulting work in railway valuation and inspection, with office at 14 East Jackson Boulevard, Chicago. He retains his connection with the engineering committee, having been made associate engineer.

GEORGE W. HAND, assistant to the president Chicago & Northwestern Ry., is chairman of the engineering committee of the Western group, Railway Presidents Conference Committee on Valuation. Mr. John R. Leighty is engineer for this group, instead of being chairman as noted Dec. 8.

## Obituary

GUSTAVUS O. NEWMAN, chief engineer for the San Joaquin Light and Power Company and the Midland Counties Public Service Corp., of California, died in Los Angeles, Cal., Dec. 4. He was born in Fortuna, Sweden, in December, 1844, and following his technical education, became an engineer of the Swedish government railroad. He came to America in 1868, and his first work was on the construction of a bridge at Kansas City. He entered the service of the U. S. Geological Survey in 1881, and later was connected with the Southern Pacific and Central Pacific railways. For 12 years following 1884 he was chief engineer of the Riverside (Cal.), Water Company. In 1897 he went with the San Gabriel Electric Co. as chief engineer, and when the company was purchased by the Pacific Electric Light & Power Co. he was retained in the same capacity.

## Business Notes

THE OSGOOD CO., Marion, Ohio, has recently opened a branch sales office in the Conway Building, Chicago, in charge of Arthur B. Sonneborn.

C. E. SLAWSON, contracting engineer, has assumed charge of the Milwaukee district of the Federal Bridge & Structural Co., succeeding L. F. Vonier.

COL. HENRY P. BOPE, for many years first vice-president and general manager of the Carnegie Steel Co., with headquarters at Pittsburgh, Pa., has been elected president and general manager of sales of the International Steel Tube Co., Cleveland, Ohio.

THE GOLDEN-ANDERSON VALVE SPECIALTY CO., Pittsburgh, Pa., announces that it has appointed Lawrence C. Whitsit and F. W. DuBois as its Michigan representatives, to operate under the name of the Waterworks Equipment Co., in Detroit.

E. W. PITTMAN, president of the Pittman-Smith Engineering Co., has been made general manager of the Penn Bridge Co.

B. L. WHITNEY, formerly with the Byers Co., is now representative for Orton & Steinbrenner Co., manufacturers of material-handling machinery, with headquarters at Detroit.

THE PHOENIX IRON WORKS CO., Meadville, Pa., has opened an office in Dallas, Tex., with K. B. Thorndike, as manager.

# Business Side of Construction

*Facts and Events that Affect Cost and Volume*

## Bids Wanted on Big Jobs

Among the projects on which are being either asked or will soon be called for in Construction News, pp. 279@287, are the following:

[illegible] Lumber Co., [illegible]

Terminal Substructure for China Basin Terminal, San Francisco, Cal., $800,000.

[illegible] Co., at Cleveland, Ohio, $2,500,000.

[illegible] Bank of America, [illegible]

Theatre and office for Fox Film Corp., Philadelphia, Pa., $1,000,000.

Asylum for Secaucus, N. J., $700,000.

Hotel for Bellerive Investment Co., Kansas City, Mo., $1[illegible]

## Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 279@287 are the following large projects: An 18-story office building in Dallas, Tex., to G. W. Hewitt, Slaughton Bldg., $1,000,000; a 2-story hospital in Milwaukee, Wis., to H. Schmitt & Son, 43 Farwell Ave., Milwaukee, $1,094,000; a 12-story apartment hotel in Cleveland, O., to J. Gill & Sons, Cleveland, $1,500,000; a sewage disposal plant at Columbia, Mo., to C. J. McCoy Construction Co., Emporia, Kan., $178,857.

## Hearings on Freight Cases on Building Materials Set

Hearings on the freight rate cases involving shipment of sand and gravel, brick, lime, cement, gypsum and asphalt have been set for Jan. 24 and 25 by the Interstate Commerce Commission. On Jan. 26 and 27 hearings on the lumber and forest products cases will be heard.

## Durable Highways Built in Pennsylvania in 1921

Durable highways in Pennsylvania for 1921 exceeded 650 mi. on Nov. 18. According to the State Highway Department this is 300 mi. better than any mark reached by other state highway departments for this type of pavement in one year. The departments maintenance forces put down 215 mi. of waterbound macadam and 297 mi. of unbound macadam and have surface-treated with oils and bituminous materials 1,797 mi. of roadway.

*NEXT WEEK*

*1. Explanation of E. N.-R. Construction Cost and Construction Volume Index Numbers.*

*2. E. N.-R. tabulation of spring prices since 1913.*

*3. Price trends of construction materials shown graphically for nine to twenty-two years.*

*4. Trend of labor—Actual rates [illegible] twenty-one cities for January of 1921 and 1922; chart of common labor and cost of living for nine years.*

*5. Representative unit bids in 1921.*

*6. Review of the bond market.*

*7. Analysis of contracts let.*

## Majority of Jobs in Chicago Under Landis Award

Reporting on the activities of the week of the Chicago Citizens' Committee to enforce the Landis Award *Chicago Commerce*, published by the Chicago Association of Commerce which is backing the committee states:

"The seven automobiles belonging to the committee have been used in making a check of 800 jobs. Of these 153 are being operated exclusively with men furnished by the citizens' committee. The Landis award was being obeyed on 545 others and a total of only 102 violators was discovered. The first day's investigation was confined to Evanston and the towns north of it. In this locality 63 jobs were visited and 19 violations discovered. Of the violators seven promised the committee that they would reform and abide by the Landis award of $1 an hour for carpenters. During the second day of this work the city was divided into four sections, extending north from Madison St. One car made a further check of Wilmette, Winnetka and as far north as Glencoe. During the second day 128 construction jobs were visited and only 20 violators found."

The committee proposed to be as drastic with contractors who cut below the Landis scale as with those who pay the higher wage demands of the unions.

## Paving Prices—Materials and Recent Contracts

With the buying season on road materials over for 1921 and not yet open for 1922, this is a good time to consider how prices have been moving in the last few years and what is their present trend. Road oils and asphalt were most sensitive to the cessation of war orders and the necessity of stimulating the normal peace demand. This is easily shown by averaging the per gallon prices of the five oils listed monthly by *Engineering News-Record*, as follows: 1920 peak, 14c.; December, 1920, 13c.; November, 1921, 5.6c.; today, 6.3c. The same general trend holds for asphalt, which has dropped from $45 per ton at the peak to $15 a month ago and $17 today, in bulk, f.o.b. Bayonne, N. J.

Examination of Table I will give a working knowledge of paving prices. As an index, adding the prices of a square yard of common granite blocks, Chicago, a square yard of wood-blocks, New York, a cubic yard of crushed stone, New York, and a barrel of cement, Chicago, the result is $8.94 for December 1, as against $11.64 at the peak and $11.59 one year ago, the decline being 23 per cent. Quotations prior to 1920 are listed in the last column.

See Table II for contract prices.

TABLE I PRICES OF ROAD AND PAVING MATERIALS

| Material | Current | One Month Ago | One Year Ago | 1920 Peak | | Previous to 1920 |
|---|---|---|---|---|---|---|
| Road Oils: | | | | | | |
| Price per gal., f.o.b., N. Y. (at terminal) in tank cars, 8,000 gal. minimum: | | | | | | |
| 40° asphalt | $0.055 | $0.05 | $0.13 | $0.14 | (Sept.) | $0.065 (July, 1917) |
| 65° asphalt | .05 | .05 | .12 | .14 | (Sept.) | .07 (July, 1917) |
| Binder | .08 | .06 | .13 | .14 | (July) | .085 (July, 1917) |
| Flux | .065 | .055 | .13 | .15 | (July) | .0475 (Nov., 1919) |
| Refined asphalt | .065 | .065 | .13 | .14 | (Sept.) | .06 (Nov., 1919) |
| Asphalt: | | | | | | |
| Price per ton f.o.b. Bayonne, N. J., in 350 lb. barrels or 42 gal. drums | $26.00 | $24.00 | $36.50 | $50.00 | (June) | $15.00 (Nov., 1915) |
| In bulk, tank cars or later | 17.00 | 15.00 | 29.00 | 45.00 | (June) | 20.00 (Nov., 1917) |
| Paving Stone: | | | | | | |
| About 4x8x4, f.o.b. Chicago, per sq. yd. Dressed | $3.35 | $3.35 | $3.40 | $3.40 | (Sept.) | $2.15 (Sept., 1916) |
| Common | 3.00 | 3.00 | 3.05 | 3.05 | (Sept.) | 1.65 (Sept., 1916) |
| Curbing: | | | | | | |
| Bluestone 5x16 in., N. Y., per lin. ft. | .77 | .77 | .70 | .70 | (July) | .40 (Nov., 1915) |
| Wood Block Paving: | | | | | | |
| Size 3 x 10 treatment, N. Y., per sq. yd. | 2.17 | 2.17 | 4.02 | 4.07 | (Sept.) | 2.00 (Nov., 1917) |
| Crushed Stone: | | | | | | |
| 1½ in. carload lots, f.o.b. N. Y., per cu. yd. | $1.80@ $1.90 | $1.80@ $1.90 | 2.15 | 2.15 | (May) | $0.90@ 1.00 (Nov., 1913) |
| Cement: | | | | | | |
| Chicago distributors' list prices without bags | 1.97 | 1.97 | 2.37 | 2.37 | (Sept.) | 1.19 (Fall, 1913) |

TABLE II PRICES OF SOME RECENT CONTRACTS AWARDED ON STREET AND ROAD WORK

| Materials and Unit Prices | Amount | Location | Date | By Whom Awarded | To Whom Awarded |
|---|---|---|---|---|---|
| 32,042 sq. yd. [illegible] asphalt at $1.489 per sq. yd. | $44,538 | Gloucester City, N. J. | Oct. 20, 1921 | State Hy. Comm., Trenton, N. J. | Union Paving Co., Phila., Pa. |
| 32,220 sq. yd. two-course [illegible] at 5[illegible] per sq. yd. | 114,000 | Clarksville, Tex. | Aug. 25, 1921 | Red River Co. | McGuire & Cavender, Leavenworth, Kan. |
| 31,300 sq. yd. concrete at $4.79 per sq. yd. Bituminous Macadam | 150,000 | Hot Springs, S.D. | Aug. 25, 1921 | Municipality of Hot Springs | Allied Contractors, Inc., Omaha, Neb. |
| 7,400 ft. by 18 ft., 14,800 sq. yd. at $2.[illegible] per sq. yd. | 38,704 | Attleboro, Mass. | Oct. 31, 1921 | Dept. Pub. Wks. Div. Highways, Boston, Mass. | Hassam Paving Co., Worcester, Mass. |
| Grading, draining, curbing [illegible] 70,000 cu. yd. at $4 per cu. yd. | 280,000 | Durham, N. C. | Aug. 18, 1921 | City of Durham | Murray Constr. Co., Knoxville, Tenn. |

## Trend of Business

**Money**—Call loan rates 4½@5 per cent, time money 5¼.

**Foreign Exchange**—Canadian Exchange 94.3 cents, which is highest in two years. Sterling about $4.20. Generally rising exchanges are aiding sales of foreign bonds.

**Railway earnings** of Class 1 American railways for 1921 will approximate $561,665,000, net, according to the Bureau of Railway News and Statistics. This is about 3 per cent on the $18,900,000 valuation of the Interstate Commerce Commission. The 1920 net operating income was minus $22,338,836.

**Steel employees are offered stock** in the U. S. Steel Corporation at $84 for common, to a total amount of 100,000 shares. In other years the offerings were made at the following prices: 1909, $50; 1911, $70; 1912, $65; 1913, $66; 1914, $57; 1915, $85; 1917, $107; 1918, $92; 1919, $92; 1920, $106; 1921, $81.

**Textiles** — Seasonal dullness in woolen and worsted trades, but William Wood of the American Woolen Co. promises no wage reductions by his company. Demand for cotton goods better, with prices unchanged. Raw silk up to 30 cents a pound owing to advancing market in Japan. Lower prices expected for raw furs. Careful buying of jewelry during holiday season. Little activity in the leather trade. In general, 1922 is expected to be a better year than the one passing; money is easier and many of the large surplus stocks have been sold.

## Foreign Construction Projects

Shanghai, China, is planning a sewerage system according to United States Commerce Reports, at an estimated cost equivalent to about $3,000,000 gold, including value of land for a disposal-plant.

A loan of £200,000 has just been floated in London to complete a drainage and sewerage system for Rosario, Argentina. The original estimated cost of this work was £266,000, but £284,720 have already been spent on the uncompleted contract of November, 1910, which was delayed by the war.

Tokyo, Japan, is to install a complete sewerage system at a cost of 20,000,000 yen. Kobe is also to install a system at a cost of 40,000,000 yen. It is possible that some of the pipe used may be of American wood. Tokyo is spending 39,500,000 yen on street repairing and paving in which creosoted wooden paving blocks play an important part. At present these blocks are made in Japan of American fir, but some doubt is expressed as to the efficiency of the Japanese creosoting methods, and there is a possibility that later the blocks may be imported from America.

Large increases in exportations of American lumber to Japan are reported as being due to increased demands in the Japanese market, the cheap price of American lumber as compared with that of Japanese lumber, cheap ocean freight rates and plenty of cargo space, and to the fact that accessible Japanese timber is becoming increasingly scarce. The immediate outlook for American lumber is good provided prices do not greatly increase.

# Determining Wages of Building Trade Mechanics

### Carpenter's Wage Taken as a Basis—Fair Rates Can Be Computed For Any City

By Thomas H. Coe
Of O. D. Purington & Company, General Contractors, Providence, R. I.

Computation of what fair building trade wages should be was made by the writer in connection with a recent study undertaken for the Master Builders' Association of Rhode Island. In the computation the wages of the carpenter are taken as the basic wage in the so called skilled trades and the wages of the laborer as the basic wage in the unskilled and helpers trades and normal construction year. The amount is the average of the increases in 1920 over 1913 of all the trades. This column then shows what the May, 1920, rates would have been if all trades had received the same increase in wages over 1913 rates.

We have assumed that the 1921 basic wages should have been 1.6 times the 1913 basic wage. Therefore, the average wage through the country for the carpenter should have been 1.6 × 53 cents, or 84.8 cents per hour, an increase of 31.8 cents. The average for the country for the other trades is then found by adding to the 1913 wages the sum of 31.8 cents and the result is shown in the column headed "Computed 1921."

By tabulating all the 1913 wages for 1913 as the basic year. For the purpose of illustrating the computation of wages by statistics, let us assume that last spring a study of economic conditions showed that basic wages in the building trade for 1921 should be 1.6 times those of 1913.

The two accompanying tables have been constructed from data taken from the *Monthly Labor Review* of the U. S. Department of Labor. A careful study of these tables shows that the differentials between the wages of the trades remained about the same during the period covered. During the first years the relation remained almost exactly the same. Later on it varied slightly, and during the skyrocketing of wages the trades making the most exorbitant demands made some gains over the trades that were more modest.

In the table of wages of skilled mechanics (Table I) the column headed "1913 plus 0.47.1" was computed by giving each trade the same advance over wages in 1913, or the last full any city and making a comparison with the 1913 average for the country a fair 1913 carpenter's basic wage may be found for that particular city, and the 1921 carpenters wage computed by applying the 1.6. The 1921 wages for the other skilled trades would then be found by adding the same increase in cents per hour to the 1913 country average wages.

The table of unskilled labor and helper's wages is computed in the same manner as the table of the so-called skilled trade wages with the laborer's wage as the basic wage. Computation for any city for unskilled labor rates would be made in the same manner as in the case of skilled labor.

It would seem that for some time statistics are to be the governing factor in the determination of wage scales. If we are working back toward 1913 conditions it is not going to be easy to argue that if we were to arrive at that point the different trades should have the same differentials in pay that they did in 1913.

TABLE I PAST AND COMPUTED WAGES OF SKILLED MECHANICS IN THE BUILDING TRADES

U. S. Average May Rates per Hour

| | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1913 Plus 0 471 | Computed 1921 |
|---|---|---|---|---|---|---|---|---|---|---|
| Bricklayers | 0 686 | 0 699 | 0 706 | 0 713 | 0 734 | 0 789 | 0 878 | 1 200 | 1 157 | 1 004 |
| Carpenters | 0 530 | 0 541 | 0 546 | 0 562 | 0 610 | 0 668 | 0 774 | 1 034 | 1 001 | 0 848 |
| Cement finishers | 0 532 | 0 557 | 0 563 | 0 588 | 0 602 | 0 662 | 0 745 | 1 010 | 1 023 | 0 870 |
| Engineers | 0 586 | 0 592 | 0 598 | 0 604 | 0 633 | 0 727 | 0 797 | 1 032 | 1 057 | 0 904 |
| Granite cutters | 0 513 | 0 518 | 0 518 | 0 539 | 0 559 | 0 667 | 0 790 | 0 970 | 0 984 | 0 831 |
| Electricians | 0 547 | 0 564 | 0 575 | 0 586 | 0 624 | 0 695 | 0 799 | 1 051 | 1 018 | 0 865 |
| Fixture hangers | 0 491 | 0 521 | 0 521 | 0 540 | 0 580 | 0 634 | 0 707 | 0 953 | 0 962 | 0 809 |
| Lathers | 0 485 | 0 494 | 0 499 | 0 514 | 0 533 | 0 577 | 0 640 | 0 916 | 0 956 | 0 803 |
| Marble setters, helpers | 0 665 | 0 672 | 0 678 | 0 678 | 0 685 | 0 718 | 0 798 | 1 051 | 1 136 | 0 983 |
| Painters | 0 505 | 0 520 | 0 526 | 0 571 | 0 591 | 0 652 | 0 763 | 1 044 | 0 976 | 0 823 |
| Plasterers | 0 674 | 0 680 | 0 680 | 0 707 | 0 728 | 0 761 | 0 883 | 1 152 | 1 145 | 0 992 |
| Plumbers | 0 619 | 0 625 | 0 631 | 0 637 | 0 662 | 0 724 | 0 823 | 1 064 | 1 090 | 0 937 |
| Sheet metal workers | 0 512 | 0 532 | 0 538 | 0 548 | 0 573 | 0 671 | 0 737 | 0 988 | 0 983 | 0 830 |
| Steam fitters | 0 598 | 0 610 | 0 622 | 0 634 | 0 658 | 0 723 | 0 807 | 1 070 | 1 069 | 0 916 |
| Stone cutters | 0 570 | 0 593 | 0 598 | 0 604 | 0 633 | 0 673 | 0 798 | 1 043 | 1 041 | 0 888 |
| Stone masons | 0 610 | 0 628 | 0 634 | 0 646 | 0 671 | 0 731 | 0 823 | 1 146 | 1 081 | 0 928 |
| Structural iron workers | 0 617 | 0 629 | 0 629 | 0 641 | 0 678 | 0 777 | 0 882 | 1 161 | 1 088 | 0 935 |
| Tile layers | 0 652 | 0 658 | 0 658 | 0 671 | 0 704 | 0 723 | 0 788 | 1 062 | 1 123 | 0 970 |
| Average rate | 0 578 | 0 591 | 0 596 | 0 609 | 0 637 | 0 698 | 0 791 | 1 049 | 1 049 | 0 896 |
| Average increase over 1913 | | 0 013 | 0 018 | 0 031 | 0 059 | 0 120 | 0 213 | 0 471 | 0 471 | 0 318 |

TABLE II. PAST AND COMPUTED WAGES OF LABORERS, TENDERS AND HELPERS IN THE BUILDING TRADES

U. S. Average May Rates per Hour

| | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1913 Plus 0 440 | Computed 1921 |
|---|---|---|---|---|---|---|---|---|---|---|
| Building laborers | 0 309 | 0 312 | 0 312 | 0 327 | 0 361 | 0 423 | 0 482 | 0 698 | 0 749 | 0 494 |
| Hod carriers | 0 356 | 0 359 | 0 363 | 0 373 | 0 416 | 0 487 | 0 569 | 0 825 | 0 796 | 0 541 |
| Marble cutters' helpers | 0 404 | 0 408 | 0 408 | 0 408 | 0 432 | 0 453 | 0 517 | 0 873 | 0 844 | 0 589 |
| Plasterer's laborers | 0 405 | 0 417 | 0 417 | 0 429 | 0 458 | 0 528 | 0 601 | 0 871 | 0 849 | 0 594 |
| Stone derrick helpers | 0 312 | 0 319 | 0 328 | 0 331 | 0 353 | 0 409 | 0 490 | 0 709 | 0 752 | 0 497 |
| Tile layer's helpers | 0 359 | 0 362 | 0 373 | 0 387 | 0 398 | 0 409 | 0 498 | 0 814 | 0 799 | 0 544 |
| Average rate | 0 358 | 0 363 | 0 367 | 0 376 | 0 403 | 0 451 | 0 526 | 0 798 | 0 798 | 0 543 |
| Average increase over 1913 | | 0 005 | 0 009 | 0 018 | 0 045 | 0 093 | 0 168 | 0 440 | 0 440 | 0 185 |

## Engineering News-Record's Cost Index 1915 to Date

*Engineering News-Record's* Construction Cost Index Number is here tabulated monthly from January, 1915, to December, 1921, inclusive. Next week's issue, Jan. 5, which will feature the Business Side of Construction, will carry the complete monthly list of the Cost Index Number, with chart and an explanation of the Number.

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER
(100 = 1913)

| | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|---|---|---|
| January | 86 12 | 130 46 | 167 75 | 184 51 | 198 05 | 206 55 | 230 87 |
| February | 87 36 | 134 46 | 167 75 | 184 51 | 201 50 | 225 10 | 230 62 |
| March | 87 66 | 142 96 | 175 66 | 184 51 | 198 05 | 240 85 | 224 22 |
| April | 90 16 | 147 31 | 183 41 | 186 01 | 191 25 | 265 20 | 213 07 |
| May | 90 16 | 148 86 | 187 61 | 186 01 | 191 25 | 268 90 | 210 82 |
| June | 88 96 | 146 51 | 199 26 | 186 31 | 191 85 | 273 80 | 209 82 |
| July | 90 51 | 145 76 | 204 01 | 188 65 | 193 65 | 265 65 | 203 82 |
| August | 91 76 | 146 56 | 198 41 | 193 85 | 196 65 | 252 00 | 193 07 |
| September | 93 01 | 149 56 | 190 31 | 193 85 | 202 85 | 255 20 | 188 27 |
| October | 96 16 | 152 91 | 167 11 | 193 85 | 202 25 | 255 20 | 182 57 |
| November | 101 06 | 155 66 | 166 50 | 193 55 | 206 85 | 255 32 | 166 32 |
| December | 107 06 | 167 15 | 167 11 | 194 75 | 206 85 | 251 62 | 167 82 |

# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. More exact and detailed quotations on costs of work can be had by noting actual biddings as reported in Engineering News-Record. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1; the next, on January 5.

| Steel Products. | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $2 78 | $4.00 | $4 00 | $2.88 | $3 06 | $3.75 | $3.45 | +$3.85 | $4.00 |
| Structural rivets, 100 lb. | 3.50 | 5.25 | 5.50 | 3.43 | 4 15 | 4.25 | 5.50 | 4.25 | 6.50 |
| Reinforcing bars, ¾ in. and larger, 100 lb. | 2 48 | 3.20 | 3.50 | 2.68 | —2.96 | 3.57½ | 3.00 | 3.75 | 2.75 |
| Steel pipe, black, 2½ to 6 in. lap, discount | 41% | 57.65% | 45% | 57% | 61.9–5% | 41% | 53.7% | —55% | 35.10 |
| Cast-iron pipe, 6in. and over, ton | 47.30@48.30 | 45.00 | 54.30 | 44.10 | 47.80 | 52.00 | 50.00 | 55.00 | 60.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.30 | 2.69 | 2.55 | 1.97 | 2.26 | 3.10 | 2.84 | 3.10 | 3.12 |
| Gravel, pit, cu.yd. | 1 75 | 1.85 | 2.25 | 2.00 | 1.50 | 2.50 | 2.25 | 1.50 | 1.50 |
| Sand, cu.yd. | 1.00 | 1.25 | 2.25 | 2 00 | .50 | 1.10 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.80 to 1.90 | 2.00 | 3.20 | 1.60 | 2.25 | 3.50 | 2.25 | 3.00 | 2.10 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M ft. | 49.00 | 38.00 | 34 00 | 48 00 | +36.00 | 50.00 | 30 00 | 22 00 | 120.00 |
| Lime, finishing, hydrated, ton | 16.99 | 19.00 | 25 00 | 18 00 | 29.00 | 30.00 | 22.00 | 27.00 | 21.00 |
| Lime common, lump, per bbl. | —3.00@3.49 | 1.50 | 2.75 | 1.40 | 1.40 | 2.95 | 1.90 | 3.25 | 11.00 |
| Common brick, delivered, 1,000 | 17.40@18.40 | 9.00 | 12.72 | 11.00 | 17.00 | 14.00 | 15.00 | 14.00 | 16.00 |
| Hollow building tile, 4x12x12, block | Not used | .0675 | .13 | .0821 | .0792 | .09 | .12½ | .10 | .08@.29 |
| Hollow partition tile 4x12x12, block | .111.00 | .0675 | .13 | .0057 | .... | .10 | .14½ | .11 | ..... |
| Linseed oil, raw, 5 bbl. lots, gal. | .72 | .78 | .88 | 74 | .80 | .90 | — .82 | .79 | .85 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | 35 | | 72 | 50 | .50@.55 | .75 | .50@ .60 | ..... |
| Common labor, non-union, hour | ..... | .20 | .35@ 45 | .35@.40 | .50 | .35@.40 | 50@.55 | .50 | 25@ 30 |

Explanation of Prices.—[illegible] from previous quotations are indicated by [illegible] vailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. New York [illegible] tiles, which are "on trucks." Common lump [illegible] f.o.b. cars, New York. Sand, gravel and crushed stone are quoted along- [illegible] $2 per cu.yd. **Chicago** quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile de- [illegible] Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; [illegible] for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump [illegible] Dallas [illegible] 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath [illegible] f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

## Changes Since Last Week

Slight advances are reported in two important construction materials during the last week. Seattle quotes structural steel shapes at $3.85 as against $3.75 per 100 lb. and Minneapolis quotes Douglas fir, base sizes, at $36 as compared with $35 per M. ft. one week ago.

Pittsburgh quotes an average reduction of $5 per ton on wire rods, wire and cut nails, making the present price of wire nails $2.50 as against $2.90 and cut nails $2.25 as compared with $2.60 per keg on Dec. 1. Wire rods, are [illegible] as against $42 per ton at the mill.

Mill shipments of steel shapes are quoted in Seattle at $3.47; reinforcing bars at $3.37 per 100 lb. An additional discount of 5 per cent is quoted on steel pipe, making the present rate 55 per cent as against 50 per cent. Changes in hollow tile and brick block quotations are expected in the Seattle district after Jan. 1; advances in lumber are anticipated owing to continually increasing demands.

Minneapolis quotes a decrease of 12½c. on reinforcing bars, making the present price $2.96 as against $3.08½ per 100 lb. Common lump lime is quoted in New York at $3@$3.49, f.o.b. cars, as compared with the former quotation of $3.39@$3.69 per lb. (280 [illegible] quoted in San Francisco at 82c. as compared with 83c. per gal. last week.

The National Lumber Manufacturers' Association reports production 27 per cent; shipments 33 per cent and orders 36 per cent below normal, for the week ending Dec. 23.

The Southern Pine Association reports 76,534,677 ft. of lumber cut; 67,886,640 ft. shipped and orders for 56,209,284 ft. for the week ending Dec. 17.

The West Coast Lumbermen's Association reports for the same period 62,261,599 ft. cut; 52,020,892 ft. shipped and orders amounting to 60,708,605 ft. b.m.

# CONSTRUCTION NEWS

## PROPOSALS

**For proposals Advertised see the pages immediately following the "Construction News" Section.**

### WATERWORKS

| Bids Close | | | See Eng. News-Record |
|---|---|---|---|
| Jan. | 3 | Earlville, Ill. | Dec. 22 |
| Jan. | 3 | St. Paul, Minn. | Dec. 22 |
| Jan. | 6 | Phila., Pa. | Dec. 29 |
| Jan. | 11 | Central Islip, N. Y. Adv. Dec. 22 and 29. | Dec. 29 |
| Jan. | 23 | Madison, S. D. | Dec. 29 |
| Jan. | 31 | Atlanta, Ga. Adv. Dec. 29. | Dec. 29 |

### SEWERS

| | | | |
|---|---|---|---|
| Jan. | 2 | Marceline, Mo. | Dec. 15 |
| Jan. | 3 | Indianapolis, Ind. | Dec. 22 |
| Jan. | 3 | Detroit, Mich. | Dec. 29 |
| Jan. | 4 | Columbus, O. | Dec. 29 |
| Jan. | 4 | Appleton, Wis. | Dec. 15 |
| Jan. | 4 | Dearborn, Mich. Adv. Dec. 22 and 29. | Dec. 22 |
| Jan. | 7 | Streator, Ill. | Dec. 22 |
| Jan. | 13 | Milwaukee, Wis. Adv. Dec. 8 to 29. | Dec. 8 |
| Jan. | 23 | Madison, S. D. | Dec. 29 |

### WASTE DISPOSAL

| | | | |
|---|---|---|---|
| Jan. | 4 | New Orleans, La. | Dec. 22 |

### BRIDGES

| | | | |
|---|---|---|---|
| Jan. | 5 | Sedgwick, Kan. | Dec. 29 |
| Jan. | 10 | Lake Charles, La. Adv. Dec. 15 to 29. | Dec. 15 |
| Jan. | 10 | Oklahoma | Dec. 29 |
| Jan. | 14 | Bradentown, Fla. | Dec. 29 |
| Jan. | 16 | Royersford, Pa. Adv. Dec. 29. | Dec. 29 |

### RAILWAYS

| | | | |
|---|---|---|---|
| Jan. | 9 | Ontario | Dec. 15 |

### EXCAVATION AND DREDGING

| | | | |
|---|---|---|---|
| Jan. | 4 | Belzoni, Miss. Adv. Dec. 15 to 29. | Dec. 15 |
| Jan. | 4 | Carrollton, Mo. | Dec. 29 |
| Jan. | 6 | Ivanhoe, Minn. | Dec. 29 |
| Jan. | 7 | Riverton, Wyo. | Nov. 10 |
| Jan. | 7 | Duluth, Minn. | Oct. 13 |

### STREETS AND ROADS

| | | | |
|---|---|---|---|
| Jan. | 2 | Petersburg, Ind. | Dec. 22 |
| Jan. | 3 | Gaston, N. C. Adv. Dec. 29. | Dec. 29 |
| Jan. | 3 | Stockton, Cal. | Dec. 15 |
| Jan. | 3 | Lewisburg, W. Va. | Dec. 22 |
| Jan. | 3 | Akron, O. | Dec. 22 |
| Jan. | 3 | San Luis Obispo, Cal. | Dec. 22 |
| Jan. | 3 | Jacksonville, Fla. | Dec. 22 |
| Jan. | 4 | Florida | Dec. 15 |
| Jan. | 5 | Florida | Dec. 15 |
| Jan. | 5 | Jackson, Mich. | Dec. 29 |
| Jan. | 5 | Virginia | Dec. 29 |
| Jan. | 6 | Gladwin, Mich. | Dec. 29 |
| Jan. | 6 | Marlin, Tex. | Dec. 29 |
| Jan. | 6 | Denton, Tex. | Dec. 29 |
| Jan. | 9 | Dallas, Tex. | Dec. 29 |
| Jan. | 9 | Benton, Ill. | Dec. 29 |
| Jan. | 9 | Elmhurst, Ill. Adv. Dec. 29. | Dec. 29 |
| Jan. | 10 | Palatka, Fla. | Dec. 22 |
| Jan. | 10 | Akron, O. | Dec. 29 |
| Jan. | 10 | Bridgeton, N. J. | Dec. 29 |
| Jan. | 10 | Oklahoma | Dec. 29 |
| Jan. | 10 | Jasper, Tex. | Dec. 29 |
| Jan. | 10 | Georgetown, Tex. | Dec. 29 |
| Jan. | 12 | Wisconsin | Dec. 29 |
| Jan. | 14 | Bradentown, Fla. | Dec. 29 |
| Jan. | 16 | California | Dec. 29 |
| Jan. | 31 | Lake Wales, Fla. Adv. Dec. 22 and 29. | Dec. 22 |

### INDUSTRIAL WORKS

| | | | |
|---|---|---|---|
| Jan. | 2 | Pleasantville, N. J. | Dec. 22 |
| Jan. | 3 | Phila., Pa. | Dec. 22 |
| Jan. | 5 | St. Louis, Mo. | Dec. 29 |
| Jan. | 7 | Racine, Wis. | Dec. 29 |
| Jan. | 11 | Middletown, N. Y. Adv. Dec. 22 and 29. | Dec. 22 |
| Jan. | 15 | Corning, Ia. | Dec. 15 |
| Jan. | 19 | Parke, N. D. | Dec. 22 |

### BUILDINGS

| | | | |
|---|---|---|---|
| Jan. | 2 | New Orleans, La. | Dec. 29 |
| Jan. | 3 | Butler, Ind. | Dec. 22 |
| Jan. | 4 | Cleveland, O. | Dec. 29 |
| Jan. | 4 | Los Angeles, Cal. | Dec. 29 |
| Jan. | 4 | Frankfort, Ky. | Dec. 29 |
| Jan. | 4 | Ottawa, Ont. | Dec. 29 |
| Jan. | 5 | Gettysburg, Pa. | Dec. 29 |
| Jan. | 5 | New York, N. Y. | Dec. 29 |
| Jan. | 5 | Cookeville, Tenn. | Dec. 22 |
| Jan. | 5 | Murfreesboro, Tenn. | Dec. 29 |
| Jan. | 5 | New York, N. Y. | Dec. 29 |
| Jan. | 5 | Nashville, Tenn. | Dec. 29 |
| Jan. | 6 | Columbus, O. | Dec. 29 |
| Jan. | 6 | Harrisburg, Pa. | Dec. 22 |
| Jan. | 8 | Indianapolis, Ind. | Dec. 29 |
| Jan. | 10 | Fayetteville, N. C. | Dec. 29 |
| Jan. | 10 | Independence, Kan. | Dec. 29 |
| Jan. | 10 | Marathon, Wis. | Dec. 22 |
| Jan. | 10 | Manitowoc, Wis. | Dec. 22 |
| Jan. | 12 | Secaucus, N. J. | Dec. 29 |
| Jan. | 17 | Newcastle, Ind. | Dec. 22 |
| Jan. | 17 | Institute (Sturgeon Bay P. O.), Wis. | Dec. 22 |
| Jan. | 18 | Grand Rapids, Mich. | Dec. 22 |
| Jan. | 24 | Grand Rapids, Mich. | Dec. 22 |
| Jan. | 24 | Madison, Wis. | Dec. 22 |
| Jan. | 30 | Grand Rapids, Mich. | Dec. 22 |
| Feb. | 1 | Williamsport, Pa. | Sept. 6 |
| Feb. | 1 | Duluth, Minn. | Oct. 27 |
| Feb. | 2 | Battle Ground, Ind. | Dec. 29 |

### MISCELLANEOUS

| | | | |
|---|---|---|---|
| Jan. | 3 | Electroliers—Redwood City, Cal. | Dec. 15 |
| Jan. | 3 | Road Machinery—Lancaster, Wis. | Dec. 29 |
| Jan. | 3 | Street Signs — Minneapolis, Minn. | Dec. 29 |
| Jan. | 4 | Turbo-Generator — Lincoln, Neb. | Dec. 15 |
| Jan. | 4 | Railway Material—San Francisco, Cal. | Dec. 15 |
| Jan. | 4 | Wharf Cranes—Rochester, N. Y. Adv. Dec. 8 to 29. | Dec. 8 |
| Jan. | 6 | Station Finish — New York, N. Y. | Dec. 22 |
| Jan. | 11 | Electrical Work—Buffalo, N. Y. | Dec. 22 |
| Jan. | 11 | Asphalt Heating Plant—Santa Rosa, Cal. | Dec. 29 |
| Jan. | 11 | Refrigeration System—Rochester, N. Y. | Dec. 22 |
| Jan. | 12 | Distribution System—Watertown S. D. | Dec. 15 |
| Jan. | 12 | Terminal Sub-structure — San Francisco, Cal. | Dec. 29 |
| Jan. | 18 | Station Finish — New York, N. Y. | Dec. 29 |
| Feb. | 7 | Shafts and Tunnel—Jersey City, N. J. | Dec. 29 |

**Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.**

## Waterworks

### PROPOSED WORK

**O., Wellsville**—Plans improving waterworks. $300,000. Morris-Knowles, Inc., 1200 Jones Law Bldg., Pittsburgh, engrs.

**Wis., Beaver Dam**—Soon takes bids, centrifugal pump with motor, in pumping station. W. A. Gergen, clk.

**Ia., Moulton**—Making plans waterworks. $46,000. Henningson Eng. Co., Natl. Bldg., Omaha, Neb., engrs.

**S. D., Vermilion**—Making plans reservoir and iron pipe line connecting present pumping plant. $30,000. J. M. Brown, Vermilion, engr.

**Que., Montreal**—A. E. Doucet, City Hall, dir. Pub. Wks., soon takes bids, 11,000 ft. pipe in Cremazie Blvd., $80,000; 5,000 ft. 24 in pipe in Ville Emard Ave., $90,000; 30 in. pipe in various streets, $266,000.

**Ont., Sarnia**—Election Jan. 2, to vote on $15,000 bonds for extending mains. Prices wanted on 6 and 8 in. c.i. mains. M. D. Stewart, clk.

### BIDS DESIRED

**Pa., Phila.**—Jan. 6, by F. H. Caven, dir. pub. wks., furnishing and general construction of foundations for pumping station at Belmont pumping station, 8,000 lb. steel, 200 cu.yd. concrete, 500 cu.yd. excav., $25,000, high pressure steam and water pipes, exhaust lines, covering for pipe, valves, 10 in. oil separator, 3 separators, etc. $18,000; laying cable at Roxboro and Belmont pump stations, $30,000. C. E. Davis, City Hall, engr.

**Ga., Atlanta** — Jan. 31, by Purchasing Agent, City Hall, filter plant and reservoir. P. H. Norcross, 1405 Candler Bldg., consult. engr.; adv. this issue.

**Ind., Marion**—Alvord & Burdick, engrs., 8 South Dearborn St., Chicago, receiving bids altering pumping station, new 5,000,000 gal. steam pump, for city. $50,000. Noted Dec. 1.

**Ill., Earlville**—Jan. 3, by F. H. Smith, city clk., for double acting deep well pump driven by oil or gasoline engine. $65,000. Engineer not announced.

**Minn., St. Paul**—Jan. 3, by H. W. Austin, city purch. agt., 39 tons c.i. water specials, 300 coils ⅝ in., 200 coils ¾ in., 50 coils 1 in., 50 coils 1¼ in. lead pipe, 1,500 lb. lead wool, 55 tons pig lead in 100 lb. pigs. O. Claussen, city engr.

**S. D., Madison**—Jan. 23, waterworks extensions, incl. 8,655 ft. 4-10 in. mains, 5,000 c.i. fittings, etc. $25,000. C. A. Trimmer, city engr.

### BIDS RECEIVED

**Mich., Monroe**—For rein.-con. filtered water reservoir, from Kitchell Constr. Co., Monroe, $41,573; Duboise Constr. Co., Flint, $46,395; Realty Constr. Co., Monroe, $49,013.

**Cal., Fullerton**—For 240 x 320 ft. reservoir, from P. H. Ehlers, 1959 North Raymond Ave., Pasadena, $49,350; Mercereau Bridge Co., 313 North Ave. 22, Los Angeles, $49,390; Bent Bros., 1714 Eagle St., Los Angeles, $51,000. Noted Dec. 8.

### CONTRACTS AWARDED

**Mich., Flushing**—Will extend water mains and install new pumping equipment, by day labor. $60,000. United Eng. Corp., 522 Griswold St., Detroit, engrs.

**Neb., Lincoln**—Furnishing one 1,000 hp. economizer, to Green Fuel Economy Co., 90 West St., New York, $16,662; 2 chain grate stokers for 500 hp. boilers, to Kent Eng. Co., Omaha, $6,917; 1 superheater for two 500 hp. boilers, to Power Specialty Co., 111 Bway., New York, $3,450; 2 soot blowers, to Diamond Power Specialty Co., Kansas City, $922; 1 centrifugal driven boiler feed pump, to C. H. Carr Mchy. Co., 411 Mutual Bldg., Kansas City, Mo., $1,286; 1 open feed water heater, to Kent Eng. Co., Omaha, $5,318; 1 hot process water softener, to International Filter Co., 38 South Dearborn St., Chicago, $3,230. Noted Dec. 1.

**Wash., Yakima**—For pipe line system, to Burnett & Deming, Bellingham, $181,877. Noted Dec. 1.

**Cal., Redding**—Pacific Gas & Electric Co., will improve reservoir, install filtration plant, re-route and install new mains, by day labor. Cost between $40,000 and $60,000. R. A. Monroe, engr.

## Sewers

### PROPOSED WORK

**Conn., Stratford**—Town plans to issue $250,000 bonds to extend sewerage system. R. K. Hunter, mgr.

**Pa., McKees Rocks**—See "Streets and Roads."

**N. C., Hamlet**—See "Streets and Roads."

**O., Warren**—Comrs. Trumbull Co. open bids, after Jan. 1, 4 mi. 8 in. rein.-con., 1 mi. 10-12 in. vitr. clay, ½ mi. 15 in. segmental block and ¾ mi. 10-24 in. tile sewers, Brookfield Twp. $150,000.

**Mich., Northville**—Plans being prepared for sewerage system incl. 50,000 ft. 8-15 in. vitr. pipe, 1,500 ft. 8-15 in. c.i. pipe, sewage treatment works, settling tank, etc $110,00. C. W. Hubbell, 2348 Penobscot Bldg., Detroit, engr.

**Mich., River Rouge**—Plans being prepared 2 mi. main outlet sewer, 4-6 ft. diam., depth of cut 10 ft. $100,000. G. Jerome, 1331 Majestic Bldg., Detroit, engr.

**Mich., Springwells**—A. Roth, village engr. and C. W. Hubbell, consult. engr.,

Sewers (Continued)

... about Jan. 31, concrete or brick sanitary sewers in Dix, Mulkey and Southern Axes.

**Ia., Decorah**—... sewerage system, incl. flushtanks, manholes and lampholes. $30,000. F. M. Hughes, clk

**Minn., Virginia**—... sewerage system, ... beds at purification plant, $7,500. E. F. Johnson, city engr.

**Wis., Fox Lake**—... sewerage system. $60,000. W. F. O'Connel, clk. Engineer not selected.

**Wis., Milwaukee**—Metropolitan Sewerage Comn., 221 Grand Ave., making surveys intercepting sewers to drain Milwaukee Co., 8,000 ft. 36 and 48 in. concrete pipe in Watertown Plank Rd. from 40th St. here, to City of Wauwatosa; 10,000 ft. 30 in. concrete pipe in National Ave. from Milwaukee city limits to West Allis; 400 ft. 20 in. c.i. pipe, under Milwaukee River from Lake St. on west side to east side; 4,000 ft. 30 in. concrete pipe, from east end of above syphon along Milwaukee River north to village of Whitefish Bay; 18-36 in. concrete pipe from foot of Lake St. at Milwaukee River north to North Milwaukee. $3,000,000. T. C. Hatton, City Hall, engr. Noted Nov. 10.

**Wis., Milwaukee**—Sewerage Comn making plans and takes bids in spring 5,500 ft. 36 in. concrete intercepting sewer in National Ave. from 18th Ave. to city limits and 1,800 ft. of 48 in. in Becker St. from 6th Ave. to 1st Ave. $1,300,000; bids during winter for 24 sluice gates and 6 in. mud valves, also large number of gate valves in connection with sewage disposal plant on Jones Island. T. C. Hatton, City Hall, engr.

**Nev., Gardnerville**—Making plans sewerage system, 13,000 ft. 6-12 in. vitr. pipe, manholes, flushtanks and concrete septic tank. $30,000. L. H. Taylor & Co., 309 I. O. O. F. Bldg., Reno, engrs.

**Que., Montreal**—Takes bids soon for sewers in Sherbrooke St. E. from Maisoneuve to St. Jean Aves., $235,000, and from St. Jean de Dieu Ave. to Pointe Aux Trembles, $398,000. A. E. Doucet, dir. pub. wks.

**Ont., London**—Takes bids about Jan. 21, 6-27 in. sewer pipe for sanitary sewerage system. $300,000. H. A. Brazier, city engr.

### BIDS DESIRED

**S. C., Hartsville**—... Streets and Roads."

**O., Columbus**—... clk. Franklin Co., 3 mi. 15-36 in., joint intercepting sewer in Clinton Dist. 2. $130,000. E. G. Bradbury, Gugle Bldg., engr. Noted Aug. 25.

**Mich., Detroit**—Jan. 3, by Dept. Purchase & Supplies, 710 Marquette Bldg., sewer pumping apparatus, incl. suction pump on standard chassis, gasoline driven. $5,000.

**S. D., Madison**—Jan. 23, sewer improvements, incl. 13,725 ft. 6-12 in. vitr. pipe, 216 ft. 12 in. c.i. pipe, 38 manholes, etc. $40,000. C. A. Trimmer, city engr.

### BIDS RECEIVED

**N. Y., Brooklyn**—... (1) 83rd St., (2) Maple St., (3) Ave. S, (4) Ave. U, (5) Riverdale Ave., from Tomasetti & Co., 1133 60th St., (1) 77% of engineers estimate ($7,000), (2) 91% ... Ocean Parkway, (1) 82.96%; ... Murphy Bros., 8856 26th Ave., (1) 81%, (2) 87%; J. V. Timoney Co., 220 East 201st St., New ... ($2,000), (5) 124%; J. J. Guiman Contg. Co., 2314 Gravesend Ave., (3) 85%, (4) 81%. Noted Dec. 21.

**N. Y., Long Island City**—... Junction Ave., reconstructing outlet at (1) ... (2) $11,[illegible]; ... St., Flushing, (3) $4,686, (4) $4,864, (5) $[illegible]; ... $1,826; ... $1,657, (8) $2,788, (9) $1,752, (10) $11,761; J. F. Clancy, Inc., Long Island City, (1) $4,520, (3) $5,003, (8) $3,332, (9) $1,639; H. J. Mullin Contg. Co., Fulton St. and Twombly Pl., Jamaica, (2) $3,852, (3) $4,498, (5) $9,046, (7) $2,359, (8) $3,077, (9) $1,482, (10) $10,351, (11) $4,564; Kennedy & Smith, Inc., 93 Amity St., Flushing, (1) $3,737, (2) $3,693, (6) $1,646, (7) $2,422; J. V. Timoney Co., 200 East 201st St., New York, (2) $3,664; F. L. Paino, Woodhaven, (4) $5,841; A. Rivera, (11) $4,450; Tidus & Wright, (11) $4,508. Noted Dec. 15.

**N. J., Passaic**—Passaic Valley Sewerage Comrs., 128 Market St., Newark, opened bids Dec. 20, central portion of Sect. 19, Sta. 24 plus 42 to Sta. 41 plus 00, Garfield-Wallington-Passaic Branch Intercepting Sewer, here: (1) 1,100 lin.ft. earth excav. and refill, in trench, for 42 in. concrete sewer, (2) 558 lin.ft. earth excav. and refill, in trench, for 48 in. concrete sewer, (3) 1,000 cu.yd. concrete masonry, etc., from V. Spiniello, Orange, (1) $28.60 per lin.ft., (2) $21.80, (3) $15, total, $65,654; Cenedella & Co., Milford, Mass., (1) $29, (2) $29, (3) $15), $70,032; Arnolt-More, Inc., 45 Clinton St., Newark, (1) $29, (2) $40, (3) $14, $[illegible]. Noted Nov. 24.

### CONTRACTS AWARDED

**N. Y., Long Island City**—M. E. Connolly, pres., Queens Boro, Queens Subway Bldg., sewer in Walker St., etc., here, F. Gallo, 940 Crescent St., Astoria, $65,879. Noted Nov. 17.

**N. C., Charlotte**—... Extending sewerage system, to Tucker & Laxton, Realty Bldg., $36,836; storm sewers, to Myers Constr. Co., Meridian, Miss., $54,132. Noted Nov. 3.

**Minn., Minneapolis**—Will extend trunk sewer in 38th Ave., N.E., to Central Ave., $60,000; in 42nd Ave., N., from Thomas to Washburn Aves., and in Washburn Ave. from 42nd to 35th Aves., $60,000; trunk sewer in Linden Hills Dist. $75,000; relief sewer in 21st Ave., N. from 6th to Colfax Ave., continuation of Minnehaha sewer, $100,000. W. C. Elsberg, city engr., C. Ilstrup, sewer engr. Work will be done by day labor.

**Mo., Columbia**—To C. J. McCoy Constr. Co., Emporia, Kan., for sewage disposal plant, here, incl. Imhoff tank and dosing chamber, complete, $14,500, sprinkling filter complete, $47,600, sludge filter complete, $2,000, secondary settling tank, $2,000, concrete bulkhead, $500, 5,100 cu.yd. earth excav., $1,020, per cu.yd., 2,166 cu.yd. rock excav., $4.50, total, $82,352; sewer mains, 1,800 lin.ft. d.s. vitr. pipe, $1.05 per lin.ft., 20,550 lin.ft. 8 in. pipe, $0.50, and 350 lin.ft. 10 in. pipe, $0.65, etc., total, $39,-905. Noted Nov. 24.

**Wash., Seattle**—Bd. Pub. Wks. clay trunk sewer and laterals in 53rd Ave. S. W., to Scalzo & Co., 1708 22nd St., S., $45,612. Noted Nov. 17.

## Bridges

### PROPOSED WORK

**Fla., Clearwater**—State Rd Dept., Tallahassee, takes bids about Jan. 15, Safety Harbor Bridge, 1,200 ft., 2,000 cu.yd. rein.-con., and Seminole Bridge, 1,800 ft., 2,500 cu.yd. rein.-con., Pinellas Co., $60,000 and $90,000 respectively. E. C. Burleson, co. engr. J. A. Shortland, state highway engr. Noted Dec. 1.

**O., Girard**—Comrs. Trumbull Co. (Warren), open bids in spring 2,000 ft. rein.-con. bridge, Gilbert St., $900,000. Watson Eng. Co., 4614 Prospect St., Cleveland, ... Noted Mar. 4.

**Nebraska** — Dept. Pub. Wks., Lincoln, takes bids late in winter, bridge over Platte River, at Brady, to have seven 50 ft. concrete arches; over Platte River, at Lisco, twelve 50 ft. concrete arches; over Platte River, at Silver Creek, twenty 50 ft. concrete arches; over Elkhorn River, at Ewing, three 70 ft. pony Pratt trusses; over Platte River, at Oshkosh, twelve 50 ft. concrete arches. G. E. Johnson, State Dept. Pub. Wks., engr.

**Ill., Rockford**—... plans Trask Bridge, rein.-con. and steel, 1½ ft. roadway, two 5 ft. sidewalks, $50,-... Noted Dec. 15.

**Utah—Ogden**—State Rd Comm., Salt Lake City, opens bids early in 1922, rein.-con. viaduct and two 132 ft. steel bridges, 20 ft. roadways, for Union Pacific R.R. State and Federal Government. $200,000. ...

### BIDS DESIRED

**Fla., Bradentown**—Jan. 14, by Comrs. Manatee Co., 40 concrete bridges, six 50 ft. spans, 79 gal. iron culverts, 4 wooden tressles, length 10,000 ft., in Manatee Oneco Dist. $100,000. McElroy Eng. Co., Giddens Bldg., Tampa, engrs. Former bids rejected. Noted Dec. 1.

**Oklahoma**—Jan. 10, by E. S. Alderman, state highway engr., Oklahoma City, one 28 ft. concrete girder bridge, one 210 ft. truss and two 50 ft. trusses, with concrete substructures, McCurtain Co.

**Pa., Royersford**—Jan. 16, by H. W. Smedley, controller Montgomery Co., Court House, Norristown, 3 span rein.-con. bridge over Schuylkill River between here and Spring City; adv. this issue.

**Illinois**—Dept. Pub. Wks. and Buildings, Div. Highways, Springfield, following bridges, (1) 1 concrete and substructure for steel, Route 13, Sect. 9-B, Saline Co. (2) superstructure for steel span, Route 13, Sect. 9-C, Saline Co. (3) 1 concrete and 1 steel, Route 13, Combination E, Saline Co. (4) 1 concrete and 1 substructure for steel, Route 13, Sect. 10-B, Gallatin Co. (5) superstructure for steel, Route 13, Sect. 10-C, Gallatin Co. (6) 1 concrete and 1 steel, Route 13, Combination F, Gallatin Co. (7) 3 concrete, Route 13, Sect. 11-B, Gallatin Co., (8) 5 concrete and 2 substructures for steel, Route 13, Combination G, Saline-Gallatin Co. (9) 5 concrete and 2 steel, Route 13, Combination I, Saline Gallatin Co. (10) 2 concrete, State Aid 6, Sect F, Rock Island Co., from Thornton & Linden, Arcola, (1) $18,086 (7) $6,956 (10) $4,322, D. Jenkins, Terre Haute, Ind., (1) $13,166, (4) $8,778, (7) $9,041, (8) $35,484 Zimmerly Bridge Co., Paris, (4) $19,984, (4) $9,998, (8) $40,000, (10) $5,435. Standard Eng. Co., Toledo, O., (2) $8,764, (5) $17,941. Rochester Bridge Co., Rochester, Ind., (2) $8,977. Clinton Bridge Wks., 101 South 2nd St., Clinton, Ia., (2) $9,057, (5) $19,964. E. F. Clarke & Sons, St. Louis, Mo., (3) $32,031, (4) $32,379. Decatur Bridge Wks., East Eldorado St. & Chicago, Illinois & Western Rd., Decatur, (5) $19,-935. W. H. Shons, 109 Spring St., Freeport, (4) $11,037, (7) $510,503, M. & P. Contg. Co., Rockport, Ind., (8) $46,000. L. Weldon Co., Davenport, Ia., (9) $84,499, (10) $5,556. Noted Dec. 8.

**Kan., Sedgwick**—Jan. 5, by Sedgwick Co., 250 ft. rein.-con. T. girder, 5 spans, alternate two 125 ft. radius arch spans, for Sedgwick and Harvey Counties. $50,000. M. Roseberry, Wichita, engr. Noted Sept. 1.

### BIDS RECEIVED

**Tex., Del Rio**—Val Verde Co opened bids Dec. 6, 450 ft. bridge over Pecos River, (a) three 150 x 18 ft. steel spans, concrete abutments on rein.-con. piers (b) three 150 ft. steel spans, mass piers, (c) two 225 ft. steel spans on rein.-con. piers, (d) two 225 ft. steel spans on mass piers, from McCall-Moore Eng. Co., 308 Amicable Bldg., Waco, (a) $64,705, (b) $68,458, (c) $61,098, (d) $64,376; Illinois Steel Bridge Co., c/o H. K. Webb, Box 351, Dallas, (a) $72,450, (b) $84,623, (c) $69,367, (d) $73,-861; J. De Puy, Bedell Bldg., San Antonio, (a) $81,632, (b) $88,898; General Constr. Co., 308 Cotton Exch. Bldg., Ft. Worth, (c) $75,892, (d) $77,615. Noted Nov. 24.

### CONTRACTS AWARDED

**N. Y., Buffalo**—Pub. Wks. Comn., Municipal Bldg., reconstructing, renewing and protecting ... Louisiana and Perry Sts., to Lackawanna Bridge Co., Ell and Abbey Sts., $76,651 and $84,615 respectively. Noted Nov. 24.

**N. Y., North Tonawanda** — ... "Miscellaneous."

**Wisconsin**—State Hy. Comm., Madison, Melrose Bridge, Jackson Co., to Worden Allen Co., Port Washington Rd., Milwaukee, additional concrete in substructure no greater depth $30, additional concrete in substructure greater depth $40, less concrete substructure $12, total $44,987. Noted Dec. 1.

**Kan., Topeka**—Shawnee Co., to F. Luttjohann, 2104 Kansas St., Mill Dam Bridge, Silver Creek Bridge, $17,347. Lowmeet Bridge, $12,347; to Rohr & Wayland, Leavenworth, Lawton Bridge, $5,983. County Line Bridge, $7,794; to Voback & Beetle McFarlan Nelson Bridge Co., 901 to St. Joseph Structural Steel Co., 9th and Atchinson Sts., St. Joseph, Mo., Seward Bridge, $17,[illegible]. Noted Dec. 8.

**Minn., New Ulm**—State Hy. Comm., St. Paul, Bridge 3660, and Bridge 3661, over Minnesota River near here, for Brown and Nicollett Counties, City of New Ulm and State, to Illinois Steel Co., 836 Security Bldg., Minneapolis, $48,792. Noted Dec. 8.

**Tex., Dallas**—... "Streets and Roads."

# Railways

BIDS DESIRED

**California**—E. Cox, vice-pres. Sugar Pine Lumber Co., 801 1st Natl. Bank Bldg., San Francisco, and pres. of Minerets & Western R.R., taking bids for all work in connection with grading 35.5 mi. standard guage railway from Fresno into timber lands, incl. grading, filling, excavating, etc., trestle construction, masonry and concrete work, 4-42 in. culvert pipe, this work is for Minerets & Western R.R., Madera, a common carrier. Balance of railway, 19.5 mi., making total of 55 mi., will be constructed for Sugar Pine Lumber Co., from end of above mentioned road into timber property. $2,500,000. T. L. Russell, Madera, ch. engr. for Minerets & Western R.R. Noted Dec. 22.

CONTRACTS AWARDED

**North Carolina**—Carolina & North Western R.R., Lincolnton, 3¼ mi. grading from Mt. Holly to Mountain Island, to Bolton Constr. Co., Marion, $75,000.

# Excavation and Dredging

PROPOSED WORK

**Freight Terminals—Denison, Tex.**—Missouri, Kansas & Texas Ry., Railway Bldg., St. Louis, Mo., making plans freight terminals, incl. switching yards, roundhouse, shop, storeroom, warehouse, transfer buildings, fuel oil storage tank and other buildings. F. Ringer, ch. engr. A. L. Sparks, c/o owner, archt. $3,000,000

**Ia., Toledo**—Tama Co. making plans to straighten Iowa River, to drain 35,840 acres. $537,000. F. B. Ingersoll, Marshalltown, engr.

**Ont., London**—London Twp. plans 6, 8 and 10 in. tile drains. $25,000. F. W. Farncombe, Dominion Savings Bldg., engr.

BIDS DESIRED

**Minn., Ivanhoe**—Jan. 6, by Lincoln Co., Ditch 53, 62,707 cu.yd. excav. and 32,025 ft. 6-32 in. tile. $45,511. A. L. Swenson, aud.

**Mo., Carrollton**—Jan. 4, by Norborne D. D., 100 mi. ditch and levee work, 2,494,100 cu.yd. excav. $400,000. Elliott & Harman Eng. Co., Peoria, Ill., engrs.

BIDS RECEIVED

**Cal., Los Angeles**—Dredging and filling Los Angeles Harbor, San Pedro, (a) east basin, (b) west basin, from United Dredging Co., Central Bldg., (a) $0.1224 per cu.yd. complete in 7 months. $0.1184 complete in 12 months. (b) $0.126 complete in 7 months, $0.1184 complete in 12 months; Los Angeles Dredging Co., Los Angeles, (a) $0.1124, (b) $0.1989; San Francisco Bridge Co., Nevada Bank Bldg., San Francisco, (a) $0.1135. (b) $0.1435.

CONTRACTS AWARDED

**Minn., Jackson**—P. D. McKellar, aud. Jackson Co., drainage work in Jackson and Noble Counties, Judicial Ditch 65 and Judicial Ditch 83, to D. A. Lahart, Windom, $9,000 and $9,440 respectively; Judicial Ditch 76, tile work to P. Thompson, Windom, $106,765; Judicial Ditch 84, tile work to Nielsen & Sorensen, Worthington, $38,216. Noted Dec. 8.

# Streets and Roads

PROPOSED WORK

**Pa., McKees Rocks**—Boro. c/o Clerk, Municipal Bldg., plans street and sewer improvements. $150,000. Engineer not selected.

**Va., Portsmouth** — Norfolk Co. selling $259,000 bonds improving roads. R. B. Preston, New Kirn Bldg., co. engr.

**North Carolina**—State Hy. Comm., Raleigh, plans clearing, grading, bridging and surfacing 21.6 mi. road from Cullowhee to Cashiers Valley, State Project 952, Jackson Co., $110,000; clearing, grading and surfacing 13.85 mi. from Andrews to Murphy, State Project 912, Cherokee Co., $60,000, 10.9 mi. from Dillsboro to Macon Co. line, State Project 953, Jackson Co., $50,000; grading and surfacing 6 mi. from Toxaway to Jackson Co. line, State Project 991, Transylvania Co., $30,000; grading, bridging and surfacing 7.3 mi. from Springdale to Transylvania Co. line, State Project 941, Haywood Co., $35,000. C. M. Upham, state highway engr.

**N. C., Hamlet** — Plans [illegible] streets in business section and [illegible] sanitary sewers in East Hamlet [illegible]

**Fla., Fort Pierce**—St. Lucie Co. plans paving 25 mi. Okeechobee Road, probably bituminous macadam on rock; 14 mi. Ft. Pierce-Vero Rd., bituminous macadam or asphalt on rock or cement grouted brick. $396,000. E. H. Collins, co. engr.

**Fla., Titusville**—Brevard Co. plans paving 6 mi. highway from Indian River City to St. Johns River, probably macadam on 8 mi. rock. $120,000.

**Fla., Wauchula**—Plans paving 10 mi. 10th Ave., Bay, Orange, Palmetto and Oak Sts. $200,000.

**O., Akron**—Voted $500,000 for resurfacing and repairing streets in 1922. E. A. Kemmler, 300 Delaware Bldg., engr.

**O., Lisbon**—Comrs. Columbiana Co. open bids in spring grading and brick paving 2.5 mi. Lincoln Highway, west of here, $110,000; 8.7 mi. Salineville-Wellsville Rd., $120,000; 3 mi. Unity-Youngstown Rd., $70,000; 2.5 mi. Youngstown-Lisbon Rd., Center Twp., $45,000; 7.28 mi. Hanover-Salem Rd., $70,000; 5.3 mi. Salineville-Lisbon Rd., $90,000. F. Kirk, co. engr.

**Ill., Benton**—Received no bids Dec. 19, grading, paving and building sewers, ½ mi. South Main St. $46,833. Will be readvertised. C. B. Mautz, city engr. Noted Dec. 8.

**Ill., Bloomington**—Making plans paving various streets, brick and asphalt on concrete. $250,000. E. Packard, City Hall, engr.

**Ill., Durand**—Bd. Local Impvts. making plans paving various streets, vitr. brick on concrete, $30,000. A. R. Carter, Court House, Rockford, engr.

**Ill., Galena**—Bd. Local Impvts. making plans paving, vitr. brick on concrete, and building 10 to 14 in. vitr. tile sewers in Bench St. $38,000. W. Hinn, Galena, engr.

**Ill., Herrin**—Plans paving streets, vitr. brick on concrete. $200,000. A. T. Pace, city council. Engineer not selected.

**Ill., Marion**—Plans paving various alleys, vitr. brick on concrete. $28,000. P. B. Wilson, City Hall, engr.

**Ill., Rockford** — Plans paving various streets, vitr. brick or asphalt on concrete. $29,000. B. C. Harvey, City Hall, engr.

**Ill., Rockford**—Winnebago Co. making plans paving road from Shirland to Harrison, bituminous macadam on concrete, $40,000. A. R. Carter, Court House, engr.

**Ia., Tipton**—Making plans resurfacing 4 blocks and paving about 75 blocks, 4,800 sq.yd. resurfacing and 55,000 sq.yd. paving. M. Tschirgi & Son, 712 Amer. Trust Bank Bldg., Cedar Rapids, engrs.

**Kan., Wichita**—Making plans paving, curbing and guttering Harrison Ave. from Litchfield to Porter Aves., 1,000 sq.yd. concrete, $3,000; Central Ave. from Washington to Hydraulic Aves., 7,000-8,000 sq.yd. vitr. brick, $40,000; Central Ave. from Mead to Washington Sts., 3,000 sq.yd. vitr. brick, $15,000; ½ block Laura Ave. from Douglas Alley south, 600 sq.yd. asphaltic concrete, $2,500; Wichita St. from Harry to Skinner Sts., 6,000 sq.yd. asphaltic concrete, $25,000; Elk St. from Cleveland to Methewson Aves., 1,000 sq.yd. asphaltic concrete, $3,750; Hydraulic Ave. from 3rd St. to Central Ave., 2,000 sq.yd. asphalt, $8,000; 1st St. from New York Ave. to Spruce St., 6,000 sq.yd. asphaltic concrete, $22,000; Kellogg St. from Patti to Hydraulic Aves., 4,000 sq.yd. concrete, $12,000; 1st St. from Estelle to Volutia Sts., 1,000 sq.yd. asphaltic concrete, $3,750. P. L. Brockway, 155 South Emporia St., city engr.

**Kan., Wichita**—Sedgwick Co. making plans paving and bridging 12½ mi. North Lawrence Ave., road north to county line, 18 ft., brick or concrete, $40,000 to $50,000 per mi. (first provision may only include 4½ mi. to Kechi Rd. intersection); paving 19 mi. Cannon Ball Rd. west to county line, 18 ft., brick or concrete, incl. 2 mi. spur to Cheney, $34,000 to $44,000 per mi. M. [illegible]

**S. D., Sioux Falls**—Comrs. Minnehaha Co., making plans grading and gravel surfacing 3.5 mi. Washington Highway, Hartford Twp., and 14 mi. Colton Rd. $35,000. A. G. Risty, chn.

**N. D., Wahpeton** — Plans paving [illegible] S. H. Mariner, [illegible]

**Mont., Bozeman**—Gallatin Co. making plans improving various roads. $200,000. F. Lay, aud.

**Missouri**—State Hy. Dept., Jefferson City, plans 4.49 mi. road from Maryville, northward, southward and westward, State Aid Project 20.120, Nodaway Co., 56,976 cu.yd. earth excav. and 274 cu.yd. concrete masonry, etc., $37,431; 7.743 mi. road from Van Buren northward, State Aid Project 20.122, Carter Co., 40,678 cu.yd. earth and 9,265 cu.yd. rock excav., 1,372 cu.yd. borrow and 227.2 cu.yd. concrete masonry, etc., $52,416. A. Graham, state highway engr.

**Missouri**—State Hy. Dept., Jefferson City, soon takes bids 6.693 mi. road near Oregon, State Aid Project 20.37, Holt Co. $53,870. A. C. Lingley, St. Joseph, div. engr. Noted Dec. 8.

**Missouri**—State Hy. Dept., Jefferson City, plans 2.244 mi. road from Mt. Sterling eastward. State Aid Project 20.124, Gasconade Co., 19,888 cu.yd. earth and 8,126 cu.yd. rock excav., 138.2 cu.yd. concrete masonry, etc. $40,231. A. Graham, state highway engr.

**Mo., Carthage**—City, c/o Carthage Special Rd. Dist., plans surfacing 12 mi. road from here to Jasper, concrete. $350,000. S. E. Wheeler, supt. Engineer not selected.

**Tex., La Grange**—Fayette Co. making plans grading, gravel surfacing and bridging 14.47 mi. State Highway 3-B, from end of present Federal Aid Project 241 to Carmine, 2,000 cu.yd. concrete, $154,000 lb. reinforcing and 61,000 lb. structural steel, 33,952 cu.yd. gravel surfacing, $147,000; 9.32 mi. Highway 3-A, from La Grange to Prairie Valley, 41,600 cu.yd. borrow and 18,235 cu.yd. earth excav., 528 cu.yd. concrete, 34,751 lb. reinforcing, 21,880 cu.yd. gravel surfacing $73,627; 15.5 mi. State Highway 3-A, on the La Grange, Rutersville, Oldenburg Rd., incl. rein.-con. bridge over Cummings Creek, 509.9 cu.yd. concrete, 131,683 lb. reinforcing, 33,995 cu.yd. gravel, $181,882. A. Schlaffi, Schulenberg, co. engr.

**Idaho, Nampa**—Plans grading and surfacing 32 mi. various streets, lava gravel and crushed rock; paving 19 blocks, bitulithic. $293,000.

**Nev., Reno**—Plans grading, paving and surfacing Belmont Rd., California, Evans and Wheeler Aves., Plumas, Chestnut, Ralston, West 2nd, East 2nd, 10th, 8th, Lake, East 6th, West, West 4th, Vine, Elm, East Mill, and Cheney Sts. 15,005 ft. type A pavement, 1½ in. asphaltic concrete on 3½ in. asphaltic concrete, asphaltic seal coat, and 10,363 ft. type B, 2 in. asphaltic concrete, asphaltic seal coat on old, redressed macadam. $243,913. H. Chism, city engr.

**Ontario**—Dept. Pub. Highways, Toronto, plans 31.575 mi. concrete pavements, Contrs. 600, and 602-611 inclusive; 5 mi. concrete pavement, alternative asphaltic concrete, 7 in. loose stone compacted macadam base or 8 in. concrete base, 1-3-6 mix, Contr. 601; 20.25 mi. asphaltic concrete pavement, Contrs. 612-616 inclusive; 12.65 mi. bituminous penetration, Contrs. 617-620 inclusive; 9 mi. macadam road, Contrs. 621 and 622; 43.8 mi. macadam base course, Contrs. 623-630 inclusive; 44.25 mi. earth and rock work, Contrs. 640-644 and 647-650 inclusive; Cooksville subway, Bloor St. E. subway, Binkleys subway, filling in 2 spans of Belleville Prince Edward Bridge, 1,000 culverts, 300 mi. grading, Contr. 645. H. G. Hogarth, Parliament Bldgs., engr.

BIDS DESIRED

**Virginia**—Jan. 5, by State Hy. Comm., Richmond, paving 5.36 mi. road between Williamsburg and Lee Hall, in James City, Warwick Co., concrete, or bituminous macadam. $100,000. G. P. Coleman, state hy. comr.

**N. C., Gastonia**—Jan. 3, by Comrs. Gaston Co., 8 mi. hardsurfaced highway. D. L. Struthers, highway engr.; adv. this issue.

**S. C., Hartsville**—Jan. 5, paving and laying storm sewers in various streets, 50,000 yd. asphaltic concrete, sheet asphalt, concrete or vitr. brick, 15,000 yd. excav., 40,000 ft. curbing and 17,000 ft. storm sewers. Lee, Pennell & Murray, Sumter, engrs.

**Fla., Bradentown**—Jan. 14, by Comrs. Manatee Co., grading and paving 55 mi. Manatee-Oneco Rd. Dist., 250,000 cu.yd. excav., 94,000 sq.yd. asphalt and 105,000 sq.yd. shell. $250,000. McElroy Eng. Co., Cedar Rapids, Iowa, engrs. Former bids rejected. Noted Dec. 1.

**O., Akron**—Jan. 10, by Summit Co. grading and paving 1 mi. Copley Rd., 15,000 sq.yd. asphalt or concrete on concrete, $45,000; 5 mi. Richfield-Hudson Rd., 75,000 sq.yd. bituminous macadam, $165,000. J. Weaver, Court House, engr.

**Mich., Gladwin**—Jan. 6, by State Highway Dept., at office Bd. Rd. Comrs. Gladwin Co., grading and surfacing 5.516 mi. State Trunk Line Rd. 61-1, 1,615 cu.yd. excav., 51,776 sq.yd. gravel. F. F. Rodgers, Lansing, state highway comr.

**Mich., Jackson**—Jan. 5, by State Highway Dept., at office Bd. Rd. Comrs. Jackson Co., grading and surfacing 4.646 mi. State

Ill., Benton ... 5,300 ft. curbing, 1,190 ft. 10-36 in. pi ... $14,190.

Ill., Lindenhurst—

**Wisconsin**—Jan. 12, by Wisconsin Hy. ... City Bridge, Sauk City, 1.4 acres clearing, 2,833 cu.yd. ... excav., 29.9 cu.yd. concrete, 13,000 lb. reinforcing.

**Tex., Dallas**—Jan. 9, by Comrs. Dallas Co., improving 25.7 mi. Irving Cappell Rd., asphaltic ... Bryant & Huffman, Denton, engrs.

**Tex., Denton**—Jan. 6 by Comrs. Denton Co., improving 10 mi. Denton-Dallas Highway, 3 in. waterbound crushed stone maca- ... 000. Bryant & Huffman, Denton, engrs.

**Tex., Georgetown**—Jan. 13, by F. D Love, judge Williamson Co., grading and limestone shale surfacing, 7.51 mi. State Highway 36-B, 3,504 cu.yd. borrow, 25,564 cu.yd. roadway and 517 cu.yd. rock excav., ... lb. reinforcing, 12,839 cu.yd. limestone shale, $41,475. R A. Nichols, co. engr. Noted Dec. 8.

**Tex., Jasper**—Jan. 15, by H H ... grading ... Broad Gage, 67,572 cu.yd. excav., 733.6 cu.yd. concrete, 61,567 lb. reinforcing, 23,356 cu.yd. shipped gravel to be furnished ... C. F. Hunter, co. engr.

**Tex., Marlin**—Jan. 6, by E. M. Dodson, judge Falls Co., surfacing ... Highway 2, through Precinct 1, 67,769 sq.yd bituminous macadam ... W. Courter, co. engr.

**Oklahoma**—Jan. 13, by E. S. Alderson ... Oklahoma City, ... Federal Aid Project ... & Sons, Inc., Oklahoma City, ... earth and 31,400 cu.yd. borrow excav., 465 cu.yd. concrete, 29,455 lb. reinforcing, 18,775 cu.yd. gravel or crushed rock; Federal Aid Project ... Sec. B, Chickasaw Co., ... cu.yd. earth and 40,000 cu.yd. borrow excav., ... lb. reinforcing, 24,275 cu.yd. gravel or crushed ... Federal Aid Project ... Sec. F, Mc- ... Co., ... cu.yd. concrete, 107,738 lb. reinforcing, 30,721 cu.yd. gravel or crushed ... cu.yd. concrete, 107,738 lb. reinforcing, 30,721 cu.yd. gravel or crushed rock; Federal Aid Project 43, Sect. B, Rogers Co., grading, improving 4.67 mi. Federal Aid Project ... Sect. B, F. G., P. Q., Kay Co., vertical fibre brick and concrete.

**California**—Jan. 16, by State Hy. Dept., Sacramento, paving 17.5 mi. highway between Wasco and Edison and 11.5 mi. between ... Riverside Co., cement concrete or asphaltic concrete. A. B. Fletcher, state highway engr.

### BIDS RECEIVED

**N. Y., New York**—... for ... office ... Dept. Parks, Municipal Blvd., opened bids ... for ... patterns of ... in Crotona Park ... Webster Ave. to Crotona Park ... Co., Brooklyn, $21,... Co., Brooklyn, $21,... Co., Brooklyn, $22,... Co., Brooklyn, $22,... Co., Brooklyn, $26,770. Noted ...

**N. Y., S. I., Stapleton**—C. D. Von Natzmer ... Federal Bldg., ... Hall Street ... for ... Noted Dec. 15.

**N. Y., Cortlandt St., New York**—... Bldg., ... for ... $63,411; J. Meehan & Son, 74 Cortlandt St., New York, $63,109. Noted Dec. 15.

**O., Warren**—... Broadway ... Co., ... Bldg., ... Noted Dec. 15.

**Illinois**—... Noted Dec. 15.

... Bldg., ... Noted Dec. 15.

... Co., ... Noted Dec. 15.

... Co., ... Noted Dec. 15.

... Co

Streets and Roads (Continued)

to C. F. Sculley Equipment Co., 300 Dakota Bldg., St. Paul, and Connolly Contg. Co., 427 Rice St., St. Paul, $64,616, $27,669 and $25,459, respectively; State Project 18-21, Federal Aid Project 217, Sherburne Co., to Winston Bros. Co., 801 Globe Bldg., Minneapolis, $16,753; State Project 10-23, Federal Aid Project 210, Meeker Co., to C. Weaver, Anoka, $17,867; State Project 6-26, Federal Aid Project 161-A, Wilkin Co., to Miller Constr. Co., Grain Exch. Bldg., Sioux City, Ia., $16,151; State Project 8-24, Federal Aid Project 237, Itasca Co., Div. A, to Northern Road & Constr. Co., 2214 Sheridan Ave., N., Minneapolis, $19,897, Div. B, to Floan-Sundstrom Co., Hibbing, $7,564; State Project 8-25, Federal Aid Project 57, Beltrami Co., to Campbell Equipment Co., 230 Oak Grove St., Minneapolis, $16,840; State Project 10-22, Federal Aid Project 211, Swift, Pope and Stevens Counties, to Dobbleman & Rasmussen, 4232 Colfax Ave., S., Minneapolis, $20,066; State Project 21-22, Federal Aid Project 119-A, Le Sueur Co., to S. J. Peterson, 300 West Lake St., Minneapolis, $14,430. Noted Dec. 8.

**Minnesota**—State Hy. Comn., St. Paul, State Project 35-21, Federal Aid Project 245, Aitkin Co., to Winston Bros. Co., 801 Globe Bldg., Minneapolis, $54,706; State Projects 23-21, Federal Aid Project 234, and State Project 23-22, Federal Aid Project 243, Benton Co., to Wilkins & Pettijohn, Park Rapids, $33,910 and $37,927 respectively; State Project 65-21 and 8-26, Federal Aid Project 248, Clearwater Co., grading to Winston Bros. Co., 801 Globe Bldg., Minneapolis, $93,146, and Co. Aid to W. Barnard & Son, Globe Bldg., Minneapolis, $19,747; State Project 7-29, Federal Aid Project 247, Blue Earth Co., to J. Brown, Madison Lake, $14,501; State Project 28-23, Federal Aid Project 246, Pope and Stearns Counties, excavation to Torgenson Constr. Co., Summit, S. D., $44,186, culverts to Morris Constr. Co., Morris, $13,724; State Project 9-25, Federal Aid Project 244, Filmore Co., to A. Guthrie & Co., Inc., 366 Jackson St., $52,575. Noted Dec. 8 and 15.

**Minnesota**—State Hy. Comn., St. Paul, gravel surfacing State Project 28-28, Federal Aid Project 205, Todd Co., to S. J. Peterson, 300 West Lake St., Minneapolis, $19,910; State Project 28-21, Federal Aid Project 209, Stearns Co., and State Project 3022, Federal Aid Project 117, Mahnomen Co., to Dobbleman & Rasmussen, 4232 Colfax Ave., S., Minneapolis, $2,795 and $41,067, respectively; State Project 9-23, Sect. B, Federal Aid Project 224, Jackson Co., and State Project 3-24, Federal Aid Project 218, Wabasha Co., to Gatxmeier Bros., 5120 Upton Ave., S., Minneapolis, $14,086 and $16,591 respectively; State Project 2-25, Federal Aid Project 242, Cass Co., to G. W. Kinney, Foley, $8,539; paving State Project 1-21, Federal Aid Project 212, Dakota Co., to Butler Bros. Bldg. Co., Hamm Bldg., St. Paul, $2.26 per sq.yd. for concrete paving, $0.40 per cu.yd. for grading and $0.02 for overhaul, total $630,542. Noted Dec. 8.

**Kan., Atchinson**—Bd. Comrs., Atchinson Co., grading 6.212 mi. Sect. A, Federal Aid Project 100, to E. P. Olson, 2901 Monterey St., St. Joseph, Mo., $31,976; culverts on Sect. A and bridges on Sect. B, to Collins & Collins, Atchinson, $15,399 and $18,804 respectively.

**Mo., Carthage**—Grading and paving with 7 in. concrete, Garrison Ave. to Carterville Constr. Co., Carterville, $2.79 per sq.yd.; Main St., to Baker & Koontz, $2.65.

**Tex., Dallas** — Dallas Co., paving with asphalt macadam and gravel surfacing 12.5 mi. Preston Rd., to Miller Constr. Co., Sioux City, Ia.; bridges to A. Jackson, 424 Spring Ave. Total $207,581. Noted Dec. 8.

**Tex., Denton**—Denton Co. paving 8.54 mi. Denton-Sherman Rd., 512.36 cu.yd. concrete, 155,378 lb. structural and 29,208 lb. reinforcing steel, 9,885 sq.yd. concrete pavement, to Denton Constr. Co., Denton, $34,340. Noted Dec. 15.

**Tex., Greenville**—Hunt Co. grading, surfacing and bridging 16.6 mi. State Highway 1, Federal Aid Project 188, to Bd. of Permanent Rd. Comrs. of Hunt Co., c/o A. D. Duck, supt. construction, $231,289. Noted Nov. 24.

**Oregon**—State Hy. Dept. Portland, grading 18.1 mi. Elgin Sect. La Grande Enterprise Highway, Union Co., to Union Co. Court, La Grande, $67,610.

**Washington**—State Hy. Comn., Olympia, clearing, grading and surfacing 3 mi. Navy Yard Highway from Tidewater Creek to Charleston, Kitsap Co., to E. Morgan, Buckley, $79,584; 9 mi. Olympic Highway between Beaver and Forks, Clallam Co., to Reinseth & Co., Everett, $70,752; 3 mi. North Bank Highway from Crooks to Underwood, Skamania Co., to H. Pederson, Alaska Bldg., Seattle, $54,538; clearing and grading 2 mi. Ocean Beach Highway from Nasel to Johnson's Landing, Pacific Co., to Bentalla & Appletree, $26,138. Noted Dec. 1.

**Wash., Morton**—Paving 5 blocks in business section, 6,915 sq.yd. concrete, to J. H. Collins, Morton, $34,400. Noted Dec. 1.

**Cal., El Centro**—Bd. Supervs. Imperial Co., paving Brawley-Holtville Rd., Imperial-Holtville Rd., Bramley-Holtville Rd. north, Imperial Ave., and Holtville-Bonds Corner Rd., to H. H. Peterson, Loma Portal, San Diego, $184,520.

# Industrial Works

### PROPOSED WORK

**Mass., Boston** — Blodgett, Ordway & Webber, 100 Kingston St., having plans prepared by Blackall, Clapp & Whittemore, archts., 20 Beacon St., 5 story warehouse, brick, concrete foundation, Harrison Ave. $225,000.

**Conn., South Norwalk**—Norwalk Box Co., North Main and Ann Sts., having plans prepared by Fletcher-Thompson, Inc., engrs., and archts., 542 Fairfield Ave., Bridgeport 4 story, 60x180 ft., brick factory, North Main St. $100,000.

**N. Y., Hornell**—Dairymen's League plans milk condensing plant. $200,000.

**N. Y., New York**—F. M. Schwaber, c/o Koch & Wagner, archts. and engrs., 32 Court St., Brooklyn, having plans prepared ice plant, brick, steel and concrete, plain foundation, Webster Ave. and 174th St., here. $750,000.

**N. Y., New York**—U-Need Ice Co., 2050 Amsterdam Ave., soon takes bids ice plant, brick, concrete and steel, plain foundation, Inwood Ave. $250,000. Koch & Wagner, 32 Court St., Brooklyn, archts. and engrs.

**N. J., West Hoboken**—J. Keavy, 357 Palisade Ave., had plans prepared by McDermont & Binda, archts., 582 Bergenline Ave., and takes bids in about 2 weeks, 4 story, 75x100 ft., brick garage, Malone St. $42,000.

**Pa., Philadelphia** — Phila. Steamheat & Eng. Co., Juniper and Cherry Sts., having plans prepared and takes bids early in spring, 2 story, 57 x 120 ft., brick and steel shop and office building, plain foundation, 3316-3320 Lancaster Ave. $60,000.

**D. C., Washington**—R. Nash having plans prepared by N. S. Prager, archt., 1930 Kearney St., N. E., 3 story, storage warehouse, concrete, brick and hollow tile. $150,000.

**O., Cleveland**—Specialty Mfg. Co., 11414 Madison Ave., plans 2 story, brick and steel factory, plain foundation. $50,000. Architect not selected.

**O., Dayton**—Terminal Cold Storage & Ice Co. having plans prepared by G. B. Bright Co., archts., 103 Marquette Bldg., Detroit, Mich., 8 story, 135 x 150 ft. refrigerating and cold storage plant, rein.-con. and brick, Eaker and Ludlow Sts. $500,000. H. J. Brenner, c/o B. & C. Baking Co., 233 Clinton St., pres.

**O., Lakewood** (Cleveland, P. O.) H. Kaplan, 2016 Marlowe Ave., plans 1 story, brick and timber garage, plain foundation, Madison Ave. near Marlowe Ave. $40,000. Private plans.

**Ind., Indianapolis** — Citizens Gas Co., South Pennsylvania and Maryland Sts., having plans prepared coke screening plant, concrete, brick and steel, Prospect St. $40,000. Private plans.

**Ind., South Bend**—Twentieth Century Garage, 121 South Lafayette St. having plans prepared by Austin & Shambleau, archts., 111 North Lafayette St., 2 story, 60x160 ft., brick, steel and terra cotta garage. $150,000.

**Mich., Grand Rapids**—Buick Sales Co. having plans prepared by Osgood & Osgood, archts., Grand Rapids, 3 story, 70 x 160 ft. brick and steel garage and sales building, $75,000. W. H. Adams, Campau Bldg., Detroit, engr.

**Mich., St. Joseph**—Davidson & Weiss, archts., 53 West Jackson Blvd., Chicago, preparing plans and soon takes bids, two 1 story, 50 x 225 ft. and 80 x 162 ft. additions to factory, brick and wood, for Auto Specialty Mfg. Co. $100,000.

**Ill., Charleston**—Clover Leaf Produce Co., c/o M. Usher, mgr., plans 1 story, 100 x 150 ft. factory, brick and steel, here. $55,000. Architect not selected.

**Ill., Harvey**—Ongalls, Sheppard Div. of Wyman Gordon Co., having plans prepared for brick, steel and rein.-con. power house. $100,000. H. Johnson, c/o owner, engr.

**Ill., Kankakee**—Lockwood, Green & Co., archts., 38 South Dearborn St., Chicago, soon take bids, 3 story, 50 x 80 ft., rein.-con. factory, for Paramont Knitting Co., 237 West Madison St. $50,000.

**Ill., Rockford** — Peterson & Johnson, archts., 406 Swedish Amer. Bank Bldg., preparing plans 4 story, 128x211 ft., factory, brick, stone and steel. $135,000. Owners name withheld.

**Ill., Sterling**—Sterling Canning Co., c/o C. W. Sauers, pres., plans 2 story cannery, brick and steel. $45,000. Architect not selected.

**Wis., Antigo**—C. W. Fish Lumber Co., Elcho, having plans prepared 1 story, 60x75 ft. mill, rein.-con. and brick, here. $45,000. Private plans.

**Wis., Chippewa Falls**—Chippewa Wood Mfg. Co. having plans prepared 2 story, 50 x 95 ft. rein.-con. brick and steel factory, plain foundation. $65,000. F. Sterzik, mgr. Private plans.

**Wis., Chippewa Falls**—F. Sterzik, pres. Natl. Floy & Tinsel Co., 16th and Hamilton Sts., Manitowoc, having plans prepared 2 story, 52x76 ft., rein.-con., brick and steel factory, here. $50,000. Private plans.

**Wis., Madison**—Ellwood Tractor Mfg. Co., c/o W. S. Heddles, Assn. of Commerce, Cantwell Bldg., having plans prepared 2 story, 60 x 150 ft., rein.-con., brick and steel factory, plain foundation. $50,000. Private plans.

**Wis., Madison**—Universal Grocery Co., 113 South Webster St., plans 4 story, 70 x 200 ft., rein.-con., brick and steel warehouse, plain foundation. $150,000. R. H. Hammel, pres. Architect not selected.

**Wis., Oconto Falls**—Falls Mfg. Co. having plans prepared 1 story, 60 x 200 ft. paper mill, rein.-con., brick and steel, plain foundation. $150,000 Private plans. D. G. Moon, Marinette, engr.

**Wis., Orfordville**—O. A. Roen plans 1 story, 50 x 90 ft., rein.-con., brick and steel machine shop, plain foundation. $45,000. Architect not selected.

**Wis., Oshkosh**—F. E. Zuelke, 238 Waugoo St., having plans prepared by Auler & Jensen, archts., F. R. A. Bldg., 2 story, 50 x 54 ft., ice cream factory, rein.-con., brick and steel, Main St. $40,000.

**Mo., St. Louis**—C. Ulman, 4550 Lindell Ave., having plans prepared by P. J. Bradshaw, archt., International Life Bldg., 1 story, brick and steel garage, 221 York Ave. $40,000.

**Cal., Burbank**—C. F. Braun Co., 604 Mission St., San Francisco, having plans prepared foundries and machine shops, brick, steel, glass and heavy mill, here. $400,000. Private plans.

**Cal., Fresno**—W. P. Fuller Paint Co. having plans prepared by E. Mathewson, archt., Cory Bldg., 145 x 244 ft. plant. $100,000. H. J. Brunnier, Sharon Bldg., San Fancisco, engr.

### BIDS DESIRED

**Ill., Chicago**—Western Fixtures Mfg. Co., 3039 Elston Ave., receiving bids 1 story, 80 x 119 ft. addition to factory, mill construction, 3033-3037 Elston Ave. $40,000. S. V. Ablamovitcz, 2937 North Talman Ave., archt.

**Wis., Racine**—Jan. 7, by E. L. M. Tire Co., Deane Blvd. and R.R. tracks, 2 story, 80 x 130 ft. brick and timber addition to factory, plain foundation, Deane Blvd. Private plans.

**Mo., St. Louis**—Jan. 5, by P. J. Bradshaw, archt., International Life Bldg., 1 story, brick and steel garage, 221 York Ave., for C. Ulman, 4550 Lindell Ave. $40,000. Noted Dec. 22.

**Cal., San Francisco**—O'Brien Bros., Inc., archts., 240 Montgomery St., receiving bids 1 story, rein.-con. garage, Jones St., for R. W. Kern, 1329 Sacramento St. $40,000.

### BIDS RECEIVED

**N. Y., Marcy** — State Hospital Comn., Albany, opened bids Dec. 21, kitchen and cold storage building, for acute patients at Marcy State Hospital, here, construction, from A. J. Burgess Co., Utica, $130,970, Shane Constr. Co., 302 Herald Bldg., Syracuse, $155,744, R. Richards & Son, 246 Elizabeth St., Utica, $166,500; refrigeration, from Carbondale Co., 175 Christopher St., New York, $33,485. Noted Dec. 8.

Industrial Works (Continued)

**Wis., Wauwatosa** — M[illegible] Co. Ed. T[illegible] ... plant, brick, plain foundation, Watertown Plank Rd., from Jahns & Knuth, 1915 Chestnut St., Milwaukee, $77,500; W. F. Tubesing, 130 Chestnut St., Wauwatosa, $87,000; P. W. Bringe, 940 3rd St., Milwaukee, $99,892.

### CONTRACTS AWARDED

**N. J., Jersey City**—Erie R.R., [illegible] Church St., New York, 1 story, 23 stall, brick and steel roundhouse, plain foundation, incl. machine shop and boiler house, Pavonia Ave., here, to Austin Co., Bulletin Bldg., Phila., $75,000.

**Pa., Philadelphia** — Grubard Bros., 114 Arch St., 1 story, 76 x 205 ft. rein.-con., brick and steel factory, plain foundation, 2nd and Erie Aves., to Austin Co., Bulletin Bldg., $40,000.

**O., Cleveland**—M. Marmorstein, Ulmer Bldg., 2 story, 68 x 195 ft., brick, steel and concrete garage and commercial building, plain foundation, 2500 Euclid Ave., to A. A. Lane Constr. Co., 1869 East 55th St., $75,000.

**Ind., Mishawaka**—Mishawaca Woolen Co., 6 story, 76 x 105 ft., brick warehouse, to G. H. Christman Constr. Co., 302 Union Trust Bldg., South Bend, $500,000.

**Ill., Chicago** — Newhouse & Bernham, archts., 4630 Prairie Ave., 1 story, 101 x 150 ft. garage, brick and steel, 5018 Cottage Grove Ave., to A. T. Herlin, 6117 Evans Ave., for H. Salvat, 5322 Harper Ave. $50,000. Noted Sept. 15.

**Ill., Chicago**—See "Buildings."

**Ill., Chicago** — Dubow Glove Co., 1911 Milwaukee Ave., 3 story, 35 x 45 ft. factory addition, brick, at 1915 Milwaukee Ave., to Fish & Wasserstrum, c/o Ludgin & Leviton, archts., 53 West Jackson Blvd., $40,000.

**Ill., Kankakee**—Paramount Knitting Co., 377 West Madison St., Chicago, 2 story, 50 x 80 ft. factory addition, brick and wood, plain foundation, here, to Hutter Constr. Co., Western Ave., Fond du Lac, Wis., $40,000.

**Ill., Rock Island**—Rock Island Transfer & Storage Co., 4 story, 75 x 100 ft., rein.-con. warehouse, 1st and 17th Sts., to P. H. Lorenz, 506 15th St., Moline, $150,000. Noted Nov. 24.

**Ill., Rockford**—Hess & Hopkins Leather Co., c/o F. L. Morgan, secy., 1 story, 80x 115 ft. tannery, brick and steel, by day labor, $40,000. Noted Dec. 22.

**Wis., Appleton** — Standard Oil Co., 68 Wisconsin St., Milwaukee, 2 story, 50 x 72 ft., brick and concrete warehouse, plain foundation, here, to Brun Constr. Co., 387 Clinton St., Milwaukee, $40,000.

**Wis., Hortonville**—W. L. Schroeder will build 1 story, 50 x 120 ft. rein.-con., brick and steel factory, plain foundation, by day labor, $50,000.

**Wis., Neenah**—Tri City Nash Co., c/o G. Sande, 110 North Church St., 55 x 150 ft., rein.-con., brick and steel garage, plain foundation, Commercial St., to L. P. Nielsen, 408 Isabella St., $60,000. Noted Dec. 1.

**Wis., Wauwatosa**—Modern Builders, Inc., Spring Ave. and Vliet St., will build 1 and 2 story, 40 x 100 ft., rein.-con., brick and [illegible]

**Kan., Topeka** — See "Buildings."

260-262 North Kansas St., 3 story, 50 x 150 ft. rein.-con., brick and stone plant, to F. M. Spencer & Son, Mulvane Bldg., $150,000.

**Kan., Wichita** — [illegible] Co., 213 South Rock Island Ave., 5 story, 75 x 90 ft. rein.-con. and brick plant, to H. L. Ellis Constr. Co., 927 North St. Francis Ave., $200,000. Noted Nov. 3.

**Mo., St. Louis** — [illegible] Juniata Ave., 1 story, 120 x 160 ft., brick, [illegible] Nebraska Aves., to Fisher Bros., Grand Ave. and Meramec St., $50,000. Noted Dec. 8.

**Cal., Los Angeles** — [illegible] Co., 1 story, 250 x 250 ft., brick, garage, 9th and San Pedro Sts., to W. Crowell, [illegible]

## Buildings

### PROPOSED WORK

**Mass., Northampton** — [illegible] —Goldstein Bros., Bridge St., Springfield, [illegible]

**Mass., West Springfield** — [illegible]

H. K. Chandler, 76 Bliss St., chn. of com. Architect not selected.

**Conn., Bristol**—St. Josephs Church, South Main St., plans 1 story, brick and stone, $150,000. Architect not selected.

**Conn., Hartford**—Store and Auditorium —M. M. Kupperstein, 26 State St., having plans prepared by Berenson & Moses, archts., 1026 Main St., 2½ story, 80 x 110 ft., rein.-con. and brick, Capitol Ave.

**Conn., West Haven**—High School—School Comrs. having plans prepared by R. W. Foote, archt., 185 Church St., New Haven, 3 story, brick, Campbell Ave. $350,000.

**N. Y., Astoria** (Long Island City P. O.)—Apartment—A. J. Oliva, 717 Crescent St., plans 6 story, Jamaica and 4th Aves. $350,000. Architect not selected.

**N. Y., Brooklyn** — Apartment — Trish Building Co., c/o M. A. Cantor, archt. and engr., 371 Fulton St., having plans prepared 4 story, 100 x 100 ft., brick, steel and stone, plain foundation, Bedford Ave. and Farragut Rd. $150,000

**N. Y., Brooklyn**—School—Bd. Educ., 500 Park Ave., New York, having plans prepared by C. B. J. Snyder, archt. and engr. Municipal Bldg., New York, P. S. 188, 5 story, brick, steel and stone, plain foundation, Neptune Ave. and 33rd St., here. $750,000.

**N. Y., Buffalo**—School—Mt. St. Joseph Academy, 2064 Main St., having planss prepared by H. L. Spann, archt., 52 West Chippewa St., 2 story, 90 x 150 ft., rein.-con. and brick, Humboldt Parkway. $250,000.

**N. Y., New York**—Apartment—Accidental Holding Co., 123 William St., plans 5 story, 80 x 180 ft., Andrews Ave. and 179th St. N. Wilson, pres. Architect not selected.

**N. Y., New York**—Apartment—Margon & Glaser, archts. and engrs., 2806 3rd Ave., prepared plans 5 story 90 x 110 ft., brick, steel and stone, plain foundation, West 197th St. $200,000. Owners name withheld.

**N. Y., New York**—Apartment—Margon & Glaser, archts. and engrs., 2806 3rd Ave., prepared plans 5 story, brick, steel and stone, plain foundation, 230th St. and Kingsbridge Rd. $450,000. Owners name withheld.

**N. Y., New York** — High School—Bd. Educ., 500 Park Ave., plans 5 story, brick, steel and stone, plain foundation, 2nd Ave. and 67th St. $1,000,000. C. B. J. Snyder, Municipal Bldg., archt. and engr.

**N. Y., New York** — High School — Bd. Educ., 500 Park Ave., having plans prepared by C. B. J. Snyder, archt. and engr., Municipal Bldg., brick, steel and stone, plain foundation, Amsterdam Ave. and 183rd St. $300,000.

**N. Y., New York**—School—Bd. Educ., 500 Park Ave., soon takes bids P. S. 139, brick, steel and stone, plain foundation, 139th St. and Lenox Ave. $850,000. C. B. J. Snyder, Municipal Bldg., archt. and engr.

**N. Y., New York**—Show Room and Office —Eighteen Forty One Bway. Realty Co., c/o B. H. and C. N. Whinston, archts. and engrs., 2 Columbus Circle, soon takes bids brick, steel and stone, plain foundation, Bway. and 60th St. $350,000.

**N. Y., Rochester**—Y. M. C. A., Gibbs St., plans 2 story, 130 x 140 ft., brick, Arnett Blvd. and Kenwood Ave., also 2 story, 86 x 120 x 140 ft., brick, Monroe Ave. $100,000 each. Architect not selected.

**N. J., Newark**—Synagogue—B'nai Abraham Synagogue, c/o N. Myers, archt. and engr., 7 Nelson Pl., soon lets contract brick and stone synagogue and social center, plain foundation, Clinton Ave. $650,000.

**N. J., Paulsboro**—School—Bd. Educ., c/o P. Miller, pres., Gibbstown, having plans prepared by J. I. Bright, archt., Otis Bldg., Philadelphia, 2 story, 16 room, here. $150,000.

**Pa., Johnstown** — Store—J. Thomas & Sons plan 4 story, 80 x 120 ft., concrete, brick and steel, Franklin St. $200,000.

**Pa., York**—High School—School Bd. c/o C. M. Crider, having plans prepared by Hamme & Whitman, archts., City Bank Bldg., York, and J. I. Bright, associated archt., Otis Bldg., Phila., 3 story, 235 x 245 ft. rein.-con., brick and steel, plain foundation, Beaver and College Sts. $350,000.

**Pa., South York** — Bank — First Natl. Bank, plans 3 story, 70 x 80 ft. brick, steel and stone, Maple and Main Sts. $150,000.

**D. C., Wash.**—Office—F. H. Smith Co., [illegible] 10 story [illegible] ... $400,000. J. [illegible]

**Va., Virginia Beach**—Hospital and Sanitarium—Bybees Natl. Chiropractic Sanitarium and Institute having plans prepared by P. B. Moser, archt., Dickson Bldg., Norfolk, 6 story, 100 x 125 ft., terra cotta, brick and steel. Waterfront St. $300,000. H. R. Bybee, pres.

**W. Va., Charleston**—High School—Bd. Educ. had plans prepared 3 story, brick and stone, Ruffner Ave. $200,000. Warne, Tucker & Patterson, Charleston, archts.

**W. Va., Clarksburg** — Hotel — Waldo Hotel opens bids about June 1, 3 story brick addition. $500,000. Holmboe & Pogue, c/o owner, archt.

**N. C., High Point** — Municipal—Plans municipal building, $150,000. J. W. Hedrick, mayor. Architect not selected.

**Fla., Daytona**—Hospital—G. N. Rigby, C. C. Bohannon and associates plan hospital and sanitarium. $500,000.

**Fla., Miami** — Court House—Dade Co. plans rein.-con. and steel. $200,000. H. Crabtree, co., engr.

**Ala., Anniston** — School—Barber Industrial School for Girls, c/o J. F. Sherer, soon takes bids 4 story, 115 x 180 ft., brick, stone and steel, plain foundation. $250,000. T. Stephens, Temple Bldg., Camden, N. J., archt.

**O., Cincinnati** — High School—Kunz & Beck, archts., 22 Carew Bldg., opens bids about March 1, 3 story, 72 x 120 ft., rein.-con., brick and steel, Iliff Ave., for Catholic Parish. $200,000. W. Schmidt, pastor.

**O., Cleveland**—Apartment—A. Land, 1935 Euclid Ave., having plans prepared by J. M. Miller, archt., 1935 Euclid Ave., 3 story, brick and steel, plain foundation, southeast corner Coventry Rd and Hampshire Lane. $175,000.

**O., Cleveland**—Commercial—L. W. Kelly, Hippodrome Bldg., plans brick and steel, plain foundation, on lot 116 x 185 ft., on Bolivar Rd. and East 14th St. $150,000. Architect not selected.

**O., Cleveland**—Commercial—F. Stein, 2195 East 93rd St., having plans prepared by A. F. Janowitz, archt., Permanent Bldg., 1 story, 50x230 ft., brick and timber, plain foundation, 8511 Lorain Ave. $150,000.

**O., Cleveland**—Commercial and Theatre —Utica Realty Co., c/o G. A. Ebeling, archt., 602 Newman-Stern Bldg., having plans prepared 2 story, 50 x 150 ft., brick, steel and concrete, plain foundation, 1773 East 55th St. $150,000.

**O., Columbus**—Dormitory—Westminster Foundation Presbyterian Church, having preliminary sketches made for mens dormitory, Neil Ave. $150,000. Address M. Breeze, 80½ North High St. Architect not selected.

**O., Columbus**—Home—R. L. Wirtz, 2028 Iuka Ave., having sketches made 3 story home for Builders and Traders Exch. $200,000.

**O., Sidney**—Temple—Temperance Lodge 73, F. & A. M., c/o C. H. Neil, plans 3 story, rein.-con. and brick. $150,000. Architect not selected.

**Ind., Beech Grove** — School — Catholic School having plans prepared by E. E. Dunlap & Co., archts., State Life Bldg., Indianapolis, 2 story, 65 x 100 ft., brick and stone. $150,000. P. Killian, pastor. W. Gavin, member Bd. Trustees.

**Ind., Chalmers**—School—J. A. Kassabaum, trustee, having plans prepared by Riedel & Zink, archts., 2 story, 75x110 ft., brick and stone. $150,000.

**Ind., Evansville** — Church — St. Johns Church, 3rd and Ingle Sts., having plans prepared by Fowler & Cappelle, archts., Amer. Trust Bldg., 2 story, 55 x 150 ft., brick and stone, 3rd and Ingle Sts. $150,000. W. N. Dressel, pastor.

**Ind., Evansville** — Church — St. Johns Church having plans prepared by J. T. Comes, archt., Renshaw Bldg., Pittsburgh, Pa., 2 story, 60x100 ft., brick and stone. $150,000.

**Ind., Ft. Wayne**—Office—E. H. Sedberg 21 White Apartments, having plans, prepared by A. M. Strauss, archt., 706 Shoaff St., 2 story, 40x70 ft., brick, East Berry St. $150,000.

**Ind., Frankfort**—High School—Bd. Educ. having plans prepared by R. F. Daggett, archt., 960 Lemke Annex, Indianapolis, 2 story, 100 x 160 ft., rein.-con. and brick. $150,000.

**Ind., Indianapolis** — Apartment—H. C. Baker, 607 East 32nd St., having plans prepared by Myers & Colbin, archts., 112 Traction Trust Bldg., 2 story, 40 x 73 ft., brick, 3211 College Ave. $150,000.

Buildings (Continued)

**Ind., Indianapolis** — Apartment, 1 H. N. Maloney Apartment Co., c/o E. I. Smith of E. W. Chaille Co., 921 Hume-Mansur Bldg., having plans prepared brick and limestone, 34th and Meridian Sts. $350,000. Private plans.

**Ind., Indianapolis**—Church, First United Brethren Church, W. R. Mommer, chn. building com., c/o Delco Light Products Co., 60 West New York St., having revised plans prepared by Rubush & Hunter, archts., 428 Amer. Central Life Bldg., 2 story, 80 x 110 ft., brick and stone, Walnut and Park Sts. $150,000.

**Ind., Indianapolis—Office**—H. H. Wood small, Fidelity Trust Bldg., plans 4 story rein-con., brick and steel, North and Delaware Sts. $20,000. Architect not selected.

**Ind., Indianapolis**—School, St. Joan of Arc Church, 42nd and Ruckle Sts., having plans prepared by D. A. Bohlen & Co., archts., Majestic Bldg., 2 story, 85 x 110 ft., brick, 42nd St. $150,000. J. Chartrand, Bishop.

**Ind., Indianapolis** — Temple — Irvington Lodge No. 666, F. and A. M., c/o J. Fitzgerald, chn. building com., 204 Hume-Mansur Bldg., having plans prepared by C. E. Bacon, archt., 605 Odd Fellows Bldg., 3 story, 100 x 100 ft., brick and terra cotta, East Washington St. $150,000.

**Ind., Knightville**—School, O. Boyd, trustee, having revised plans prepared by Johnson, Miller & Miller, archts., 30 North 5th St., Terre Haute, 2 story, 80 x 140 ft., brick. $150,000.

**Ind., Layafette—Union**—Purdue University, Student Union, having plans prepared by Pond & Pond, archts., 64 Van Buren St., Chicago, 2 story, brick, stone and steel. $1,000,000.

**Ind., Lorer**—School—B. F. Jenkins, trustee, having plans prepared by E. E. Dunlap & Co., archts., Harrison Bldg., Kokomo, 2 story, 95 x 125 ft., brick. $150,000.

**Ind., Marion**—Lodge—Marion Lodge of Eagles, plans 3 story, brick. $150,000. Architect not selected.

**Ind., New Albany**—Apartment, A. Moosmiller, archt., 9th and Market Sts., will prepare plans for brick apartment house. $150,000. Owners name withheld.

**Ind., Newcastle**—School—Bd. Educ. having plans prepared by H. Folz, archt., Lemcke Annex, Indianapolis, 2 story, 95x125 ft., brick. $200,000.

**Ind., Poneto**—School, O. F. Tate trustee, plans 2 story, 80 x 110 ft. brick. $150,000. E. I. Brown, Studebaker Bldg., South Bend, archt.

**Ind., Shelbyville**—School—Bd. Educ. having plans prepared by J. E. Koph & Woolling, archts., 403 K. of P. Bldg., Indianapolis, 2 story, 87x110 ft., brick. $150,000.

**Ind., South Bend**—Bank—Union Trust Co., 204 South Michigan Ave., having revised plans prepared by Austin & Shambleau, archts., 111 North Lafayette St., 12 story, 60x125 ft., brick, granite and steel addition. $800,000.

**Ind., South Bend** — Church, Second Presbyterian Congregation having plans prepared by Austin & Shambleau, archts., 731 J. M. S. Bldg., 2 story, 65x90 ft., brick and stone. $150,000.

**Ind., Terra Haute**—Church—First Church of Christ Scientist having plans prepared by Johnson, Miller & Miller, archts., 30 North 5th St., 2 story, 90x110 ft., brick and stone. $150,000.

**Mich., Ann Arbor**—Gymnasium, Students Athletic Assn. having tentative plans prepared for 160 x 300 ft. rein.-con., brick and steel, Ferry Field. $250,000. Architect not selected.

**Mich., Detroit—Bank**—Detroit Branch of Federal Reserve Bank of Chicago, West Congress St., Detroit, plans 4 or 5 story with foundation for additional stories, 100 x 160 ft. rein.-con., brick, steel and stone, caisson foundation. Fort and Shelby Sts. $750,000. Architect not selected.

**Ill., Aurora**—Apartment, [illegible] 275 Lake St., having plans prepared by W. Scott Armstrong, archt., 1[illegible] Dearborn St., Chicago, 3 story, 80 x 100 ft., brick, steel, rein.-con. and stone, Lake St. $300,000.

**Ill., Benton**—Court House, Franklin Co. election in April to vote on $200,000 bonds, for court house.

**RESERVOIR—CLEVELAND, OHIO**

**Contract No. 2**

Bids were received Nov 4 by Dept. of Pub. Utilities, Div. Water, for constructing Baldwin Reservoir, from (A) Stange & Walsh Constr. Co., St. Clair Bldg.; (B) Thompson-Starrett Co., Perry-Payne Bldg.; (C) Hunkin-Conkey Constr. Co., 601 Century Bldg.; (D) Mellon-Stuart Co., 2112 Oliver Bldg., Pittsburgh, $2,029,501; (E) Central Dredging Co., 600 Bangor Bldg., $2,109,051; (F) Bates & Rogers Constr. Co., B. of L. E. Bldg., $2,309,224. The unit bids of the lowest 3 bidders were as follows:

| | A | B | C |
|---|---|---|---|
| 57,000 cu.yd. excavation | $2.00 | $2.03 | $2.50 |
| 16,500 cu.yd. concrete—wall foundations | 13.00 | 10.70 | 10.52 |
| 29,500 cu.yd. concrete—walls, pilasters, conduit | 13.00 | 11.68 | 11.90 |
| 7,500 cu.yd. concrete—sub-floors and foundations for columns | 13.00 | 9.70 | 11.76 |
| 2,200 cu.yd. concrete-pipe covers, sumps and foundations for overflows | 13.00 | 11.10 | 11.61 |
| 16,000 cu.yd. concrete—groined and barrel arches | 13.00 | 19.10 | 19.00 |
| 4,800 cu.yd. concrete—flumes, stiffening walls and overflows | 13.00 | 22.30 | 20.25 |
| 13,500 cu.yd. concrete—floors | 13.00 | 12.18 | 12.08 |
| 8,300 cu.yd. concrete—columns | 13.00 | 15.45 | 16.92 |
| 5,600 cu.yd. concrete—valve house | 13.00 | 12.21 | 12.46 |
| 2 30-in. cast iron manhole frames and covers | 70.00 | 188.00 | 97.73 |
| 2 43-in. cast iron pressure manhole frames and covers | 125.00 | 142.00 | 131.11 |
| 59 24-in. cast iron ventilating manhole frames and covers | 20.00 | 26.00 | 24.80 |
| 4 36-in. cast iron ventilating manhole frames and covers | 40.00 | 57.00 | 41.88 |
| 2 48-in. cast iron ventilating manhole frames and covers | 65.00 | 95.00 | 61.45 |
| 120,000 cu.yd. fill, embankment and subgrading | .40 | .85 | .85 |
| 16,000 cu.yd. puddle | 2.00 | 2.52 | 2.57 |
| 78,000 sq.yd. top-soil and seeding | .10 | .19 | .30 |
| 1,200 cu.yd. broken stone fill | 3.00 | 4.73 | 4.05 |
| 3,500,900 lb. reinforcing steel | .03 | .031 | .0294 |
| 7,000 lb. structural steel | .10 | .14 | .137 |
| 820 tons cast iron—standard lengths bell and spigot pipe | 7.00 | 63.40 | 65.93 |
| 120 tons cast iron—standard fittings, bell and spigot pipe | 150.00 | 116.50 | 148.12 |
| 80 tons cast iron—special fittings, bell and spigot pipe | 165.00 | 126.00 | 154.08 |
| 5 tons cast iron—standard short length flanged and bell, and flanged and spigot pipe | 165.00 | 135.00 | 134.43 |
| 5 tons cast iron—standard fittings flanged pipe | 225.00 | 158.00 | 218.29 |
| 60 tons cast iron—special fittings, flanged pipe | 140.00 | 110.30 | 121.07 |
| 240 tons cast iron—plain pipe, no bell, spigot or flange | 70.00 | 66.50 | 69.14 |
| 5 tons cast iron—miscellaneous and special castings | 135.00 | 147.00 | 147.24 |
| 5 60-in. valves | 2,500.00 | 2,410.00 | 2,509.04 |
| 7 48-in. valves | 1,500.00 | 1,410.00 | 1,442.04 |
| 2 36-in. valves | 900.00 | 985.00 | 988.54 |
| 2 30-in. valves | 675.00 | 740.00 | 748.47 |
| 2 12-in. valves | 90.00 | 77.00 | 76.27 |
| 7 6-in. valves | 30.00 | 31.00 | 26.15 |
| 26,000 lin.ft. tile drain | .10 | .19 | .32 |
| 450 lin.ft. vitrified pipe drain | 6.00 | 5.57 | 3.74 |
| 6,500 lb. hand railing | .30 | .18 | .20 |
| 13,500 lb. copper expansion joints | .30 | .41 | .45 |
| 2 5x7-ft. sluice gates | 1,200.00 | 2,425.00 | 1,290.00 |
| Brass pipes, valves, etc., for float tube connection (lump sum) | 200.00 | 235.00 | 106.57 |
| Stop plank and weirs (lump sum) | 1,000.00 | 1,775.00 | 1,660.00 |
| Number of calendar months to complete work | 14 | 14 | 18 |
| Extended totals | $1,824,125 | $1,933,248 | $1,994,833 |

**Ill., Carbondale**—High School—Bd. Educ., c/o J. W. Mitchell, secy., having plans prepared by R. Z. Gill, archt., Murphysboro, 2 story, brick, stone and rein.-con. $160,000.

**Ill., Chicago**—Office and Sales Davidson & Weiss, archts., 53 West Jackson Blvd., soon receives bids 10 story, rein.-con., brick and steel, Michigan Ave. and 13th St., for E. C. Rutenberg, 6 North Franklin St. $450,000.

**Ill., Chicago**—Store and Hotel, Loewenberg & Loewenberg, archts., 111 West Monroe St., soon receive bids 4 story, 141 x 187 ft., rein.-con., brick, steel and terra cotta, Howard St. and Bosworth Ave., for L. J. Rubin & Co., 224 South Market St. $350,000.

**Ill., Evanston**—Hotel and Store—W. C. Jones, archt., 19 South La Salle St., Chicago, preparing preliminary plans 7 story, rein.-con., brick and steel, for $1,000,000. Owners name withheld.

**Ill., Joliet** — Apartment-Hotel — B. J. Bruns, archt., 1548 Belmont Ave., Chicago, [illegible] 4 story, rein.-con., brick and steel, Jefferson St. Owners name withheld.

**Ill., Martinsville**—School—Bd. Educ. having plans prepared by Johnson, Miller & Miller, archts., 30 North 5th St., Terre Haute, Ind., 2 story, 80 x 125 ft., brick, steel and rein.-con. $150,000.

**Ill., Melvin**—Bd. Educ. having plans prepared by A. L. Pillsbury, Bank Bldg., Bloomington, 2 story, rein.-con., brick and stone. $100,000. W. J. McKenna, clk.

**Ill., Moline**—Club—Country Club Com., [illegible] 2 story, rein.-con., brick and stone. $175,000. Architect not selected.

**Ill., Monmouth**—Stadium and Gymnasium [illegible] College, 3 East Boggs, secy., has plans prepared for stadium, rein.-con., 15,000 seating capacity and gymnasium, $150,000. P. H. McMillan, pres. Architect not selected.

**Ill., Rock Island** — High School — Bd. Educ. having plans prepared by Corwin & Hoes, archts., 411 Safety Bldg., 2 story, brick, stone and steel. $500,000. Noted Dec. 1.

**Ill., White Hall**—High School—Bd. Educ., c/o H. W. Shultz, secy., having plans prepared by A. L. Pillsbury, archt., Peoples Bank Bldg., Bloomington, 2 story, brick, rein.-con., and stone, $150,000.

**Wis., Beloit**—Theatre—Beloit Amusement Co., c/o E. S. Hall, secy. of State, Madison, soon takes bids, 1 and 2 story, 93 x 130 ft., brick, plain foundation, here. $200,000.

**Wis., Fond du Lac**—Hospital—St. Agnes Hospital, c/o F. S. Wiley, 100 East Division St., plans 4 story, 200 x 250 ft., rein.-con., brick and steel, piath foundation. $500,000. Architect not selected.

**Wis., Oconomowoc**—High School—School Bd. having plans prepared by Parkinson & Dockendorff, archts., Linder Bldg., Chicago, 2 story, 68 x 118 ft., brick and concrete, plain foundation. $150,000 to $200,000. E. W. Delaney, secy.

**Wis., West Bend**—High School—Bd. Educ. having plans prepared by Foeller & Schober, archts., 123 North Washington St., Green Bay, 2 high, 80 x 200 ft., rein.-con., brick and steel, plain foundation. $250,000.

**Ia., Decorah**—High School—Bd. Educ., plans 2 story, [illegible] brick and steel [illegible] $150,000 bond issue. Arthur C. Bent, clk. Engineer not announced. Noted Dec. 8.

**Minn., Minneapolis**—School, etc.—Augsburg Seminary, c/o G. Sverdrup, pres., 8th St. and 21st Ave., S., plans brick, tile and stone, at Wood Lake, $300,000. Architect not announced.

**Minn., Minneapolis**—School—De La Salle Institute, c/o A. Dowling, Archbishop, 226 Summit Ave., St. Paul, plans 3 story, rein.-con., brick, tile and stone, at 17 Grove St., here, $250,000. Architect not announced.

**Minn., Olivia**—High School—Bd. Educ. receives bids in January, 2 story, rein.-con., brick, tile and stone, $180,000. W. L. Alban, 347 Endicott Bldg., St. Paul, archt.

**Minn., Virginia**—[illegible] Club, c/o A. E. Bickford, clk., having plans prepared by A. W. Kent & Co., archts., 200 La Salt Bldg., Minneapolis, and Virginia, 4 story, rein.-con., brick, tile and stone. $300,000.

**Kan., Salina**—Temple—Masonic Temple Ass'n, Joseph Jelonek, chn. building com., Candlish Co., archts., 53 West Jackson Blvd., Chicago, 6 story, 123 x 162 ft., rein.-con., brick and steel. $1,000,000.

Buildings (Continued)

**Mo., Carrollton** — Home — State Bd. Eleemosynary Institutions, Jefferson City, [illegible] home here, for neglected children. $200,000. [illegible]

**Mo., Columbia** — Chemistry — University of Missouri, c/o L. Cowan, secy., having plans prepared by J. P. Jamieson, archt., Security Bldg., St. Louis, 2 story, rein-con., brick and stone. $175,000.

**Mo., Columbia** — Dormitory — Stephens College plans 3 story, rein.-con. and brick, on campus. $150,00. Architect not selected.

**Mo., Columbia** — Temple and Students Building—Oddfellows of Missouri, Columbia Branch, c/o G. Starrett, chn., Building Comn., plans 3 story, rein.-con., brick and stone. $150,000. Architect not selected.

**Mo., Greenfield**—County Home—Dade Co. election Jan. 31 to vote on $160,000 bonds, 2 story, brick, stone and steel. Architect not selected.

**Mo., Kansas City**—Hotel—P. J. Bradshaw, archt., International Life Bldg., St. Louis, soon lets contract 15 story, 110 x 203 ft., rein.-con., brick and stone, here, for Bellerive Investment Co., c/o A. M. Cornwall, 111 North 7th St., St. Louis. $1,-000,000. Noted Nov. 24.

**Mo., St. Joseph**—Lodge—St. Joseph Aerie 19, Fraternal Order of Eagles, 517 North 5th St., plans 3 story, rein.-con. and brick. $175,000. Architect not selected.

**Mo., St. Louis**—Hotel—A. B. Groves, archt., Stock Exch. Bldg., soon lets contract 2 story, 94 x 112 ft.; brick, stone and steel, Jefferson and Franklin Sts., for Jefferson Bank, c/o V. T. Moberly, pres. $150,000.

**Mo., St. Louis**—Sales—Thirty-Sixth St. Realty Co., 111 North 7th St., having plans prepared by P. J. Bradshaw, archt., International Life Bldg., 96x144 ft., rein.-con., brick and stone, 3510 Lindell Blvd. $150,000.

**Cal., Fresno**—Hotel and Store—F. Dodd and F. W. Williams, having preliminary plans prepared by B. G. McDougall, archt., 381 Bush St., San Francisco, 10 story, rein.-con., Tulare St. and Bway. $500,000.

**Cal., Los Angeles**—Jail Bd. Supervs. Los Angeles Co. having plans prepared by Allied Architects Assn., 1128 Citizens Bank Bldg., 11 story, 195 x 226 ft., Temple, Buena Vista and New High Sts. $2,500,000. Noted April 21.

**Cal., San Luis Obispo**—Hotel—Carpenter Hotel Co., having preliminary plans prepared by G. Kensforth, archt., 354 Pine St., San Francisco, 5 story, rein.-con. and brick. $250,000.

### BIDS DESIRED

**Conn., Greenwich**—Apartment—F. G. C. Smith, archt., Smith Bldg. receiving bids 5 story, 54x100 ft., rein.-con. and brick, plain foundation. Greenwich Ave., for F. Zittell, c/o architect. $150,000.

**N. Y., New York**—Apartment—E. Waters, c/o J. M. Felson, archt. and engr., 1133 Bway., 5 story, brick, steel and stone, plain foundation, Grand Ave. and 190th St. $150,000. Work will be done by separate contracts.

**N. Y., New York**—Apartment—M. J. Kramer, c/o G. F. Pelham, archt. and engr., 200 West 72nd St., 7 story, brick, steel and stone, plain foundation, Hamilton Pl. $750,-000. Work will be done by separate contracts.

**N. Y., New York**—Bank and Office—Jan. 5, by Trowbridge & Livingston, archts. and engrs., 512 5th Ave., 23 story, brick, steel and stone, plain foundation, Wall, William and Pine Sts., for Bank of America, 44 Wall St. $2,500,000. Noted Nov. 10.

**N. Y., New York**—Theatre—Jan. 5 by Reilly & Hall, archts. and engrs., 405 Lexington Ave., 3 story, 100 x 120 ft., brick, steel and stone, plain foundation, MacDougal and West Houston Sts., for Fagazy & Rosetti, c/o architects. $150,000. Noted [illegible]

**N. J., Secaucus (Weehawken P. O.)**—[illegible] Bd. of Chosen Freeholders, [illegible] five 2 story, brick and steel buildings, here, [illegible] T. Rowland, Jr., 100 Slip Ave., Jersey City. [illegible]

**Pa., Gettysburg**—Hotel—[illegible] Medoff, archt., Lincoln Bldg., Philadelphia, [illegible] foundation, for Lynch Bros., Eagle Hotel. $150,000. Noted Nov. 24.

**Pa., Philadelphia**—Theatre and [illegible] receiving bids 16 story, 129 x 129 ft., rein.-16th and Market Sts., here, for Fox Film [illegible] 126 West 46th St., New York. $1,-[illegible]

**N. C., Fayetteville**—School—Jan. 10 by building com., State Colored Normal School, for several buildings. Bids are asked on individual units and also in blanket form. $185,000. H. L. Cook, chn. S. S. Dixson, Fayetteville, archt.

**La., New Orleans**—Community House—Jan. 2, by Daugherty & Gardner, archts., Stahlman Bldg., Nashville, Tenn., 3 story, rein.-con., brick and steel, Rampart and Governor Sts., for Methodist Episcopal Bd. of Missions. $[illegible]

**Tenn., Murfreesboro**—Dormitory—Jan. 5 by J. B. Brown, supt. instruction, State Bd. Educ., State Capitol, Nashville, 2 story, 40 x 160 ft., brick, here. H. C. Hibbs, Natl. Bank Bldg., Nashville, archt.

**Tenn., Nashville—School**—Jan. 5, by L. Pope, dir. of administration, 3 story, brick school for feeble minded. $250,000. Marr & Holman, 701 Stahlman Bldg., archts. Noted Aug. 25.

**Ky., Frankfort**—Hotel—Jan. 4, by New Capitol Hotel Co., 4 story, 100 x 150 ft., brick and concrete. $250,000. F. L. Packard, New Hayden Bldg., Columbus, O., archt. Noted Oct. 13.

**O., Cleveland**—Apartment—Jan. 4, by S. H. White, archt., Schofield Bldg., 9 story, 80 x 350 ft., brick, steel and concrete, plain foundation, East 116th St. and Shaker Blvd., for Chester Gardens Co., c/o architect. $2,500,000. Former bids rejected. Noted Nov. 3.

**O., Cleveland**—Commercial—C. Krause, 2042 East 4th St., taking bids 3 story, 90x120 ft., brick, steel and concrete, plain foundation, Chester Ave. West of East 11th St. $150,000. G. G. Bohm, Williamson Bldg., archt. Noted Nov. 3.

**O., Cleveland**—Commercial and Apartment—F. Dolinsky, 10514 Pasedena Ave., taking bids 3 story, 57 x 83 ft., brick and steel, plain foundation, 11121 Detroit Ave. $150,000. A. F. Janowitz, Permanent Bldg., archt.

**O., Cleveland**—Store and Apartment—B. Koslen, 2201 East 70th St., taking bids 3 story, 91x100 ft., brick, steel and concrete, plain foundation, East 123rd St. near Durant Ave. $150,000. M. Altschuld, 5116 Woodland Ave., archt.

**O., Columbus**—Divinity Hall—Jan. 6, by O. Meese, pres. Capitol University, East Main St., 2 story, 210 x 300 ft., brick and concrete. $176,000. Perkins, Fellows & Hamilton, 814 Tower Court, Chicago, archts.

**Ind., Battle Ground**—School—Feb. 2, by C. Walters, trustee, 1 story, 133 x 169 ft., brick. $150,000. Nicol, Scholer & Hoffman, Ross Bldg., Lafayette, archts.

**Ind., Indianapolis**—Apartment—Jan. 8, by Pennsylvania Apartment Hotel Corp., 914 Hume-Mansur Bldg., 6 story, 52 x 178 ft., brick and concrete, North Pennsylvania St. $300,000. W. K. Eldridge, 914 Hume-Mansur Bldg., archt.

**Ind., Indianapolis**—Church—Columbia Pl., Christian Church receiving bids 2 story, 125 x 135 ft., brick and stone, 40th St. and Capitol Ave. $150,000. C. O. Morris, 938 West 32nd St., archt.

**Ill., Chicago**—Apartment—Johnston Bros., 109 North Dearborn St., receiving bids 3 story, 110 x 125 ft., rein.-con., brick and steel, 72nd and Jefferson Sts. $150,000. Owner will do carpentry work. T. M. Mitchell, 138 North La Salle St., archt.

**Ill., Chicago**—Apartment—J. A. Nyden, archt., 190 North State St., receiving bids 3 story, 120 x 150 ft., rein.-con., brick, steel and stone, Brompton and Pine Grove Aves., for C. R. Gleason, 111 West Washington St., $250,000.

**Ill., Chicago**—Apartment—J. A. Nyden, archt., 190 North State St., receiving bids 3 story, 107 x 150 ft., rein.-con., brick, steel and stone, Winthrop and Greenlake Aves., for C. R. Gleason, 111 West Washington St. $200,000.

**Ill., Chicago**—Apartment—Whitney & Williams, archts., 122 South Michigan Ave., receiving bids 3 story, 80 x 153 ft., rein.-con., brick, steel and stone, on Northwest Side, for R. Levine, 133 West Washington St., $150,000. Noted Dec. 15.

**Ill., Chicago**—Bernard R. G. Schmidt & Co., archts., 154 West Randolph St., receiving bids 2 story, 100 x 100 ft., rein.-con., brick and steel, Sheridan Rd. and Wilson Ave., for Garibaldi & Cuneo, 1 West South Water St. $150,000. Noted Oct. 20.

**Ill., Oak Park**—Apartment—Minchin & Spitz, archts., 19 West Jackson Blvd., Chicago, receiving bids, 3 story, brick and stone, 242 Maple Ave., for O. Prohaska, c/o architects. $175,000. Noted Dec. 1.

**Kan., Independence**—High School—Jan. 10 by N. S. Spencer & Sons, archts., 37 West VanBuren St., Chicago, 3 story, 180x235 ft., rein.-con., brick and steel, here, for Bd. Educ. C. S. Risdon, supt. $400,000. Noted Dec. 1.

**Ariz., Phoenix**—Depot—Santa Fe R.R. and Arizona Eastern R.R., P. E. Bldg., Los Angeles, receiving bids 2 story, 122 x 475 ft., steel, tile and concrete, here, $300,000. W. H. Mohr, c/o owner, archt.

**Cal., Los Angeles**—High School—Jan. 4, by Bd. Educ., Security Bldg., 2 story, 132 x 350 ft., rein.-con., brick and tile, Bronson Ave. near Fountain Ave. $280,000. E. H. Cline, c/o Bd. Educ., archt.

**Ont., Ottawa**—Collegiate—Jan. 4, by C. Bethune, secy. Ottawa Collegiate Bd., 46 Elgin St., structural steel work for institute, Carling Ave. $200,000. J. A. Ewart, Jackson Bldg., Bank St., archt.

### BIDS RECEIVED

**Mass., Boston**—Hospital—City Hospital Dept., Harrison Ave, 2 story, 43 x 150 ft. and 43 x 107 ft. top addition, two 6 story, 28 x 43 ft. and [illegible] 43 ft. annexes, rein.-con., brick and steel, plain foundations, Harrison Ave., from J. Bowen Co., 184 Dudley St., Boston, $493,000; J. Slotnik Co., 448 Bway., Chelsea, $514,780; Evatt Constr. Co., 161 Devonshire St., Boston, $515,000. Noted Dec. 15.

**Mass., Brookline**—High School—School Bd., 3 story, 61 x 153 ft., 85 x 89 ft. and 40 x 124 ft., brick, Tappan Ave., from J. F. Keating, Westboro, $374,000; R. G. McDonnell, 164 Dudley St., Boston, $377,630; Coblo & Griffin, 46 Cornhill, Boston, $379,-729. Noted Dec. 15.

**Wis., Superior**—Auditorium—City, 2 story, 75 x 140 ft. brick, plain foundation, 14th St. and Ogden Ave., from L. A. Hoffman, 1309 John St., $141,000; A. Wilcott & Sons, Superior, $144,600; A. Dauplaise, 5512 Baxter St., $145,072. Noted Dec. 8.

**Minn., Minneapolis**—Junior High School—Bd. Educ., 3 story, 218x230 ft., rein.-con., brick, tile and stone, Clinton Ave. and 38th St., from Madsen & Peterson, 646 Builders Exch. Bldg., $309,658 plus $9,020 for remodeling old building; Bracker Constr. Co., 638 Builders Exch. Bldg., $312,990 plus $6,030; Kvitrud Constr. Co., 646 Builders Exch. Bldg., $314,400. Noted Nov. 24.

**Kan., Independence**—High School—Bd. Educ., 3 story, brick, plain foundation, (general contract), from P. J. Morley, 1701 Main St., Kansas City, Mo., $284,340; A. S. Hecker Co., 815 Reserve Bank Bldg., Kansas City, Mo., $367,000; Murch Bros., R-W Exch. Bldg., Kansas City, Mo., $380,-000. Noted Nov. 24.

### CONTRACTS AWARDED

**Mass., Boston**—Hospital—Forest Hills Hospital, 29 Morton St., 3 story, 52 x 150 ft., brick, Morton St., to Coblo & Griffin, 46 Cornhill St., $150,000.

**Mass., Lawrence**—High School—Bd. Educ., 4 story, 115 x 317 ft. and 92 x 147 ft., brick and stone, to G. Dose Eng. Co., 43 West 27th St., New York, $758,700. Noted Nov. 17.

**Mass., Wakefield**—Library—Town, 1 story, 64 x 98 ft., brick, Main St., to J. E. Nelson Co., 7 Water St., Boston, $150,000. Noted Nov. 3.

**N. Y., Brooklyn**—Apartment—King-Carroll Bldg. Corp., c/o M. A. Cantor, archt. and engr., 371 Fulton St., 4 story, 100 x 100 ft., brick, steel and stone, plain foundation, Crown St. and Kingston Ave., by day labor. $150,000.

**N. Y., New York**—Apartment—Arrowhead Holding Co., 41 Convent Ave., 5 story, 90 x 125 ft., brick, steel and stone, plain foundation, Haven Ave., by day labor. $500,000. G. F. Pelham, 200 West 72nd St., archt. and engr.

**N. Y., New York**—Apartment—F. M. and S. Corp., c/o G. F. Pelham, archt. and engr., 200 West 72nd St., 5 story, brick, steel and stone, plain foundation, 212th St., by day labor. $200,000.

**Pa., McKeesport**—Y. M. C. A., 2 West 45th St., New York, 4 story, 115 x 170 ft. brick, steel and stone, plain foundation, to Schutz, Schreiner & Clyde Co., May Bldg., Pittsburgh, $535,000.

**Pa., Philadelphia**—Theatre—Willard Theatre Co., c/o C. E. Oelschlager, archt., 1615 Walnut St., 1 story, 65 x 125 ft. brick and steel, plain foundation, 40th and Market Sts., to W. S. Gore, 6 North 41st St., $150,000. Noted Dec. 22.

**D. C., Wash.**—Bank and Office—C. Tompkins, 1612 Park Rd., will build concrete bank and office building, 14th St. and

Buildings (Continued)

Park Rd., N.W., by day labor. $[illegible]. G. W. Ray, 1147 Conn. Ave., N.W., archt.

**Va., Richmond**—High School—[illegible]. 4 story concrete and brick, Marshall St. between 8th and 9th to A. M. Walkup & Co., 746 North 17th St. $[illegible]

**W. Va., Logan**—Hospital—H. D. Hatfield, R. & P. Bldg., and others, 5 story, 40 x 110 ft., brick and stone, to V. E. Taylor, 547 Adams Ave., Hungtington, $150,000.

**N. C., Winston-Salem**—High School—[illegible] Trustees constructing Richard J. Reynolds Memorial High School and power house in connection with same, to Dupont Eng. Co., Dupont Bldg., Wilmington, Del., $388,700 and $28,250 respectively; heating of school to Grinnell Co., Charlotte, $73,790.

**Fla., Tallahassee**—Capitol—Bd. State Institutions two 3 story wings, rein.-con., brick, marble and steel, to Parker & Yeager, Tallahassee, $153,000. Noted Nov. 17.

**O., Castalia**—School—Bd. Educ. 2 story, 103 x 106 ft., brick, steel and concrete, plain foundation, to Hossier Bros., Tiffin, $150,000.

**O., Cleveland**—Apartment Hotel—L. W. Kelly, Hippodrome Bldg., 12 story, 94x190 ft., brick, steel and concrete, plain foundation, Euclid Ave. and East 107th St., to J. Gill & Sons, Citizens Bldg., $1,500,000. Noted Oct. 27.

**O., Delaware**—Dormitories—Bd. Trustees Ohio Wesleyan University, building Austin Hall, brick and stone, on site of Monett Annex, also Watson Memorial, Central Ave. and Elizabeth St., to H. K. Ferguson Co., 6523 Euclid Ave., Cleveland. $200,000 and $300,000 respectively. Noted Dec. 22.

**O., North Robinson**—High and Grade School—Bd. Educ., 2 story, 100 x 124 ft., brick, steel and concrete, plain foundation, to Miller Bros., Bucyrus, $200,000.

**Ind., Indianapolis** — Church — Tabernacle Presbyterian Church, 2 story, 189 x 305 ft., concrete, stone and steel, 34th St. and Central Ave. to E. Wehr Constr. Co., East Liberty Sta., Pittsburgh, Pa., $300,000.

**Ind., Indianapolis**—Theatre—[illegible] Bros., Occidental Bldg., 2 story, 44 x 120 ft., concrete, brick and terra cotta, 17 North Illinois St., to Bedford Stone & Constr. Co., Fletcher Trust Bldg., $175,000. Noted, Dec. 8.

**Ind., Terre Haute**—School—Bd. Educ. 2 story, 65 x 88 ft. brick and stone, to W. Caton, 900 South 6th St., $150,000. Noted May 12.

**Ill., Chicago**—Office, etc.—J. H. Taylor & Co., 101 4th Ave., New York, 10 story, 100 x 110 ft., rein.-con., brick and steel office and factory, to G. Thompson & Son, 30 North LaSalle St., $550,000. Noted Nov. 10.

**Wis., Genoa Junction**—Lodge—E. G. Shinner, c/o C. B. Falkner, archt., 140 South Dearborn St., Chicago, having plans prepared 1 and 2 story, 100 x 100 ft. lodge building, 1 story, 85 x 85 ft. dining hall, 1 story, 100 x 100 ft. garage, 50 x 50 ft. power house, boat house, polo grounds, golf course, on Tombeau Lake near Lake Benedict and Lake Powers, for Nippersink Lodge. $250,000. Work will be done by day [illegible]

**Minn., Minneapolis** — Apartment — Fleisher Constr. Co., 608 Builders Exch., fifteen 3 story, 40x110 ft., brick, tile and stone. $50,000 to $60,000 each. Owner builds by day labor. A. Rose, 500 Builders Exch. Bldg., archt.

**Tex., Dallas**—Office—Carv-Schneider Investment Co., Gt. Sou. Life Bldg., 18 story, 112 x 142 ft., rein.-con. and brick, Masten and Pacific Sts., to E. W. Hewitt, Slaughter Bldg., $1,000,000. Noted Dec. 8.

**Tex., Dallas**—Y. W. C. A. [illegible] x 115 ft., rein.-con., administration building, Jackson and Prather Sts., to Watson Co., 1927 South Akard St., $375,000. Noted June 16.

**Okla., Duncan**—Hotel—Mason Hotel Co., c/o W. C. MacCready, pres. Ballinger Bldg., St. Joseph, Mo., 6 story, 140 x 140 ft., concrete, brick and steel, here, to E. H. Lawhon, 905 Edmond St., St. Joseph, Mo., $500,000.

**Cal., Los Angeles** — Office — Automobile Club of Southern California, c/o Hunt & Burns, archts., 701 Laughlin Bldg., 3 story, 207 x 267 ft., rein.-con. and stone, 26th and Figueroa Sts., to C. J. Rubach Co., Merchants Natl. Bank Bldg., $500,000.

**Cal., Santa Barbara** — Hospital — Potter Hospital & Sanitarium, [illegible] 4 story, 40 x 90 ft., rein.-con., to J. Y. Farley, c/o Lee Cox, [illegible] May 15

# Federal Government Work

## PROPOSED WORK

**D. C., Wash.**—School—War Dept., c/o Quartermaster, Constr. Div., plans 3 story, rein.-con. and brick, army medical school, at Walter Reed Hospital.

## BIDS DESIRED

**D. C., Bellevue**—Power Plant equipment and Installation—Spec. 4497—Bureau Yards & Docks, Navy Dept., Wash., receiving bids four 150 hp. return tubular boilers and mechanical stokers, boiler and fire pumps, motor driven air compressor or brick setting and superheaters, for 4 boilers, crane, 2 turbine driven forced draft fans, steel smoke flue, feed water heater, heating system return tank, condenser equipment, air condenser and circulating pumps, service water heater traveling screen, structural supports, concrete foundations and pipes, valves and fittings. Noted Dec. 1.

**S. C., Charleston**—Foam Fire Protection System—Spec. 4558—Jan. 4, (change of date) by Bureau Yards & Docks, Navy Dept., Wash., D. C., foam fire protection system, at Navy Yard, here. Noted Dec. 8.

**Ga., Augusta**—Hospital—Jan. 18, Treas. Dept., Wash., D. C., construction, incl. mechanical equipment of U. S. Pub. Health Serv. Hospital, here; adv. this issue. Noted Dec. 15.

**La., New Orleans**—Ice Making and Refrigerating Plant—Jan. 16, Treas. Dept., Wash., D. C., ice making and refrigerating plant, at U. S. Quarantine Station, here. J. A. Wetmore, acting superv. archt.

**Mo., Kansas City**—Pumping Plant, etc.—Jan. 12, Treas. Dept., Wash., D. C., pumping plant, hydraulic freight elevator, etc., in U. S. Post Office and Court House, here. J. A. Wetmore, acting superv. archt.

**Cal., San Diego**—Post Exchange and Dispensary—Spec. 4527—Jan. 18, Bureau Yards & Docks, Navy Dept., Wash., D. C., for post exchange and dispensary buildings, at Naval Base, here; adv. this issue. Noted Oct. 6.

## CONTRACTS AWARDED

**Va., Yorktown**—Water Supply System—Spec. 4514—Bureau Yards & Docks, Navy Dept., Wash., D. C., water supply system at Naval Fuel Depot, here, to Newport Contg. and Eng Co., Law Bldg., Newport News, $18,623 (240 days). Noted Dec. 22.

**N. C., Oteen**—Changes to Services—Treas. Dept., Wash., D. C., changes to services, etc., in U. S. Pub. Health Serv. Hospital, here, to Ransom & Anderson Co., Inc., 136 Liberty St., New York, $19,890 (90 days). Noted Dec. 15.

**Ga., Savannah**—Quarters—Spec. 4547—Bureau Yards & Docks, Navy Dept., Wash., D. C., quarters at radio station, here, to Universal Constr. Co., 316 West Dewald St., Fort Wayne, Ind., $2,845 (120 days). Noted Dec. 22.

**Wis., Milwaukee** — Hospital—Bd. Mgrs. Natl. Home for Disabled Volunteer Soldiers, Dayton, O., 2 story, rein.-con. and brick, at Soldiers Home, here, to H. Schmitt & Son, 430 Farwell Ave., $1,094,000. Noted Dec. 1.

**H. T., Pearl Harbor**—Storehouse—Spec. 4504—Bureau Yards & Docks, Navy Dept., Wash., D. C., 1 story storehouse, at Naval Operating Base, here, to W. F. Martens, 53 Franklin St., Rochester, N. Y., $196,775 (263 days). Noted Dec. 15.

# Miscellaneous

## PROPOSED WORK

**Stone Crusher — Medford, Wis.** — Soon [illegible] H. Mauel, clk.

**Stadium — Northfield, Minn.** — Carleton College plans concrete stadium, 25,000 seating capacity, and improvements to athletic field, 150,000. F. J. Fairbank, treas.

**Electric Lighting and Power System—Cayuga, Ont.**—Plans electric lighting and power distribution system. R. S. Colter, member of Council.

**Electric Lighting and Power System—Hensall, Ont.**—Usborne Twp. plans electric lighting and power distribution system, $30,000. Address H. Strang, member of Council.

**Electrification of Railway—North Bay, Ont.**—Temiskaming & Northern Ontario Ry., plans to investigate complete electrification of railway, incl. new line from [illegible] Port Arthur, [illegible] River, as well as several waterfalls on Ottawa, Montreal and Sturgeon water sheds. S. B. Clement, North Bay, ch. engr.

**Asphalt Plant and Street Flusher—Windsor, Ont.**—Election Jan. 2, to vote on $25,000 bonds for asphalt plant and $10,000 for street flusher. A. Brian, city engr.

## BIDS DESIRED

**Station Finish—New York, N. Y.**—Jan. 18, by Transit Comn., 49 Lafayette St., for completion of construction and station finish for 2 stations on Bway.-4th Ave. Rapid Transit R.R. G. McAneny, chn.

**Shafts and Tunnel—Jersey City, N. J.**—Feb. 7, by New York State Bridge & Tunnel Comn., and New Jersey Interstate Bridge & Tunnel Comn., Room 617, Hall of Records, New York, land shafts and vehicular tunnel under Hudson River, here. Noted Nov. 24.

**Jaw Crushers, Conveyors, etc.—Florence, Ala.**—Muscle Shoals, Rock Asphalt Co., 103 Court St., is in the market for 4 jaw crushers, 400 ton daily capacity, 4 conveyors, 4 steel rollers, 48 in. diameter about 30 in. long for pulverizing asphalt, air compressors, jack hammer drills, and ½ ton revolving shovel dipper, caterpillar preferred. A. J. Bright, Nashville, Tenn., ch. engr.

**Jaw Crusher—Blanchester, O.** — C. A. Magee in market for one 9 x 16 in. jaw crusher with elevator and screen.

**Road Machinery—Lancaster, Wis.**—Jan. 3, by H. Mink, comr. Grant Co., 12 patrol graders, 1 scarifier, 12 road drags, 4 slip scrapers, 4 plows and one hundred 6 ft. grader blades.

**Street Signs—Minneapolis, Minn.**—Jan. 3, by K. E. Alexander, city purch. agt., 1,000 metal street signs.

**Terminal Substructure — San Francisco, Cal.**—Jan. 12, by State Bd. Harbor Comrs., Ferry Bldg., sub-structure for China Basin Terminal, incl. 1,000-ft. seawall, foundations and ground floor of building, 122 x 812 ft., filling and 6,000 green piles. $800,000. F. G. White, ch. engr.

**Asphalt Heating Plant—Santa Rosa, Cal.**—Jan. 11, by Bd. Supervs. Sonoma Co. asphalt heating plant. $4,000. R. P. Smith, co. engr.

## BIDS RECEIVED

**Cranes — Stapleton, S. I., N. Y.**—Dept. Docks, Pier "A" foot of Battery Pl., New York, opened bids Dec. 21 installing and putting into successful operation cranes on Piers 12 and 13, here. Contr. 1686, from Wellman-Seaver-Morgan Corp., Real Estate Trust Bldg., Cleveland, O., proposal (a) $324,500, (b) $314,450, (c) $304,400, (d) $294,350, (e) $276,268; Heyl & Patterson, Inc., 140 West St., New York, (a) $344,921, (b) $331,198, (c) $317,234, (d) $302,540, (e) $280,228; McMyler Interstate Co., 50 Church St., New York, (a) $375,774, (b) $362,560, (c) $349,350, (d) $334,218, (e) $517,934; Niles Bement Pond Co., 111 Bway., New York, (e) $345,950. Noted Dec. 15.

## CONTRACTS AWARDED

**Steam Asphalt Roller—New York, N. Y.**—H. Bruckner, pres. Bronx Boro. Municipal Bldg., furnishing and delivering one 5 ton steam asphalt roller, to Buffalo-Springfield Roller Co., Kenton and Oak Sts., Springfield, Ohio., $2,390. Noted Dec. 8.

**Elimination of Grade Crossings, etc.—North Tonawanda, N. Y.**—New York Central R.R., Grand Central Terminal, New York, for elimination of grade crossings, raising of track, etc., subways, bridges and viaducts, here, to Walsh Constr. Co., Syracuse Herald Bldg., Syracuse, $500,000.

**Swimming Pool, etc.—Nashville, Tenn.**—Cascade Corp., concrete swimming pool, bath houses, etc., to O. F. Whittle, 2015 Linden Ave., $75,000. Noted Dec. 15.

**Electric Lighting and Power System—Blenheif, Ont.**—Harwich Twp., electric lighting and power distribution system, $40,000. Work will be done by Hydro Power Comn. under direction of J. N. Wilson, engr., 190 University Ave., Toronto.

**Electric Lighting and Power System—Charing Cross, Ont.**—Raleigh Twp., electric lighting and power distribution lines to Kent Centre, Louisville and Tupperville, $60,000. Work will be done by Hydro Power Comn. under direction of E. R. Lawlor, engr., 190 University Ave., Toronto.

**Electric Lighting and Power System—Ridgetown, Ont.**—Howard Twp., electric lighting and power distribution system. Work will be done by Hydro Power Comn. [illegible] of A. [illegible] St., London.

# OFFICIAL PROPOSALS

Bids: Jan. 10

## Steel or Concrete Bridge Construction

Lake Charles, La.

Sealed proposals for constructing the Mose East Highway Bridge across the Calcasieu River, near Lake Charles, Louisiana, and addressed to the Hon. W. J. Prater, President, Police Jury, Calcasieu Parish, Louisiana, will be received at the office of the Parish Clerk, Lake Charles, Louisiana, until 10 A. M. January 16th, 1922.

The construction of a steel highway bridge across the Calcasieu River and a reinforced concrete or creosoted timber approach trestle across the adjacent marsh, together with a steel lift span with 94 ft clear opening. The bridge will be built on either of two alternates for various combinations of the different types of construction and for each alternate the construction of the substructure a steel superstructure may be bid on separately, as distinct contracts. Contractors may bid on any or all alternate types of design or upon any combination of contracts. Both furnishing and erection of structural steel trusses and lift span are in all cases included in the same contract. Some of the river piers will be carried over sixty feet below ordinary river level. The entire structure will be about One Thousand Four Hundred Fifty (1,450) feet in length and either 18 or 20 ft. in clear width. Instructions and proposal blanks may be obtained from and detailed plans and specifications are on file with the Parish Clerk at Lake Charles, Louisiana, and at the office of The Terrell Bartlett Engineers, Calcasieu Building, San Antonio, Texas. Each proposal must be accompanied by a certified or cashiers check in the sum of not less than 5% of the amount bid.

Bidders must fulfill conditions provided in the "Instructions to Bidders."

The Parish reserves the right to reject any or all bids.

W. J. PRATER,
President Calcasieu Police Jury.
Lake Charles, Louisiana.

---

Bids: Jan. 31.

## Filter Plant and Reservoir

Atlanta, Ga.

Sealed proposals for furnishing material [illegible] a Filter Plant and a Clear Water Reservoir for the City of Atlanta, Georgia, will be received by the Purchasing Agent of the City of Atlanta at the City Hall until 2:30 P. M. on the 31st day of January, 1922.

The work will consist of a Reinforced Concrete Filter Plant, of 7 units of 3 million gallons daily, capacity each, with Laboratory attached. A 10 million gallon Reinforced Concrete, covered Reservoir, a Reinforced Concrete Wash Water Tank, together with Reinforced Concrete Conduits, cast iron pipe lines with miscellaneous [illegible] and connections to the present system.

[illegible] by a certified check payable to the City of Atlanta, in an amount equal to 5% of the [illegible] be entered into if awarded. A Bond of [illegible] tract price will be required. Payments will [illegible]

Atlanta Water Works, City Hall, Atlanta, Ga. [illegible] Candler Building, Atlanta, and with the [illegible] fications from the Purchasing Agent by enclosing check for twenty-five dollars [illegible] and to be held by him until return of the specifications, in good condition. Blue prints may be had at the cost of printing.

Purchasing Agent.
City of Atlanta, Georgia.

## These Advertisements

are official notices that bids are wanted from other than local bidders.

Maximum competition is desired, and this is assured through Engineering News-Record's large NATIONAL circulation, reaching almost every contractor, dealer, and manufacturer in the country interested in bidding on public work contracts. It is the DOMINANT MEDIUM for advertising contracts for work, material, and supplies for towns, cities, counties, state and government departments, and private organizations.

Official Proposals reaching our New York Office by 10 A. M., Tuesday can usually be printed in the issue out Thursday.

**Rate: 40 cents a line an insertion.**

---

Bids: Jan. 13.

## Sewage Disposal Plant

Milwaukee, Wis.

Sealed proposals for the construction of a Sewage Disposal Plant will be received by the Sewerage Commission of said city at its offices in the City Hall until 1:30 o'clock P.M. of the 13th day of January, 1922, at which time and place during the session of said Commission, they will be publicly opened and read.

The work to be done embraces the construction of the main portion of the Sewage Disposal Plant, consisting of aeration and sedimentation tanks, galleries, conduits, superstructures, piping and all appurtenances connected therewith. The approximate yardage of concrete is 61,500, with 5,000 tons of reinforcing steel to be placed and a large amount of miscellaneous piping.

The time allowed for the completion of the contract shall be eighteen (18) months from the date of the notice of the engineer to begin the work.

The liquidated damages for not completing the work within the time specified shall be One Hundred ($100.00) Dollars for each day in excess thereof.

Each proposal submitted must be accompanied by a cash deposit or certified check drawn to the order of the Sewerage Commission of the City of Milwaukee, to the amount of Twenty-five Thousand ($25,000.00) Dollars.

Specifications and blank forms of proposals can be obtained and detail plans examined at the offices of the Sewerage Commission. A full set of plans and a copy of the specifications will be sent to any contractor upon the receipt of Twenty-five ($25.00) Dollars, which amount will be refunded upon the return of the plans in good condition, provided such return is made on or before the expiration of 30 days after the date of receiving bids.

The Sewerage Commission reserves the right to reject any and all proposals submitted.

JOHN H. FOWLES
Secretary.

[illegible]
[illegible] M. KOVICKI,
City Comptroller.

---

## Paving

Lake Wales, Fla.

[illegible] FLORIDA: Will let [illegible] clock P. M. Plans [illegible] cifications on file on and after January [illegible] M. M. Ebert; [illegible] Lakeland, Fla.

---

Bids: Jan. 4.

## East Side Storm Sewer

Dearborn, Mich.

Sealed bids will be received at the office of the village clerk, Dearborn, Michigan up to 8 p. m. of the 4th day of January, 1922, for the furnishing of all materials and labor necessary to construct the East Side Storm Water Sewer. Sewer to be built in tunnel. The following are the approximate quantities:

707 ft. of 4 ft. 9 in. sewer.
339 ft. of 4 ft. 6 in. sewer
815 ft of 3 ft 9 in. sewer
487 ft. of 3 ft. 6 in. sewer
1 manholes
One concrete abutment and apron.

Plans and specifications are on file at the office of the village clerk and copies may be secured from the office of C. W. Hubbell, Consulting Engineer, 2348 Penobscot Bldg., Detroit, Michigan. A deposit of $10.00 will be required for a set which will be refunded upon their return in good order on or before January 14, 1922.

A certified check made payable to the Village of Dearborn for the sum of $2,500.00 must accompany each bid. In case of failure or neglect to enter into contract and furnish the required bonds, the certified check shall be forfeited to the Village of Dearborn as liquidated damages.

No proposals will be received unless made on the blanks furnished by the consulting engineer and delivered to the village clerk on or before 8 P. M., January 4, 1922.

The village reserves the right to reject any or all bids. By order of the village commission.

FRED C. REAMER,
Village Clerk.

---

Bids: Jan. 11.

## Construction, etc.

Middletown, N. Y.

NOTICE TO CONTRACTORS: Sealed proposals for construction, heating and electric work — storehouse at the Middletown State Homeopathic Hospital, Middletown, N. Y., will be received by the State Hospital Commission, Capitol, Albany, N. Y., until 3 o'clock P.M., on Wednesday, January 11, 1922, when they will be publicly opened and read. Proposals shall be enclosed in an envelope furnished by the State Architect, sealed and addressed and shall be accompanied by a certified check in the sum of five per cent (5%) of the amount of the proposal. The contractors to whom the awards are made will be required to furnish surety company bond in the sum of fifty per cent (50%) of the amount of the contract within thirty (30) days after official notice of award of contract and in accordance with the terms of Specifications Nos. 3817, 3818 and 3819. The right is reserved to reject any or all bids. Drawings and specifications may be examined and inspected at the Middletown State Homeopathic Hospital, Middletown, N. Y.; at the New York Office of the Department of Architecture, Room 618 Hall of Records Building and at the Department of Architecture, Capitol, Albany, N. Y. Drawings specifications and blank forms of proposal may be obtained at the Department o Architecture, Capitol, Albany, N. Y. upon reasonable notice to and in discretion of th State Architect, L. F. Pilcher, Capitol, Albany, N. Y.

L. M. FARRINGTON,
Secretary, State Hospital Commission
Dated December 24 1921

---

Bids Jan. 4.

## Dredging

Belzoni, Miss

Sealed bids will be received until one o'clock P. M., Wednesday, January 4th, 1922, by the Commissioners of the Belzoni Drainage District at their offices in Belzoni, Mississippi, for the redredging and cleaning out of about 100 miles of dredged ditches.

The right is reserved to reject any and all bids.

Further information upon request.

S. CASTLEMAN, President
C. E. MILLER, Engineer

OFFICIAL PROPOSALS

ids: Jan 4

## Barge Canal Terminals

Albany, N. Y.

NOTICE TO CONTRACTORS: Sealed roposals will be received by the undersigned at his office in the Capitol at Albany, N. Y., until twelve o'clock noon of Wednesday, January 4th, 1922, at which lace and hour they will be publicly opened nd read, for the construction of barge anal terminals pursuant to the provisions f Chapter 746 of the Laws of 1911, and mendatory laws, and Chapter 176 of the aws of 1921, as follows:

TERMINAL CONTRACT NO. 12a

For furnishing, instaling and testing wo two-ton, electric, overhead, wharf ranes at Rochester.

Contract plans, sheet 1.

Plans may be seen and detailed specifiations, engineer's estimates of quantities, roposal blanks, forms of contracts and onds required and other information for roposers may be had at the office of the uperintendent of Public Works at Albany, . Y. the office of the Assistant Superintendent of Public Works for the Middle ivision at Syracuse, N. Y., at the office the Assistant Superintendent of Public orks for the Western Division at Rochesr, N. Y., at the office of the Superintendnt of Public Works, Erie Basin Terminal, uffalo, N. Y., and Terminal Warehouse, er 6, East River, New York City.

Copies of detailed plans or drawing may obtained from the State Engineer and urveyor at Albany, N. Y., upon payment him of the cost of producing them.

Monthly estimates will be paid of ninety r centum (90 per cent) of the work done the contract price. Every proposal for id work must be accompanied by a money posit in the form of a draft or certified eck upon some good banking institution the city of Albany, or New York, issued a national or state bank or trust comny in good credit within the state and yable at sight to the Superintendent of blic Works for five per centum (5 per nt) of the amount of the proposal.

The person whose proposal shall be acpted will be required to execute a conict and furnish bonds within ten days om the date of notice of award delivered him or them in person or mailed to the dress given in the proposal.

Upon execution of the contract and approval of bonds, the certified check or draft ll be returned to the proposer unless the me shall have been presented for collecn prior to such time in which case the ount of the deposit will be refunded by e Superintendent of Public Works

The deposits of bidders other than the e to whom the award of contract shall made will be returned immediately after e award has been made.

The bond required for the faithful perrmance of the contract shall be in such m as shall be fixed by the Superintend t of Public Works, which sum shall not less than twenty per centum (20 per nt) of the estimated cost of the work, cording to the contract price, and an adional bond, known as the labor bond, in s sum of ten per centum (10 per cent) the amount of the estimated cost of the rk according to the contract price, will required as security that the contractor ll pay in full at least once in each month laborers employed by him upon the rk specified to be done in the contract.

In the event that more than one surety mpany is offered as surety on said bonds insurance only will be accepted.

Each proposal must be addressed to the perintendent of Public Works, Albany, Y., and must be endorsed on the enlope with the name of the construction which the proposal is made.

Award, if made, will be made to the per- or persons whose proposal shall be west in cost to the state for doing the rk, and which shall comply with all proions required to render it formal and e any award shall be made the lowest lder will be required to satisfy the Sperintendent of Public Works of his ability provide suitable equipment and mate- for the proper performance of the rk.

The right is reserved to reject all proals and readvertise and award the conct in the regular manner if, in the judgnt of the undersigned, the interests of state will be enhanced thereby.

CHARLES L. CADLE,
Superintendent of Public Work

OFFICIAL PROPOSALS

Bids: Jan. 11.

## Artesian Well

Central Islip, N. Y.

NOTICE TO CONTRACTORS: Sealed proposals for artesian well for additional water supply at South Colony Power Plant, Central Islip State Hospital, Central Islip, N. Y., will be received by the State Hospital Commission, Capitol, Albany, N. Y., until 3 o'clock p.m. on Wednesday, January 11, 1922, when they will be publicly opened and read. Proposals shall be enclosed in an envelope furnished by the State Architect, sealed and addressed, and shall be accompanied by a certified check in the sum of five per cent (5%) of the amount of the proposal. The contractor to whom the award is made will be required to furnish surety company bond in the sum of fifty per cent (50%) of the amount of contract within thirty (30) days after official notice of award of contract and in accordance with the terms of Specification No. 3523. The right is reserved to reject any or all bids. Drawings and specifications may be examined and inspected at the Central Islip State Hospital, Central Islip, N. Y., at the New York Office of the Department of Architecture, Room 618, Hall of Records Building, and at the Department of Architecture, Capitol, Albany, N. Y. Drawings, specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, N. Y., upon reasonable notice to and in the discretion of the State Architect, L. F. Pilcher, Capitol, Albany, N. Y.

L. M. FARRINGTON,
Secretary, State Hospital Commission.
Dated: Dec. 10, 1921.

---

Bids: Jan. 13.

PUBLIC SALE
By order of the Harbor Commissioners

## For a Lease of Pier

Walnut Street Pier, Camden, N. J.,
For a term of one, three or five years from January 15, 1922,
ON FRIDAY, JANUARY 13, 1922,
at 8 P.M.
Room 11, City Hall, Camden, N. J.

Bids will be received for said lease.

Bidders to state terms bid on, also annual rental to be paid. Commission may require lessee to give bond with satisfactory surety for faithful performance of lease. It reserves the right to reject any or all bids as may be best for City's interests.

A certified check for $100.00 to order of City of Camden is to accompany each bid, check to be returned on execution of lease or rejection of bid. Copies of lease mailed on application and other information as to equipment can be had from Mr. William D. Sayrs, Jr., Harbor Engineer, Room 11, City Hall, Camden, N. J.

Address proposals to Mr. George W. Bradley, Chairman of Board of Harbor Commissioners Room 11, City Hall, Camden, N. J

Dated December 10th, 1921.

---

Bids: Jan. 10.

## Highway Work

Albany, N. Y.

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster Street, Albany, N. Y., at one o'clock P.M., on TUESDAY, the 10th day of JANUARY, 1922, for the improvement of highways in the following counties:

Albany, one highway, 5.89.
Allegany, one highway, 5.01.
Dutchess, one highway, 1.33.
Franklin, one highway, 7.50.
Genesee, one highway, 2.10.
Orange, one highway, 2.75.
Orleans, one highway, 2.25
Schoharie, two highways, 3.94 and 10.33.
Sullivan, one highway, 5.69.

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved. The addresses of the division engineers and the counties in which they are in charge will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
J. C. FINCH, Commissioner.
Secretary

OFFICIAL PROPOSALS

Bids: Jan. 17. (Date extended.)

## Garbage Incinerator

New Orleans, La.

Sealed proposals will be received at this office until the hour of 11 o'clock a.m., Wednesday, January 4th, 1922, for furnishing labor, materials and equipment, and constructing in accordance with the plans and specifications on file in the office of the City Engineer, any or all of the following pieces of work:

(1) Foundations and building complete, including piling.

(2) Radial brick chimney 150 feet by 6 feet complete on foundation furnished.

(3) Furnishing and installing of Incinerator equipment of the Decarie type, including electric travelling crane and electric generating equipment complete.

A certified check for an amount equal to 10% of the total amount bid in the proposal, payable to the undersigned Commissioner of Public Finances, or a bidder's bond for the same amount, must accompany each proposal.

Bond required: Equal to the total amount of contract.

The City Engineer will furnish bidders with a blank form of proposal. No proposal will be considered unless submitted on such form, and the bid price shall be expressed in both writing and figures, and enclosed in a sealed envelope marked "Proposal for Incinerator" addressed to the Commissioner of Public Finances of the City of New Orleans.

Bidders must have paid their City License in order that their bids may be accepted.

The successful bidder must enter into contract at his expense before the City Notary.

Copies of the plans and specifications now on file, as well as proposal blank forms, may be had at the office of the City Engineer upon the deposit of $50.00, which amount will be refunded if the plans and specifications are returned in good condition within ten (10) days after the opening of bids.

The City reserves the right to reject any and all bids.

R. M. MURPHY,
Commissioner of Public Finances.
City Hall, New Orleans, La.

---

Bids: Jan. 9.

## Paving

Elmhurst, Ill.

The City of Elmhurst, Illinois, will open bids on January 9, 1922, for the construction of Bituminous Macadam Pavement with concrete curb and gutter, necessary grading and sewer work.

The estimated cost of the work is $115,000, and the quantities approximately as follows:

21,000 lineal feet of concrete curb and gutter.
55 catch basins adjusted.
12 new brick catch basins.
35 manholes adjusted.
6,000 square feet of concrete sidewalk.
16,000 cubic yards of grading.
25,000 square yards of bituminous macadam pavement.

Plans, specifications and bidding blanks can be obtained at the office of the Engineer. EDWIN HANCOCK,
Engineer.
2047 Ogden Ave., Chicago, Illinois.

---

Bids: Jan. 3

## Portland Cement

Richmond, Va.

Sealed proposals will be received at this office until 12 o'clock Noon, January 3, 1922, for the furnishing and of prompt delivery to any part of the City—40,000 barrels of Portland Cement; to be let in two separate items as follows:

20,000 barrels for sewers.
20,000 barrels for paving.

Contract terminating January 1, 1923.

Forms of proposals can be obtained on application.

A certified check for amount stated ($1,000.00) on proposals must accompany each bid as a guaranty of execution of contract. The Director of Public Works reserves the right to reject any and all bids. ALLEN J. SAVILLE,
Director of Public Works.

## OFFICIAL PROPOSALS

Bids: Jan. 7

### Hudson River Vehicular Tunnel

—CONTRACTS NOS. 3 AND 4—NEW YORK STATE BRIDGE AND TUNNEL COMMISSION AND NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION.

New York, N. Y.

As set forth in the [illegible] to Contractors, sealed proposals for the construction of the Vehicular Tunnel under the Hudson River from Canal Street, New York City, to 12th Street, Jersey City, will be received at the offices of the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission, Room 617, Hall of Records, Borough of Manhattan, New York City, until the seventh day of [illegible] at 2:00 o'clock p.m., Eastern Standard Time, at which time or at a later date the proposals will be publicly opened.

Contract No. 3 is for the construction of two cast-iron tunnels between the Canal Street and Spring Street shafts, New York City, and a point about six hundred (600) feet west of the New York pierhead line, and sinking a shaft caisson near the New York pierhead line.

Contract No. 4 is for the construction of two cast-iron tunnels between a point one thousand (1,000) feet west of the river bulkhead near the line of 12th Street, Jersey City, and a point about six hundred (600) feet west of the New York pierhead line, and sinking four caissons—two inside the bulkhead line and two near the pierhead line.

Proposals must be in the form and on the blanks prescribed by the Commissions and must be accompanied in the case of Contract No. 3 by two certified checks for One Hundred Twenty-Five Thousand Dollars ($125,000) each and two consent bonds for One Million Dollars ($1,000,000) each, and in the case of Contract No. 4 by two certified checks for One Hundred Fifty Thousand Dollars ($150,000) each and two consent bonds for One Million Dollars ($1,000,000) each.

The tunnels will be driven under compressed air by the shield method, and the shafts are to be sunk as caissons under compressed air. The contract time is thirty-six (36) months.

Attention is called to the form prescribed by the Commissions for bidders on the two contracts in that they are invited to bid under either or both of two forms in each contract. In Form "A" the bidder is to state his price for the work proposed without dependence upon the award of the other contract. In Form "B," the bidder is to state his price for the work proposed in case he should also be awarded the other contract. The proposal in Form "B," in order to be valid, must be made in the proposals for both contracts.

Plans, form of proposal, contract and specifications may be obtained by prospective bidders from C. M. Holland, Chief Engineer, [illegible] New York City. A payment of Five Dollars ($5.00) for each contract will be required.

The Commissions reserve the right to reject any and all bids.

[illegible] ADAMS
[illegible]
and Tunnel Commission.

GEORGE R. DYER,
[illegible]
Chairman.

SWART SERVICE
REALLY SERVES
Harmon V. Swart

## OFFICIAL PROPOSALS

Bids: Jan. 16.

### Reinforced Concrete Bridge

Norristown, Pa.

Sealed proposals will be received by the Controller of Montgomery County, at the Court House, Norristown, Pa., up until 11 o'clock a.m., January 16, 1922, at which time they will be publicly opened, for the furnishing of all materials, labor, tools and machinery necessary for the building of a three-span reinforced concrete bridge, over the Schuylkill River between Royersford and Spring City in Montgomery and Chester Counties, Pa., in accordance with plans and specifications now on file at the office of the Clerk of the County Commissioners of Montgomery and Chester Counties.

Prospective bidders may obtain plans and specifications by depositing $10.00 with the Clerk of the County Commisioners at Norristown, Pa.

Each bidder must use the form of proposal attached to and forming a part of the specifications.

A certified check for $5,000.00 must be deposited with the Clerk of the County Commissioners of Montgomery County, one hour before the time set for the opening of the bids, as a guarantee of good faith and to protect the counties from any loss by failure to comply with the terms of the proposal.

The right is reserved to reject any or all bids.

HORACE W. SMEDLEY,
Controller
of Montgomery County.
GEORGE S. DEWEES,
Controller
of Chester County.

Bids: Jan. 3.

### Highway Work

Gastonia, N. C.

The Gaston County Commissioners will receive bids up to Tuesday, Jan. 3rd for the construction of 8 miles of hard surface highway consisting of 56,000 square yards of [illegible] work, will consist of reconstructing an old macadam road and the construction of a wearing surface of either the three course Asphaltic Concrete (Topeka Mesa Asphaltic Macadam (Penetration) or binder course 1-1½. Each bid must be accompanied with a certified check equal to 5% of amount bid, sealed and addressed to County Commissioners, Gaston County and marked Proposal to construct Dallas Road. Surety Bond to the amount of 50% of the contract will be required. Plans and Specification may be obtained from the Highway Engineer, Gaston County, Gastonia, N. C., upon payment of $2.00.

D. L. STRETTIGERS,
Highway Engineer.

## U. S. GOVERNMENT

PROPOSALS ARE INVITED FOR COMPLETION [illegible] Building, Quartermaster, Frankford Arsenal, Philadelphia, Pa.—Sealed proposals will be received here until 2 p.m., February 8, 1922, and then opened, for the Completion of Power Plant, including installation of equipment. Plans and specifications will be furnished upon receipt of a deposit of Ten Dollars ($10.00).

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., Dec. 21, 1921.—Sealed proposals will be opened in this office at 3 p.m., Jan. 18, 1922, for construction (except mechanical equipment) of seven buildings, for the United States Public Health Service Hospital, at Augusta, Ga. Drawings and specifications may be obtained at this office in the discretion of the Supervising Architect. JAS. A. WETMORE, Acting Supervising Architect.

## U. S. GOVERNMENT

U. S. ENGINEER OFFICE, MOBILE, ALA., Dec. 12, 1921. Sealed proposals will be received here until 11 o'clock A. M., January 20, 1922, and then opened for dredge pontoon catamarans with discharge pipe for the U. S. 20-inch hydraulic dredge Wahalak. Further information on application.

U. S. ENGINEER OFFICE, JACKSONVILLE, FLA.—Sealed proposals will be received here until 12 M., Jan. 12, 1922, and then opened for dredging and rock removal in Sarasota Bay, Fla. Information on application.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., December 15, 1921. SEALED PROPOSALS will be opened in this office at 3 p. m., January 12, 1922, for new hot water piping, etc., in the United States Mint, Philadelphia, Pa., in accordance with specification and drawing, copies of which may be had at this office or at the office of the Custodian, Philadelphia, Pa., in the discretion of the Supervising Architect, Jas. A. Wetmore, Acting Supervising Architect.

U. S. ENGINEER OFFICE, 815 Witherspoon Bldg., Philadelphia, Pa. Bids are wanted until January 19, 1922, for dredging in Delaware River in front of Camden, N. J. Further information on application.

SEALED PROPOSALS, indorsed "Proposals for Post Exchange and Dispensary, San Diego, Calif., Special No. 4527," will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 11 o'clock a.m., Jan. 18, 1922, and then and there publicly opened, for post exchange and dispensary buildings, which will be supported by concrete piles furnished in place by the Government and will have reinforced concrete frames and reinforced concrete and tile floors; composition and tile flooring; tile and asphalt and gravel roofing; plastered, hollow-tile walls and partitions; plastered steel-stud partitions; wood doors and sash; and complete heating, plumbing and lighting systems, all at the Naval Base, Marine Corps Base), San Diego, Calif. Drawings and Specification No. 4527 may be obtained on application to the Bureau or to the Commandant, Eleventh Naval District, Naval Base, San Diego, Calif. Deposit of a check or postal money order for $30, payable to the Chief of the Bureau of Yards and Docks, is required as security for the safe return of the drawings and specification. W. Parks, Chief of Bureau. November 30, 1921.

Many contractors depend entirely upon the
OFFICIAL PROPOSAL COLUMNS
of
Engineering News-Record
for Opportunities to bid.

They might not see your announcements if printed elsewhere.

You undoubtedly want their bids on your contracts. Make sure of them on your next contract.

The cost is only 40 cents a line per issue.

0309

CONTRACT BONDS FOR RESPONSIBLE CONTRACTORS
[illegible] your special facilities for completing the contract
ÆTNA CASUALTY AND SURETY COMPANY
HARTFORD, CONN.
AGENTS EVERYWHERE

ENGINEERING NEWS-RECORD

# Think "SEARCHLIGHT" First

## ADVERTISING RATES

**POSITIONS VACANT**—Business Opportunities and other undisplayed ads 5 cents a word, minimum $2.00 an insertion.

**POSITIONS WANTED**—Evening work wanted, tutoring and other undisplayed ads of individuals looking for employment, 4 cents a word, minimum 75 cents, payable in advance.

**ADD 5 WORDS** for box number in undisplayed ads if replies are to any of our offices. There is no extra charge for forwarding replies.

**DISCOUNT OF 10%** if one payment is made in advance for 4 consecutive insertions of undisplayed ad.

**ADS IN DISPLAY TYPE**—Space is sold by the inch (30 in. to a page) the price depending upon total space used within a year, some space to be used each issue.

**RATE PER INCH** for ads in display space: 1 to 3 in., $5.00 an in. 15 to 49 in., $4.40 an in. 4 to 7 in., $4.80 an in. 50 to 99 in., $4.40 an in. 8 to 14 in., $4.70 an in. 100 to 199 in., $4.30 an in.

# EMPLOYMENT

POSITIONS VACANT

POSITIONS WANTED

## POSITIONS VACANT

CORRESPONDENCE desired with state road superintendents, foremen for quarry, grade, concrete and asphalt. Also steam roller engineers, steam shovel engineers, and stone crusher operators. Many positions open every spring. New York State Road Builders' Association, Room 604, Journal Building, Albany, N. Y.

INSTRUCTOR, graduate, mechanical engineer preferred, with good training in mechanics and mathematics, to teach hydraulics, mechanics of materials and laboratory. To begin February 1. State experience and salary desired. F. P. McKibben, Schenectady, N. Y.

MACHINERY salesman with thorough acquaintanceship in the trade in New York City and vicinity for position as manager of heavy machinery branch house. Only men of highest grade, technically trained, considered. P-539, Eng. News-Record.

STRUCTURAL steel and reinforced concrete detailers and designers. Give experience in detail, age, nationality, married or single, and how soon can report. Apply Southern Engineering Company, Charlotte, N. C.

STRUCTURAL steel detailers and checkers wanted for office and mill buildings, schools and stores. Location Southwest. Give full information first letter, including experience in detail, salary expected. Also nationality and state when could report. Experienced men only considered. All replies confidential. P-555, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

WANTED: civil engineer and superintendent of Streets, in New England town of 30,000. State age, education, experience, references and salary expected. P-568, Eng. News-Record.

## EMPLOYMENT SERVICE

EXECUTIVES qualified for salaries of $2,500 to $25,000 and upward, are invited to communicate confidentially with the undersigned, who will conduct preliminary negotiations for such positions. A procedure is used which places you in the position of being approached, avoids jeopardizing present connections, and conforms to the most exacting personal and ethical requirements. Of particular advantage as a test of conditions, to determine the advisability of changing. Details mailed confidentially on receipt of name and address only, without obligating or committing you in any way. Established 1310. R. W. Bixby, Inc., 304 Lockwood Building, Buffalo, New York

## EMPLOYMENT AGENCIES

EXECUTIVES. Confidential negotiations conducted with tact and dignity for professional positions. Engineering and administrative executives are courteously invited to send name and address only for literature describing my direct, successful method. Charles Clark P. O. Box 141, Newark, N. J.

**EXECUTIVES**

seeking positions find our confidential service extremely helpful. Let our Mr. H. H. Harrison personally negotiate for you with the particular employers in the industry you desire. Established 1909. Inquiries invited.

THE NATIONAL BUSINESS BOURSE
Confidential Negotiations
Association Building—Chicago

## POSITIONS WANTED

### Civil Engineers

CIVIL engineer, graduate, six years' railroad and highway experience, available. PW-557, Eng. News-Record, Chicago, Ill.

CIVIL engineer, graduate, 30, two years surveying and drafting; three years in charge of railway location and construction; two years exporting to Latin America. Expert Spanish correspondent. Executive ability. Desires permanent position. PW-561, Eng. News-Record.

### Surveyors

YOUNG engineer, four years' varied experience, college man, wants job on hydro-electric preliminary survey with opportunity of seeing the job through from start to finish. Position, salary and location immaterial. PW-502, Eng. News-Record.

### Draftsmen and Designers

DRAFTSMAN with ten years steel detailing experience, buildings, conveyors; desires position New York City, commuting distance. PW-552, Eng. News-Record.

**PRATT INSTITUTE**
**BROOKLYN, N.Y.**

EVENING COURSES IN

STRENGTH OF MATERIALS
STRUCTURAL DRAFTING
STRESSES IN STRUCTURES
STRUCTURAL DESIGN
GRAPHICS

Information on request or call at Pratt Institute, Grand Ave. Entrance between DeKalb and Willoughby Ave's., Monday, Tuesday or Thursday Evenings after Jan. 2.

**Higher ENGINEERING (By Mail)**

High grade courses prepared especially for the young engineer who needs experience, and for older men who need to brush up.

Reinforced Concrete Engineering
Structural Steel Designing and Estimating
Concrete Drafting and Estimating
BRIDGE ENGINEERING

If you are in need of help in the above subjects, send for our printed literature. It contains information not only about the courses, but also about the author. A lifetime of practical experience is embodied in these courses.

*Educational requirements: technical education, high school mathematics or their equivalent*

WRITE TODAY

**WILSON ENGINEERING CORPORATION**
10 Broadway, Hanover, Mass.

**Construction Men**

*Learn "Line" and "Grade" by Actual Practice.*

Level, Transit and Plane Table Work. "Running" of Farm, Stadia, Highway and Railroad Surveys.

*Estimating*

*Day and evening courses. Booklet.*

**The Pan-American Engineering Society**
39 West 17th St., New York City

## POSITIONS WANTED

STRUCTURAL designer, detailer, 11 years' [illegible] bridges, industrial plant layout. Coal handling a specialty. PW-520, Eng. News-Record.

### Superintendents

CONSTRUCTION superintendent wishes position, 20 years' experience sewers, water works, foundations, reinforced concrete, industrial plant construction, who has had [illegible] of concrete road and highway bridge construction, wants to get in that line with a first [illegible] to be judged by my ability to make good. Job must be year around proposition. Seven years present location. East preferred, New York or Philadelphia. Interview. Available Jan. 1. PW-437, Eng. News-Record.

AGGRESSIVE, competent, practical general superintendent of construction; 20 years' practical experience on all types of buildings, with largest and best contractors; A-1 references; good organizer; salary $6,000. PW-497, Eng. News-Record.

CONSTRUCTION superintendent with ability to handle any part of the building business, wants to connect with either owner or builder. Can arrange to go anywhere. PW-553 Eng. News-Record.

SUPERINTENDENT or Construction Engineer, experienced all branches construction; efficient organizer, accustomed to handling large work, desires responsible position. Reasonable salary, location immaterial. Phone Bensonhurst 5311-W. C. O. Sutherland, 42 Bay 22nd St., Brooklyn, N. Y.

SUPERINTENDENT or carpenter foreman; 20 years' experience on steel and reinforced concrete construction; good organizer; can get results. PW-566, Eng. News-Record.

### Miscellaneous

ARCHITECT, graduate of an Eastern university, 6 years' professional experience, seeks opening with engineering or construction concern. PW-565, Eng. News-Record.

CARPENTER, foreman, 28, experienced in reinforced concrete buildings. Will locate anywhere. Available Jan. 1. A-1 references. P. O. Box 541, Johnstown, Pa.

ENGINEER, at present in charge of estimating and costs for well-known New York City contractor, open for engagement after January 1st, 1922. Have thorough knowledge of prices and market conditions in territory as far West as Chicago and South to Kentucky. Well [illegible] executive and in supervising building construction. PW-548 Eng. News-Record.

ENGINEER desires position with general contractor, estimating, superintending and purchasing. College man, eight [illegible] experience on construction of power plants, steel mills and industrial buildings. Specialized in reinforced concrete and structural steel. Location anywhere. PW-527, Eng. News-[illegible] Old Colony Bldg., Chicago, Ill.

**Sales Over $200,000**

[illegible]

## In Replying to "Blind" Ads

Be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
533 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
531 Rialto Bldg., San Francisco.

### Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents — send copies.

0195

## POSITIONS WANTED

ENGINEER, married, 30, good health, go anywhere. All kinds surveys, railroad location, electrification, valuation, construction, highway location and construction, bridges, etc. Best references cheerfully furnished. Available at once. P. O. Box 475, Spencer, W. Va.

ENGINEER and executive desires connection of scope. Only those requiring the services of a high grade executive considered. Fourteen years' experience in construction work, purchasing, expediting, time and cost keeping, estimating. Organizer and systematizer. PW-561, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

EXECUTIVE assitant, Assoc. Mem. A. S. C. E., six years' broad experience since graduation, last year and half as assistant superintendent of structural and reinforcing steel fabrication plant, desires position offering training in accounting and industrial practice. PW-509, Eng. News-Record, Old Colony Bdg., Chicago, Ill.

PACIFIC coast manager for an Eastern industrial roofing manufacturer with an established office in San Francisco, would be interested in representing one or two companies making non-competing building materials. Is an engineer. PW-515, Eng. News-Record, Leader-News Bldg., Cleveland, O.

RESIDENT construction engineer. Civil engineer graduate. Age 29. Six years' experience in field and office work on railroad, street railway and pavement construction, also valuations and tax reports. PW-533 Eng. News-Record.

STEAM shovel operator, non-union. PW-538, Eng. News-Record.

## EXTRA WORK WANTED

DESIGNING and estimating jobs wanted in reinforced concrete, sewerage and earthwork. W. C. Warren, C. E., 2530 Pennsylvania Ave., Baltimore, Md.

**RITE-SERVICE Employment Agency**

supplies at short notice

**Laborers and Skilled Help**

for all kinds of construction works anywhere.

**All Nationalities**

*The Rite Service At Your Service FREE OF CHARGE*

Phone CANAL 1909 7560
129 Mulberry St., N. Y. City

## EXTRA WORK WANTED

DESIGNING, detailing, drafting, surveys (land or water), map work, estimates and reports, by experienced graduate C. E. Write me. I will call in New York City. EWW-560, Eng. News-Record.

THOROUGHLY equipped organization of experienced engineers and draughtsmen for construction surveys, topographical work and estimates for engineers, architects and contractors. Accurate and prompt service, John M. Farley, 12 East 44th Street, New York City, N. Y.

FIRST class detailing, checking, designing structural steel. Moderate prices. No job considered too small. Write Room 306, 126 Maiden Lane, City.

## AGENTS AND SALESMEN

### Salesman Wanted

ONE who is calling on power plants in any part of Pennsylvania, New Jersey, Delaware, Maryland to sell on commission as side line high grade article that is needed and wanted by every power plant. AS-198 Eng. News Rec. Real Estate Trust Bldg. Phila., Pa.

### Sales Engineer or Representative

One who is calling on power plants in Boston, Mass., and vicinity, Buffalo, N. Y., and vicinity to sell on commission as side line high grade article that is needed and wanted by every power plant. AS-513 Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

## WANTED

### Double-Drum Hoist Wanted

Suitable for handling 3,000 lb. on single line at 100 ft. per minute, with gas engine, or for belt drive. Give price and make. Samuel Mills, 1111 N. 16th St., Escanaba, Mich. Also pile driver 25 ft. to 30 ft. leaders; 1,500 to 2,000 lb. hammer long sills.

### Interest in Structural Plant

Structural engineer with twenty years' experience wishes to buy part interest and become active in structural plant located in or near Chicago. Give full information in reply. W-510, Eng. News-Record.

### Steel Truss Bridges

40 to 300 ft. New and second hand. W-563, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

## BUSINESS OPPORTUNITIES

### High-Grade Building Engineer

And estimator wishes to invest with services in general contracting company in South or Southwest. Only firms of high standing considered. B.O.-556, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

### Partner Wanted

Active partner for long established engineering business in the state of Massachusetts. Must be a college graduate with 5,000 to 10,000 dollars capital. Detailed information on request. BO-[illegible] Eng. News-Record.

### AGENCIES WANTED

[illegible] Railroad and Water[illegible] Equipment and Supplies. Cars, Trucks, Shovels, Cranes, Truck Accessories, etc. St. Louis and Southwest territory. Twenty years' experience. Will appreciate [illegible] connected in St. Louis.

AS-551 Eng. News Record
1[illegible] Old Colony Bldg., St. Louis, Mo.

**The Erie Employment & Supply Co.**

8701 Union Ave., Cleveland, Ohio

[illegible] Canada and Commissaries operated for Railroads, Manufacturers, Contractors, Coal Mines, etc. We furnish laborers, teamsters and all classes of skilled help. Employment offices at Cleveland, O., Cincinnati, O., Toledo, O., Columbus, O., St. Louis, Mo., [illegible] Chicago, Ill., Danville, Ill., and Buffalo, N. Y.

# AT PUBLIC AUCTION

## By Order of DOULLUT & WILLIAMS SHIPBUILDING CO., INC.,

*Large quantities of*

**METAL and WOODWORKING MACHINERY, WATER TRANSPORTATION, RAILROAD and CONTRACTORS STOCK and EQUIPMENT, NEW MATERIAL, LUMBER, SUPPLIES, MISCELLANEOUS EQUIPMENT AND MATERIALS. 17 STEEL AND WOOD BUILDINGS.**

## VALUATION $2,250,000.00

FITZPATRICK-TILL AUCTION CO., Inc.
HARRY W. FITZPATRICK

SMITH & JAFFE
PHILIP SMITH, *Auctioneers*

## Sell by PUBLIC AUCTION Without Limit or Reserve.

**January 11th, 12th, 13th and 14th at 11 AM. each day.**

## At DOULLUT & WILLIAMS SHIPBUILDING CO., INC., SHIPYARD,

Ft. Downman Road on Industrial Canal, NEW ORLEANS, LA.

**9 New Steel Oil Barges, 2 Twenty Ton O & S Locomotive Cranes, 5 Portable Ship Cranes Complete, 3 Sullivan Air Compressors, 2000 cu. ft. cap., 4 Babcock & Wilcox, A & T 250-hp. Boilers, 2 Tug Boats, 100 and 500-hp. New Curtis Hydroplane.**

**16 Pile Drivers, complete with Lidgerwood, American and Lambert double cylinder, double drum Hoisting Engines and Boilers with Turn-Tables and Vulcan No. 1 and No. 2 Steam Hammers.**

**Metal and Woodworking Machinery,** radial drills, universal millers, sensitive drill presses, bolt threaders, and nut tappers, planers, turret and engine lathes, pipe machines up to 9 in., punches and shears, plate tables, steam hammers, grinders, countersinking machinery, bull riveters, band, swing and rip saws, jointers, saw filers and other woodworking machinery, 3 plate and angle furnaces.

3—**Motors** up to 40 hp., 3 phase, 60 cycle, 440 volts.
8—**Flat Cars,** standard gauge, 5 push cars.
2—**Steam and gas portable air compressors,** Westinghouse floating air compressor on barge.
**Hoisting Engines,** pumps, floating pile drivers, drop hammers.
**Overhead and Jib Cranes.**
**Steel Tower and Tanks** up to 50,000 gal.

**Lincoln Portable Welding Machines,** pneumatic air drills, air riveting, chipping and caulking hammers, air hose, dollies, riveting sets, air tool repair parts, 50 bending slabs, hydraulic jacks, 30 and 50 ton acetylene welding and cutting torches, Hauck burners, 50 chain hoists up to 6 ton cap., high speed drills, reamers, taps and countersinks, vises, blacksmith tools, forges, anvils, etc.

**OFFICE, HOSPITAL AND CAFETERIA FIXTURES AND EQUIPMENTS.** **QUANTITIES OF NEW AND USED LUMBER**
**500 TONS RIVETS, BOLTS, NUTS, STEEL, BRASS, COPPER AND OTHER METALS**

**Ship Chandlery:**
Ladders, stanchions, grab rods, shackles, blocks, thimbles, sockets, caulking cotton, linoleum, mattresses, cable rope, floodlight, etc.
Enormous quantities pipe, pipe fittings, valves, hardware, electric, plumbing and steam fitting supplies, paints and oils.
Ten International Time Recorders, watchman's clocks, rivet guns, blue printing machine.

**Motor Cars:**
2—Winton Six 7 Passenger automobiles, Gramm-Bernstein 5-ton and Garford 1½ ton trucks.

## Buildings and Improvements will be sold Saturday, January 14th at 1 P.M.

**17 High Grade Steel, Brick and Wood Buildings to be sold for wrecking. 100 tons, 60 lb. rail, electric wire and telegraph poles, water and air piping, fire hose, fire extinguishers and other land improvements.**

**All water and rail facilities for shipping.**

**Street car marked "Villere" to Jitney bus direct to shipyard**

## Shipyard Open for Inspection commencing Thursday, January 5th, continuing daily to time of sale.

*For catalogues and further particulars write or wire to*

FITZPATRICK-TILL AUCTION CO., Inc.
225 Royal St., New Orleans, La.

SMITH & JAFFE
68 West 45th St., New York City, N. Y.

DOULLUT & WILLIAMS SHIPBUILDING CO., Inc
New Orleans, La.

---

### OFFICE SPACE TO RENT

**Madison Square District**

Offices, $600 to $1,350, best light in town, 170 Fifth Avenue, corner 22nd Street, Twelfth Floor. See superintendent or Charles G. Edwards Company, 321 Broadway, Worth 520.

### FOR SALE

**Ford Dump Trucks**

Six (6) one-ton Ford steel body dumping trucks; only run 50 miles, cost $[illegible] each; will sell for $535 each. Trucks in good condition. Michael Barbet, Box 622, Connellsville, Pa.

**For Sale By Owner**

12-Ton Buffalo-Pitts Roller 3 wheel, just refined and tested, double cylinder, first-class condition. Road Grader, Tar Tank wagons, Mixers, Road forms, Pipe, tools, etc., location New York State. FS-546 Eng. News-Record.

### FOREIGN BUSINESS

**Engineer Sailing**

for England, France, Germany and Austria desires to represent American firms, handling building and architectural material. Will also act as buyer for importers. FE-562, Eng. News-Record

### MISCELLANEOUS

**Excavating and Trenching**

Two No. 4 Keystone, 1 Model B Erie and 1 Austin trenching machine. Will take contract or rent. Washburne Engineering Co., Locust Valley, L. I.

---

### KING & KING

**Attorneys-at-Law**
**728 17th Str., Washington, D. C.**

Attention specially given to matters relating to the rights of Government Contractors before the Executive Departments and the Court of Claims.

---

### Second-Hand Transits and Levels

Guaranteed in Good Order and Adjustment

Write for New Bargain List

**WILLIAMS, BROWN & EARLE, INC.**
**918 Chestnut St., Philadelphia, Pa.**

---

NEW AND USED SURVEYING INSTRUMENTS AT FACTORY PRICES

Satisfaction guaranteed or money refunded. Write for complete list and catalogue of our high grade instruments and supplies for civil engineers, surveyors, mining, builders, contractors, etc.; 10 years' experience in repairing instruments of all makes at reasonable prices. Prompt service

**WISSLER INSTRUMENT CO.**
607 N. Broadway, St. Louis, Mo.

---

FOR RENT

### No. 0 Austin Trencher

**W. G. FRITZ CO., Inc.**
West Orange, New Jersey

---

### EXCAVATION

Steam Shovels for rent with crews or work taken by contract.

Dinkeys and cars or teams furnished.

**H. C. AMBLER**
3717 Old York Road Philadelphia, Pa.

---

FOR RENT

### Keystone Excavators

**For Ditching or Grading—**
**With Crew.**

**F. D. LEFFINGWELL**
Montclair N. J

---

# STORAGE

YARD FOR
CONTRACTORS' EQUIPMENT

**Industrial Service Co., Lincoln, N.J.**

---

### Trenching Work Wanted

For one No. 0 Vulcan gasoline driven, for ditches 22 in. to 14 in. wide, maximum depth 18 ft., and one 1921 Model Austin, all caterpillar, gasoline driven, for ditches 20 in. to 20 in. wide, maximum depth 8 ft. Machines now at Jersey City, N. J.

**S. L. ALLISON**
1503 Hudson Terminal Bldg New York

---

*For Every Business Want: "Think* SEARCHLIGHT *First"*

## Used Contractors' Equipment

WANTED

4—A frame derrick car fittings, 10 x 10 boom, 12 x 12 mast, capacity not less than 6,000 lb., length of boom 30 ft., clam shell and regular hoisting operation.

2—Double drum hoist engines, cylinders, 8½ x 10 in., equipped with boiler, to be Ohio Standard.

2—Electric hoists, double drum with boom swinger, 55 hp., 3 phase, 60 cycle, 220 volt, A.C. motor, variable speed.

2—No. 3 S Dake swinging engines.

**E. H. LATHAM COMPANY**
60 East Broad St., Columbus, Ohio

---

WANTED
225—2½-in. x 9-ft.
## BOILER FLUES
**B. F. POPE**
325 Law Building, Baltimore, Md.

---

## CRUSHERS
1—No. 8-K Gates, almost new.
1—36 x 42 Allis Chalmers Jaw Crusher. Manganese fitted.
1—No. 3 Austin Portable plant, complete.

## CARS
20—1½ yd. Koppel 24 in. Gauge two way dump cars.
40—4 yd. Western two way 36 in. gauge dump cars. Rebuilt.
20—1½ yd. Western two way 24 in. gauge dump cars.

## LOCOMOTIVES
1—20 ton Porter Saddle Tank, with Ohio Boiler, 36 in. gauge.
1—13 ton Shay Geared, 36 in. gauge. Almost new.
1—60 ton 6 wheel Baldwin Switcher. 200 lb. pressure.

**Midwestern Company**
140 So. Dearborn St., Chicago, Ill.

---

Locomotive Cranes
Steam Shovels
Locomotives and Cars
*Priced to move quickly*
PHILIP T. KING
30 Church St. New York
Phone Cortlandt 2865

---

**Gasoline Locomotives**

[illegible]

READING ENGINEERING CO., INC.
[illegible]

---

*For Sale or Lease*
**HOISTS**
Compressors—Boilers—Mixers
Derricks—Cableways
*Send for our list on rebuilt machinery*
HOISTING ENGINE SALES COMPANY
[illegible]

---

## Immediate Delivery

1—Spar Mast Oregon Pine 64 ft long, 24 in base 20 in top.
2—Spar Booms Oregon Pine 55 ft. long 16 in centre 14 in ends
1—Spar Booms Oregon Pine 55 ft long, 16 in centre 14 in and 12 in ends
The above are completely ironed and in perfect condition, never been used.
1—25 kw Generator Elec Gasoline D.C. Generator No. 1924-38S 34.54 hp., Volts 115 to 230; speed 560 r.p.m.
1—Reliable-Heer Full Base Gasoline-Kerosene A.C. Generator, 55 hp. new.
1—Ludgerwood Elec D D Hoist, 22 hp., 220 Volts A.C. Current, new.
2—35 ft DeMyer Steel Scrapper Conveyors, Cap. 75 tons per hr. New 2268 ft. Baldwin No. 53 Spec. Sprocket Chain
24—25 Teeth Sprockets, 8—18 Teeth Sprockets 18—12 Teeth Sprockets; all for above chain.

*For full particulars write or apply to*

**Selma Mercantile Corporation**
15 Moore Street, N. Y. City

---

FOR SALE

| | |
|---|---|
| 1—13E Foote Paving Mixer.... | $600.00 |
| 2—Cleveland Caterpillar Tractors, each ..... | 850.00 |
| 2—Wheel Scrapers for tractor use, each ..... | 40.00 |
| 1—Portable Sand and Gravel Screen, complete with elevator, hoist and bins ..... | 1,000.00 |
| 1—¼ yd Hayward Orange-Peel Bucket ..... | 200.00 |

**H. W. FITZ GERALD**
611 Press Bldg., Binghamton, N. Y.

---

## Asphalt Plant Special

We have for sale one rebuilt No. 1 Merriman 2000 yd. One-Car Steam Melting Asphalt Plant. In fine condition, on which we can make good delivery.

Here's an opportunity to get a real plant quickly and at a right price. Better get in touch with us immediately.

**The East Iron & Machine Co.**
Lima, Ohio

---

## ELECTRIC HOIST

Thomas, standard Y-frame, double drum, gear driven, cone friction, equipped with 35 hp variable speed motor, 220 volt, D.C., compressor type control and Thomas automatic brakes.
Has seen very little service. Price $1,200.
**OVERLAND CONSTR. CO.**
39 So. LaSalle St. Chicago

---

## JAW CRUSHERS

**In Stock—Ready for Delivery**

1—8 in. x 14 in. **Buchanan.**
1—9 in. x 15 in. No. 4 portable, with elevator, **Champion.**
1—10 in. x 15 in. No. 4CF, portable, with elevator and screen, **Champion.**
1—10 in. x 18 in. with elevator, **Reliance.**
1—11 in. x 26 in. No. 5, **Champion.**

Also a large stock of Concrete Mixers, Air Compressors, Hoisting Engines, Pumps, Boilers, and other Contractors' Equipment

**L. F. Seyfert's Sons, Inc.**
437 N. 3d Street, Philadelphia, Pa.

---

# The Searchlight Advertising in This Paper

is read by men whose success depends upon thorough knowledge of means to an end—whether it be the securing of a good second-hand piece of apparatus at a moderate price, or an expert employee.

# The Best Proof

of this is the variety of this journal's Searchlight ads. Without a constant and appreciable *demand* for such machinery or services, by its readers, the market-place which these advertisements represent could not exist for any length of time.

Are *you* using the Searchlight Section?

0134

# "WE BUY—REBUILD—SELL—OR RENT"

***All the Equipment listed below is owned by us and may be inspected at one of our own warehouses.***

### CONCRETE MIXERS

60—Concrete Mixers, [illegible]

### PAVING MIXERS

5—10 E Paving Mixers, [illegible]
Chain Belt, with boom [illegible]
with chute, all [illegible]
with chute, gas [illegible]
2—1 Bag Rocking [illegible]

### CRANES

5—Byers Auto Cranes, [illegible]
traction wheels, with [illegible]
5/8-yd. clam-shell bucket
1—15-ton 5-wheel O. & S., [illegible]
1—20-ton 5-wheel Industrial, [illegible]

### HOISTS

9—[illegible] Hoists, with or without boilers. Sizes 10 x 12, 9 x 10, 8½ x 10, 7 x 10, 6½ x 10, 6 x 8 and 5 x 8. Can be equipped with holding drum for bucket work. Several partial Clydesdale Engines on Dual Service Hoist. All boilers.
2—Gasoline Hoists.

### CLAM SHELL BUCKETS

21—Clam-shell Buckets. Size ½, ¾, 1, 1½ or 2 yd. All [illegible]

### DERRICKS

11—Stiff-Leg Derricks. Live boy, 9 mast; with boom lengths from 30 to 75 ft.; mast legs and sill of [illegible] Handling ½, ¾ or 1-yd. [illegible]
2—All Steel Gin Derricks, mast 105 ft.; boom 90 ft., bucket operating.

### RAIL AND TRACK

5 miles 24-in. Gauge Portable track with steel ties, made [illegible] with switches.
1,000 ft. [illegible] Gauge Portable Track with steel ties, with two [illegible]

### LOCOMOTIVES

1—Vulcan, 9 x 14, 16-in. gauge, steam saddle tank.
2—Kessler 24-in. gauge steam, 6½ tons.

### STEAM SHOVELS

3—Type O Thew Steam Shovels, on traction wheels, with ¾-yd. dipper.
1—Bay State, 70 deg. on MCB standard gauge truck, with 2½-yd. dipper.
2—Keystone Excavators.

### ROAD ROLLER

1—10-ton 3-wheel Austin Gasoline Roller.

### TRENCHING MACHINE

1—Buckeye; wheel type; capacity [illegible] Size No. 3.

***We carry a complete line of Boilers, Compressors, Cars, Engines, Elevators, Hoppers, Steam Hammers, Rollers, Pumps, Spouting and Portable Track. Write or wire your requirements.***

## EQUIPMENT CORPORATION OF AMERICA

**PITTSBURGH**, 855 Empire Bldg.
*Phone, Smithfield 1502*

**CHICAGO**: 1455 Lumber Exch.
*Phone, Randolph 6586*

**PHILADELPHIA**: 655 Land Title Bldg.
*Phone, Spruce 5498*

# FOR SALE

## LOCOMOTIVE CRANES

1—15-20 ton Brownhoist; 8-wheel, M C B.; 40-ft. boom bucket operating drums

1—15 ton O. & S., 8-wheel M C B., 70 ft. boom, with 25 ft. removable section; double power driven drums, also crane-line attachments, equipped with outriggers.

1—15 ton Industrial; 40-ft. boom; bucket drums.

## OVERHEAD CRANES

2—30-ton, 50-ft. span, Monorail Traveling Cranes, 4 motors; 220 volt D.C. Westinghouse equipment

## STEAM SHOVELS

1—Marion, Model 31; 1-yd. dipper. Shop No. 3008

1—Marion, Model 28; ⅝-yd. dipper. Shop No. 3328

1—Marion Model 40, on railroad trucks; 1½-yd. dipper

## NEW TRACTION CRANES

Full Revolving Road Cranes; 7 ton capacity, with ¾-yd. bucket

## LOCOMOTIVE

American 6-wheel Switcher. Cylinders 18 x 24 in.; drivers 44 in.; wheel base 11 ft. 6 in., weight 60 tons.

## BOILERS

1—30 hp. locomotive type, portable boiler, with engine mounted on top.

1—50 hp. firebox, locomotive type; 100 lb pressure

## ASPHALT PLANT

1—Iroquois 800-yd. Road Asphalt Plant; complete.

## CRUSHER OUTFIT

1—Gates 18 K, Gates 60 in. x 20 ft. revolving screens, 42-in. bucket elevator; 80-ft. centers.

***We carry in stock concrete mixers, air compressors, road rollers, hoisting engines, buckets, pipes, cars and other equipment and machinery.***

## F. Mayer, 737 Monadnock Bldg., Chicago, Ill.

---

*SACRIFICED!!*

## Five 5-Ton Garford Trucks
## $1,200 Each

Equipped with Wood Automatic Hoists and Metal Dumper Bodies. All in good running order. These trucks were taken over by a bank and must be sold. Price quoted is less than 25% of cost. Terms can be arranged if secured.

**Fredk. Davis, 137 Broadway, New York City**
Representing the Owner
Phone Rector 9560

---

### FOR SALE—PAVERS

3—Stone [illegible]
[illegible]
No. 10 [illegible]
No. 15 [illegible]
No. 11 [illegible]
10 Ton Motorist Steam Road [illegible]
**THE T. J. LANE EQUIPMENT CO**
Springfield, O.

---

### No. 14 Koehring Paver

[illegible] steam operated
[illegible]

**HENRY LEVIS & CO.**
[illegible] Third [illegible] Philadelphia

---

Second-Hand

## MACHINERY

***Contractors' Equipment***

**Stacks, Tanks, Pipe, Etc.**

**What are your requirements?**

**Henry A. Hitner's Sons Co**
4501 Richmond St., Philadelphia, Pa.

---

### Picks and Pick Handles

7/8-lb. Railroad Picks.
36-in. Hickory Handles.
Below Market Prices.

**DEWEY SUPPLY CORPORATION**
18 W. 34th St., New York City

---

### ROAD BUILDERS' PLANT

FOR SALE

Road Rollers; Pavers; Shovels; Keystone Excavators; Locomotives, Track, Dump and Flat Cars, Hoists, Cranes, Graders, Finishers.

*All necessary Equipment for complete plant*

JOHN M. GREENE
130 Chestnut Street, Philadelphia, Pa.

---

FOR SALE

1—Hauck Detroit Type Wagon Loader, 6-hp. [illegible] Engine, S800.
1—Hauck Self Propelled Loader, SL800.
1—Hauck [illegible] 4 Horse Power Hoist C4.
1—¾-yd. Owen Clam Shell Bucket.

**GEORGE HAISS MFG. CO., Inc.**
140th St. and Rider Ave. to Canal Place, N. Y.

---

### STONE CRUSHER

1—Gyratory No. 6-F with fittings

**Holbrook, Cabot & Rollins Corp**
52 Vanderbilt Ave., New York, N. Y.

---

FOR SALE

### RAILROAD DITCHER

Standard [illegible] Ladder Boom, complete and full [illegible] Guaranteed [illegible] Approved

SOUTHERN IRON & EQUIPMENT CO.
[illegible]

# IMMEDIATE DELIVERY—BARGAIN PRICES—Wire, Write, Phone

## HOISTING ENGINES AND DERRICKS

[illegible] booms 35-[illegible] and [illegible] friction, with 30 hp., 220 v., D.C. motors.

1—[illegible] Drum Electric Hoists, cut-gear driven, [illegible] with 30 hp., 220 v., D.C. [illegible]

1[illegible] [illegible] 9 x [illegible] single drum.

## PLANT EQUIPMENT

1—Steel Log Carrier [illegible] with two steel masts 36 ft. long, and two 70-ft. steel booms; 4,000 ft. [illegible] each boom.

2—[illegible] low pressure, fuel oil burners.

1—[illegible] type, [illegible] pump.

15—Steel Frame Push Cars.

Lot 2, 3, 4 and 5-ton Triplex Chain Hoists.

Lot [illegible]

Lot [illegible]

Lot Pipe Fittings, Valves and Supplies.

[illegible] Heating Boiler System [illegible]

## ELECTRICAL EQUIPMENT

1—20 Panel Slate Switchboard [illegible] with A.C. and D.C. [illegible] switches, circuit breakers and [illegible] switches.

[illegible] Cutler Eq. 5 Story heights, 120 v., D.C., [illegible]

Lot Miscellaneous Testers, Ammeter Shunts, Voltmeters, etc.

## CONTRACTORS' EQUIPMENT

3—Barber-Greene Portable Belt Conveyors, with electric motors.

1—5-ton Industrial Loco. Crane.

1—45-ton 4-wheel Switching Engine with tender.

Lot Galvanized Wire Rope, ½-in. to 1½-in.

Lot Steel and Wood Blocks.

Steel Pipe, welded seams, with one loose [illegible] [illegible] 3 in. x 3 in. angles as follows: 6 pcs. 12 ft. dia. x 24 in. x 24 in. x 9 ft. long; 4 pcs. 15 ft. diam. x 24 in. x 24 in. x 14 ft. 7 in. to 19 ft. long; 21 pcs. 19 in. diam. x [illegible] in. x 16 ft. long; 6 pcs. 23 in. dia. x [illegible] in. x 7 ft. 9 in. long; 48 pcs. 24 in. diam. x [illegible] in. x 7 ft. 9 in. to 18 ft. 10 in. long.

## PNEUMATIC TOOLS

100—Boyer Chipping and Caulking Hammers.

77—Boyer Riveting Hammers, No. 60.

16—Boyer Riveting Hammers, No. 60.

8—Boyer Riveting Hammers, inverted handles, No. [illegible]

[illegible] Boyer Drilling Machines, No. 42.

1100—Caulking Tools and Chisels.

3000—Boyer Snap flush buttonhead and flat.

## 500 TONS RIVETS

Panhead, buttonhead, conehead and countersunk in sizes ⅝-in. to 1⅛-in. dia.

## STEEL AND LUMBER

1,200 tons of Lloyd's Inspected Ship Plates.

500,000 ft. of L. L. L. Pine and Fir, 8 x 8 to 12 x 12 in., 15 ft. to 45 ft. lengths.

## MACHINERY

1—Pond 42 in. x 30 ft. Triple-Geared Engine Lathe, arranged for motor drive.

1—Batsch Multiple Spindle Heavy-Duty Drill Press; 8 adjustable spindles and centre spindle.

3—Wood Working Machines; four-sided planer and moulder; 36-in. band saw; square-head jointer, 12-in.

## SHIP MACHINERY AND EQUIPMENT

6—Scotch Marine Boilers (knocked down).

2—Triple Expansion Engines, 2800 hp.

4—Condensers; 3,500 and 600 sq. ft. cooling surface.

Lot Forced Draft Fans, Anchor Windlasses with extra wildcats, Blake-Knowles Simplex Pumps, 33 Five-ton Cargo Booms, Steering Gears, Evaporators, Feed Water Heaters, Circulating and Air Pumps, Anchor Chains, Life Boats, Smoke Stacks, Ship Chandlery.

**STOCK LIST NO. 12 MAILED ON REQUEST**

MARYLAND WRECKING COMPANY, Carolina Shipyard, Wilmington, North Carolina



FOR SALE

**25 HOISTING ENGINES**
**33 AIR COMPRESSORS**
**20 CONCRETE MIXERS**
**100 MOTORS**
**20 DERRICKS**
**30 DUMP BUCKETS**
**3 CABLEWAY OUTFITS**
**100 PUMPS**
**3 LATHES**
**10 LOCO. BOILERS**
**10 UPRIGHT BOILERS**
**12 SWINGING ENGINES**
**40 AIR RECEIVERS**

**PIERCE FOUNDATION CORPORATION**
738 East 141st St., New York City
Phone: Melrose 7678



# HOISTING ENGINES

[illegible]—10 x 12 D.C. dbl. drum with swinging gear levers banked in quadrant No. 41[illegible]

Lidgerwood—[illegible] x 12 D.C. Dbl. drum No. 25[illegible]

Lidgerwood—[illegible] x 10 D.C. Dbl. drum No. 25[illegible]

Lidgerwood—8½ x 10 D.C. Dbl. drum No. 11[illegible]

Lidgerwood—8½ x 10 D.C. 3 drum No. 25671.

Lidgerwood—8½ x 10 D.C. Dbl. drum with swinging gear base to receive boiler No. [illegible]

Lidgerwood—9 x 10 D.C. Dbl. drum with swinging gear No. 10738.

Mead-Morrison—9 x 10 D.C. 3-drum.

Lidgerwood—7 x 10 D.C. Dbl. drum

Flory—[illegible] x 10 D.C. Dbl. drum.

Lidgerwood—6½ x 10 D.C. Dbl. drum

Mundy—5½ x 10 D.C. Dbl. drum.

All the above are skeleton type, without Boilers.

Lidgerwood—8½ x 10 D.C. Dbl. drum, boiler & swinging gear.

Lidgerwood—8¼ x 10 D.C. Dbl. drum, Boiler.

Mundy—8 x 12 D.C. Dbl. drum and boiler.

Lidgerwood—7¼ x 10 D.C. Dbl. drum and boiler and swinging gear.

Mundy—7½ x 10 D.C. Dbl. drum and boiler and swinger.

Mundy—6½ x 12 D.C. Dbl. drum and boiler.

Mead-Morrison swinging engines, & Dake. Single drum types Cableway and Haulage engines. Electric Hoists.

All located our yards Baltimore.

# DERRICKS

## STIFF LEG TYPE

5—Derrick Booms 60 ft. 14 x 14 Mast 50 ft. 14 x 14 Bull Wheel.

3—Derrick Booms 65 ft. 14 x 14, Mast [illegible] 14 x 14 Bull Wheel.

6—Derrick Booms 75 ft. 16 x 16, Mast [illegible] ft. 18 x 18 Bull Wheel.

## GUY DERRICKS

1—Derrick Boom 80 ft. 14 in. Round Mast 87 ft., Rd. 3 line.

1—Derrick Boom 60 ft. Round, Mast 70 ft., Rd. Bull Wheel.

1—Steel Derrick 80 ft., Boom 10 Ton.

1—Steel Derrick 70 ft., Boom 30 Ton.

Any of the above derricks we will furnish to handle Grab Buckets and equip with Bull Wheels. A number of Traveling Derricks on hand, send for complete list. Most of these are located in our yard.

***Send for complete list of equipment***

WIRE WRITE PHONE

MARYLAND EQUIPMENT & SUPPLY CO., Baltimore, Md.



## Locomotive Cranes
FOR SALE OR RENT

[illegible]

[illegible] N. Y.

MARVIN BRIGGS, Inc.



*BRAND NEW*

## MARION STEAM SHOVELS

MODEL 61 [illegible] YARD [illegible] TON
MODEL 70 [illegible] YARD [illegible] TON

*Immediately available.*

*For quick sale, and for cash, can offer the above at real bargain prices.*

W. R. WADDELL,
50 Church Street, New York



LOCOMOTIVE CRANES
FOR SALE OR RENT

[illegible] Boom; 50-ft. boom, double [illegible] Boom; 60-ft. boom, double [illegible]

GREY STEEL PRODUCTS COMPANY



FOR SALE OR CHARTER

## CLAM SHELL DREDGE

[illegible] complete equipment

GEORGE W. SUNDERLIN
1024 Main St., Bridgeport, Conn.

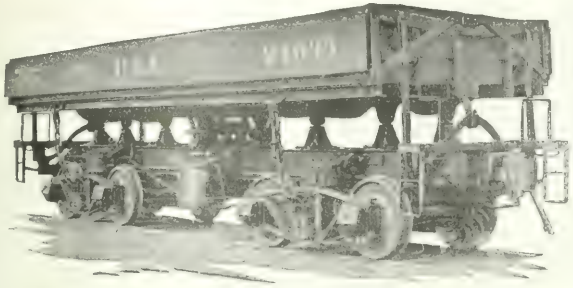


Buyers Everywhere know "Searchlight"

Try an ad for what you wish to sell.

0232

# FOR SALE OR FOR RENT



## 17 Western 20-Yd. All-Steel Air Dump Cars

### GENERAL DESCRIPTION

Gauge—Standard, 4 ft. 8½ in.
Capacity, level full—20 cu. yds.
Capacity, heaped full—26 cu. yds.
Bed dimensions—26 ft. x 9 ft. x 2 ft. 4 in.
Length of car, over all—31 ft.
Height of car, over all—8 ft. 3 in.
Air dumping arrangement—Vertical cylinder with side chains.
Capacity of trucks—80,000 lbs.
Weight, about 48,000 lbs.
M. C. B. construction throughout and U. S. Safety Appliance Standard.

***All cars slightly used, Guaranteed good as new.***

**Clapp, Norstrom & Riley Equipment Company**
**14 South Canal Street, Chicago**

---

# FOR SALE OR RENT

### STEAM SHOVELS

2—Ty[illegible] Erie, revolving; traction wheels, 8 ft. 3 inches.
1—70-ton Bucyrus; 2½-yd. dipper.
1—14-B Bucyrus, revolving; traction wheels; 3½-yd. dipper.
1—150-B Bucyrus Shovel, 2½ yd.
1—175-B Bucyrus Shovel, 2½ yd.
1—Little Giant, 1½ yd. dipper, on [illegible] trucks. Equipped [illegible] boom and dipper; also with [illegible] boom and dipper.

### BOX AND REFRIGERATOR CARS

20—60,000 lb. capacity B[illegible] cars, 40 ft. 7 in. long.
20—60,000 lb. capacity R[illegible] cars, 40 ft. long.

### LOCOMOTIVES

2—6-wheel Switcher, [illegible]
2—American Passenger; [illegible] gauge; 50 ton.
5—9 x 14 Dinkeys (3 [illegible], 2 [illegible] lb. Kelly.
2—10 x 15, 18 ton Porter, 36" [illegible]

### DRAGLINES

1—Class 7 Bucyrus, steam; caterpillars, 42-ft. boom, 1½d bucket.
1—Class 10 Bucyrus [illegible], 50 ft. boom, 2-yd. bucket.
1—[illegible] 40 ft. [illegible] boom; 2-yd. bucket.
1—Class 24 Bucyrus, [illegible] and rollers, 100 ft. [illegible]
1—[illegible] 40 ft. [illegible] and rollers, 100 ft. boom, 2½ yd. bucket.
1—Model [illegible] Marion, [illegible] 100 ft. boom, 1½ yd. bucket.
2—Michigan 1-T Walker, gasoline, 40 ft. boom, 1 yd. bucket.
1—Michigan A-L boom, [illegible] boom; 1-yd. bucket.
1—No. 2 Monighan, steam, [illegible], 60 ft. boom, 2-yd. bucket.
1—No. 2½ Monighan, [illegible], 80 ft. boom, 2½ yd. bucket.
1—No. 1 Monighan, [illegible], 100 ft. boom, 2½ yd. bucket.

### TRACTOR & TRAILERS

1—10 ton Holt Cat[illegible] Tractor.

**The above list is constantly changing. No matter what your machinery requirements are, write us—we may have it.**

**BECK & BABB, 29 So. La Salle Street, Chicago, Ill.**

---

**J. E. HAETTEN & CO., INC.**
**50 Church Street, New York**
Telephone Cortlandt 324

## CONTRACTORS' EQUIPMENT

2—10 ton Buffalo Pitts 3-wheel Rollers.
2—5-ton Buffalo-Pitts Rollers.
1—5 ton Erie Tandem Roller.
1—14-ft. Austin Paver, practically new.
2—21-E Austin Cube Pavers.
1—Smith Simplex Paving Mixer.
4—National Swinger D.D. D.C. Electric Hoist, 220 volt, 3 phase, 60 cycle, G. E. motors.
1—10 x 12 Flory Hoist, complete; 90% new.
1—½ yd. Thew Shovel.
1—150 hp. Fitzgibbons Heavy Duty Marine Type Boiler, 150 lb. steam.
1—Gravel Pit Equipment including revolving screen, hopper, bins, engine, boiler and belting.
1—½ yd. Clamshell Bucket, practically new.

*We also handle a full line of used and new contractors' equipment and machine tools. We solicit your inquiries.*

---

# FOR SALE OR RENT

Concrete Mixers, Lakewood Concrete Towers, Hoisting Engines, Derricks, Pumps, Gasoline Tractors, Steam Hammers, Buckets and Compressor outfits.

**Edward Ehrbar, Inc., 270 West St., New York City**

---

**FOR SALE**

1 Case 10-ton Road Roller.....$1500
1 Baker 10-ton Road Roller.....$1300
1 [illegible] Crusher.....$300
1 [illegible] Washer Crusher and Screening Plant.....$900

**THOMAS MITCHELL**
Turner Blk., Battle Creek, Michigan

---

**HOISTING ENGINES**

1 [illegible] Two-drum Skeleton, with boiler [illegible]
1 [illegible] x 14 Two-drum Skeleton, [illegible] above [illegible] x 14 Independent [illegible] with [illegible]
1—7½ x 12 Mc[illegible] [illegible] with attached [illegible]
1—7 x 10 Lakewood, [illegible]

**Great Lakes Equipment Company**
[illegible]

# FOR SALE OR RENT

## COMPRESSORS

66 ft. [illegible] Rand [illegible] type ERI belt driven [illegible]

150 ft. [illegible] type ERI belt driven [illegible]

210 ft. Chicago-Pneumatic, gasoline driven, on skids.

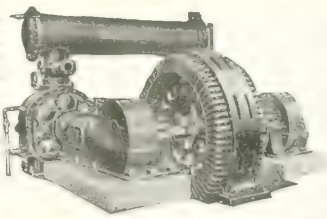
210 ft. Chicago-Pneumatic, gasoline driven, [illegible]

250 ft. Chicago-Pneumatic [illegible] steam driven.

2—500 ft. Ingersoll-Rand 12 x 10 x 12 x 10 ERI steam driven. Complete with fittings. Motor to suit.

700 ft. [illegible] Rand 17 x 12 ERI, [illegible] fittings. Motor to suit.

1—519 ft. Chicago-Pneumatic [illegible] belt driven [illegible]



## COMPRESSORS

1190 ft. Ingersoll-Rand, Imperial type X-3, heavy duty, steam driven, duplex air comp.

2—1485 ft. Ingersoll-Rand type X.B.2., with 250 hp., 220-440 v., 60 cy., 3 ph. motor, and all fittings.

2—1500 ft. Laidlaw-Dunn-Gordon latest type feather valve, belt driven Compressors. Motors to suit, complete with exciters, panels, switches, air receivers and all fittings.

850 ft. Laidlaw-Dunn-Gordon 17 x 10 x 14, complete with unloader and all fittings.

6—2674 ft. Ingersoll-Rand, class P.R.E.-2, direct connected to General Electric, 440 and 2300 volt, 60 cy., 3 ph. Synchronous Motors. Complete with exciters, panels, switches, air receivers and all fittings.

*Also Boilers, Buckets, Cranes, Cableways, Derricks, Hoists, Generators, etc.*

**ARCHER ARMSTRONG & COMPANY**

VANDERBILT 10408 — GRAND CENTRAL TERMINAL, NEW YORK CITY

## Electric Mine Pump

5-in. GOULD Three Stage Centrifugal Pump, [illegible] 150 foot head [illegible] to 300 feet, by 100 H.P. 2300 volt, 3 phase, 60 cycle Motor. Practically new, thoroughly overhauled and guaranteed.

**Three Hundred Other Pumps**

Send for our December list of the largest stock in the United States of slightly used or thoroughly overhauled MACHINE TOOLS, POWER, ELECTRICAL AND CONTRACTORS EQUIPMENT. Satisfaction Guaranteed or Money Refunded.

**WICKES MACHINERY CO.**
Jersey City, N. J.
**Established 1900.**

## For Sale—Pumping Engine

One horizontal triple expansion plunger and ring pattern Worthington 3,000,000 gallon pumping engine surface condenser in suction and attached air pump. 12 x 19 x 30 inch steam cylinders, 15 inch plungers, 24 inch stroke.

In splendid condition. Duty new 90,000,000 foot pounds. Steam pressure 120 pounds, water pressure 100 pounds, fire pressure 125 pounds.

Price f. o. b. cars $2,500.00. Delivery about March 1st, 1922. Location, Hanahan, S. C.

Full specifications on request to Commissioners of Public Works, No. 14 George Street, Charleston, S. C.

## Air Compressors

2—710 C.F.M. Class WJ3 Sullivan Angle-Compound Belt Driven Air Compressors. Practically good as new. Immediate shipment.

**A. McMILLAN**
628 Monadnock Block, CHICAGO, ILL.

**IMMEDIATE DELIVERY**

***Send us your inquiry, Steam Shovels***

[illegible]—75-hp. Single Drum Hoist, 25 cy. Hoist, [illegible]-hp. Double Drum Hoist, 60 cy. Hoist, [illegible] 5-6-7½ 9K and 18 K CRUSHERS, [illegible] 12 in. Gyrasphere, [illegible] 14 x 12, 10, Steam Hoist, drum, with bucket, [illegible] Locomotive Type Boiler, [illegible] Bucket, with [illegible] 15-ft. No. 18 GATES CRUSHER, REGULAR DRIVE, [illegible] 200 kw. and 150 kw. Turbo and Elec. Sets, [illegible] 50 hp. Steam Belt and Elec. Drive Comp's, [illegible] 10, 15 and 20-ton Locomotive Cranes, LARGE AMOUNT CONTRACTORS' EQUIP., TOWERS, ETC.

[illegible] *Contractors' Equip., Coal & Power Quick Dumps, etc.*

**ROSS POWER EQUIP. CO.**
[illegible], Ind.

**PUMPS**

1—No. 5 Pulsometer.
1—No. 3 Emerson Sinking Pump.
1—17 and 12 x 10 x 15 Worthington Duplex Fire Pump.
1—Duplex steam fire pump 7½ x 5 x 8.
2—3 in. Sucker Diaphragm Pumps on skids attached to gasoline engines.

**HOIST**

1—7 x 10 D.C., D.D. Ludgerwood with boiler.

**BOILERS**

1—H R T Boilers, 150 hp. butt strapped.
100—Boiler Tubes, 4 in. x 16 ft.

**AIR COMPRESSOR**

1—Westinghouse 9½ in.

**LATHES**

1—78 in. Putnam Wheel Lathe.
1—300 ton Niles Hydraulic Wheel Press.

**CULLEN-FRIESTEDT CO.**
1300-14 So. Kilbourn Ave., Chicago, Ill.

## Locomotive Type Boilers

1—[illegible] Ames on wheels complete with frame.
1—10 [illegible] Portable on skids, Hartford test.

**W. B. SPENCER**
[illegible] New York City
Telephone [illegible] 2941

## PORTABLE COMPRESSORS
**and PNEUMATIC TOOLS**
FOR SALE OR RENT
**Gasoline, Steam & Electric Compressors**

*Jackhammers, Rotary Hammers, Chipping Hammers and Concrete Breakers*

**JOHN H. KNIGHT**
118 E. Twenty-first Ave., New York City

**PUMP MOTOR DRIVEN**

8-in. Suction, 6-in. Discharge, Worthington Volute, 800 gallons at 65-ft. head, Direct Connected 25 HP., Westinghouse A. C. Motor, 220-440 Volts, Three, 60 Cycles, 1120 RPM, all on a cast iron base; $450. This set practically new. Second hand machines of all kinds.

**H. R. WILSON MACHINERY CO.**
St. Louis, Mo.

**AT A GREAT BARGAIN**

[illegible] Ingersoll-Rand Revolving Electric Locomotive, [illegible] Boiler, All Steel Dredging [illegible] Closed In [illegible] Shovel, [illegible] Pile [illegible] Steel Dump Cars, Wooden Cars.

**JAMES CARROLL**
[illegible] W. 42nd St., New York City

## COMPRESSORS

[illegible] 1—10 x 10 ERI 2 L R Electric, 1—1100 ft. I R [illegible] belt and beam, [illegible] 11 x 10 C E Corliss, 2 flange, belt, [illegible] Locomotive Cranes, belt and [illegible] locomotive dumps.

175 ft. NP-1 I. R.; steam.
[illegible] ERI-1 I. R., belt.
[illegible] Mine Set, IRT Ballast, 165 lb.

**A. LEE ELLIS**
[illegible] Bldg., Boston, Mass.

**Carbic and Milburn Lamps**

No. 2 and No. 3
New, In Original Cases.
Below Market Prices.

**DEWEY SUPPLY CORPORATION**
18 W. 34th St., New York City

[illegible] Ingersoll-Rand Type [illegible] Two Cyl. Duplex Horizontal [illegible] Receiver

**ENGINE**

[illegible] 15x16

**ALLEGANY LUMBER CO.**

CONTRACTOR'S PLANT

**FOR SALE OR RENT**

[illegible] Ingersoll-Rand mixer, pumps, [illegible] Ingersoll-Rand Air Lifts.

**E. GEORGE & CO., Inc.**
[illegible] Broadway, New York City

[illegible] 8 hp. D.C. Single Drum Hoist Boiler.
[illegible] 16 hp. D.C. D.D. Hoist Boiler.
[illegible] 7 x 10 D.C. D.D. Meade Morrison Boiler.
[illegible] 8 x 18 D.C. D.D. Marion Otis Mayo Boiler.
20—4-yd. Steel Draft Hoyt Western Cars.
[illegible] 50 hp. Locomotive Type Boiler on skids.

**Empire Engineering and Equipment Co.**
Empire Bldg., Pittsburgh, Pa.

# PIPE | PIPE | PIPE

**Have Ready for Immediate Shipment the Following New Pipe**

## STEEL

Two carloads ½ in. black pipe threaded and coupled.
One carload ¾ in. black pipe plain ends.
One carload 4 in. galv. pipe threaded and coupled.
One carload 5 in. black pipe threaded and coupled.
One carload 6 in. black pipe threaded and coupled.

## GENUINE WROUGHT IRON

One carload 3½ in. black pipe threaded and coupled.
Three carloads 3½ in. galv. pipe threaded and coupled.
One carload 6 in. galv. pipe threaded and coupled.
*Can offer same at prices far below the prevailing market.*

**Albert & Davidson, Inc., 256-264 Oakland St., Brooklyn, N.Y.**

## WROUGHT-PIPE

New, Second-hand and Mill Seconds

## BOILER TUBES

EAGLE PIPE & SUPPLY Co.
*General Offices-Woolworth Building*
NEW YORK CITY

## WROUGHT PIPE

### WITH PERFECT THREADS AND COUPLINGS

| BLACK | GALVANIZED | BLACK | GALVANIZED |
|---|---|---|---|
| 40,000 ft. 1" | 15,000 ft. 1" | 4,000 ft. 3½" | 1,000 ft. 3½" |
| 30,000 ft. 1¼" | 10,000 ft. 1¼" | 8,000 ft. 4" | 4,000 ft. 4" |
| 15,000 ft. 1½" | 9,000 ft. 1½" | 4,000 ft. 5" | 2,000 ft. 5" |
| 50,000 ft. 2" | 10,000 ft. 2" | 2,500 ft. 6" | 1,500 ft. NEW 12" |
| 20,000 ft. 2½" | 5,000 ft. 2½" | 2,000 ft. 8" | galv. spiral flanged |
| 15,000 ft. 3" | 15,000 ft. 3" | 2,500 ft. 10" | pipe. |

*For price apply:*

**MARINE METAL & SUPPLY CO., 167 South Street, New York City**

## PIPE

New, Untested, Black Steel Pipe for every industrial and manufacturing purpose—random or cut lengths. We have a large stock of first quality mill material.

*Immediate shipment*

**Davidson Pipe & Supply Co.**
861 Western Avenue, Pittsburgh, Pa.

## PIPE

### CAST IRON, B & S

20,000 ft. 4 in. Class "C"
50,000 ft. 6 in. Class "C"
50,000 ft. 8 in. Class "C"
3,000 ft. 10 in. Class "C"
3,000 ft. 12 in. Class "C"
500 ft. 14 in. Class "A"

### FITTINGS, B & S.

1,000 tons, all sizes.
Valves, all sizes.
Hydrants, Corey & Matthews.

### WROUGHT STEEL

25,000 ft. 3½ in.
15,000 ft. 4 in.
3,000 ft. 4½ in.
3,000 ft. 5 in.
2½ in. to 8 in. Blk. Steel
10, 12 and 16 in. O.D. Blk. Reading.

### FITTINGS, Cast and Malleable

Screwed and Flanged.
Std. Ex. Hvy. All Sizes.
Valves, Std. Ex. Hvy. Hydraulic.

*IMMEDIATE SHIPMENTS—Cast Iron Pipe, from Pennington, Va. Parlin & Mays Landing, N. J., and Chester, Pa.*

**CHARLES J. GRANT SUPPLY COMPANY, Boyertown Bldg., Phila., Pa.**

## GREENPOINT

## SECOND-HAND PIPE

All sizes—with new threads and couplings.
*Also cut to sketch*
**GREENPOINT IRON & PIPE CO., Inc.**
330 Graham Ave., Brooklyn, N. Y.

## PIPE

*Large Stocks, New and Second Hand.*
*Immediate Delivery*

**L. & D. Metal & Supply Co., Inc.**
1096 Flushing Avenue, Brooklyn, N. Y.

## PIPE

SECOND HAND AND NEW

**Large stock, all sizes.**
**Immediate Delivery**

**FRANK GRIFFITH**
412-21 Moyer St., Philadelphia, Pa.

## OIL LINE PIPE

***Offered at much less than market prices***

All or any part of 42 miles new, ten-inch, 41 lb., steel line pipe F. O. B. or F. A. S. New York. Inspected by Pittsburgh Testing Laboratories.

**F. B. LYNCH,**
Room 1200 2 West 45th St. N. Y. C.

## WROUGHT IRON AND STEEL PIPE

New and second hand. With new threads and couplings. All sizes from ⅛ to 12 in. Also cut to sketch.

**DAVIDSON PIPE & IRON CORP.**
436-40 Kent Ave., Brooklyn, N. Y.

## *Notice to Advertisers!*

Owing to the holiday—Monday, January 2nd—the "Searchlight" pages of the January 5th issue of Engineering News-Record will close for press earlier than usual. Copy should reach us as follows:

***For January 5th issue:***

**Display Ads**—Copy [illegible] by 5 P. M. Friday, December 30th
**Want Ads**—Copy [illegible] 10 A. M. Saturday, December 31st
**Proposal Ads**—Copy [illegible] 9:30 to 11 A. M., Tuesday, January 3rd

## PIPE

Large Stock All Sizes
New and Second Hand

**REPUBLIC PIPE & IRON CORP.**
1185-1223 Flushing Ave.
BROOKLYN, N. Y.

## PIPE SECOND HAND

With new threads and couplings; also cut to sketch.

**PFAFF & KENDALL**
Perry & Foundry Sts., Newark, N. J.

*For Pipe Buyers* — **Engineering News-Record's PIPE PAGE** — *For Pipe Sellers*

# CONTRACTORS' OVERHAULED EQUIPMENT

### PUMPS

1—18 in. Morris centrifugal pump connected direct to double vertical steam engine, 12 x 12 Corliss, 12,000 gals. 75 ft. head.
1—1 [illegible] pump [illegible] by friction clutch pulley, 24 in. dia., 14 in. face.
1—8 in. Worthington Turbine belt driven, pulley 34 in. diameter by 38 in. face.
1—3 in. Rumsey belt driven pulley 30 in. dia. by 22 in. face.
1—10 in. Morris Vertical belt driven.
1—7 in. Gardner 9 x 5½ x 10 force pump.
1—Worthington Duplex 6 x 4 x 6 force pump.
1—Knowles Duplex 11½ x 2¾ x 4 force pump.
1—Cameron force pump No. 7.

### CARS

20—12 yd. Western dump cars, standard gage.

### CHANNELLING MACHINES

2—Sullivan Y8 Channelling Machines.

### LOCOMOTIVES

1—10 x 16 18 ton Vulcan Dinkey, 36-in. gage.
2—10 x 16 18 ton H K Porter, Dinkey, 36 in. gage.

### ROCK DRILLS

3—Tripod rock drills steam or air operated.
1—Drill sharpener Sullivan.
1—Drill sharpener Leyner.

### BOILER

1—50 hp. Loco. type.

### STEAM SHOVEL

1—Model 20 Marion 1¼ yd. dipper.

### TRUCKS

3—4-wheeled House Moving Trucks.
2—Heavy Machinery Truck Wagons.

### COMPRESSORS

1—18 x 18¼ x 24 Ingersoll Sargent Steam Driven, 1,000 cu. ft. per min.
1—Sullivan 2 stage 20 x 12½ x 16 Belt Driven, 887 f.p.m.
1—12 x 12 x 16 Rand Duplex Steam Driven, cap. 500 f.p.m.
1—Westinghouse compound, 10½ in.
2—Westinghouse 9½ x 9½ x 10.

### BUCKETS (CONCRETE)

2—McMyer 1½ yd. Center Line Dump.
4—Lockwood 2½ yd. Bottom Line Dump.
2—Stephens 1½ yd. Controllable.
2—Stephens 2 yd. Controllable.
1—Stephens ¾ yd. Controllable.
2—Atlas 1½ yd. Bottom Dump.
4—Top dump circular coal Buckets 3½ ft. D x 3 ft.

### MISCELLANEOUS

1—Lidgerwood unloader 25 ton pull.

## UNITED STATES EQUIPMENT CO., 208 S. La Salle St., Chicago

## LOCOMOTIVE CRANES

3—20-ton, 8-wheel Browning, 50 ft. boom, double drums, A. S. M. E. boiler, M.C.B. trucks, outriggers, excellent condition.
2—15 ton, 8-wheel Industrial 40 ft. boom. Hook block A. S. M. E. Boiler.
1—15 ton Brownhoist, 8-wheel, 50-70 ft. boom.
1—7½-ton Browning Electric.
1—7½ ton Industrial

**HOISTING MACHINERY CO.**
50 Church St., New York

## LOCOMOTIVE CRANE

**15-ton, 8-wheel McMyer, Bucket Handling, Lap Joint Boiler**

**Mechanical Factory SUPPLIES**

**STEEL LOCKERS NEPONSET SHINGLES**

**National Aniline and Chemical Co.**
**21 Burling Slip, New York, N. Y.**

RENT OR SELL

## Locomotive Crane

30-ton Industrial [illegible] handle 100 ft. boom). Double Drum Bucket Handling, M.C.B., A.S.M.E. Boiler. Immediate delivery; ready now.

Also 20 ton MCB McMyler, 50 ft. boom, [illegible] wheels. Locomotives, hoisting engines, [illegible] etc.

**Contractors' Machinery & Supply Company**
[illegible]

## LOCOMOTIVE CRANE

[illegible]

**TITAN EQUIPMENT COMPANY**
[illegible]

# FOR SALE OR RENT

***Equipment owned by us sold under absolute guaranty subject to trial in service***

### STEAM SHOVELS

1—14-B Bucyrus Full Revolving Steam Shovel, mounted on [illegible] traction. Shop No. 2162, ¾ yd. dipper.
1—70-B Bucyrus Steel No. 1700 2½-yd. dipper.
1—70 Bucyrus, Shop No. 1202; 1¾ yd bucket.
1—50 Bucyrus, Shop No. 394, 2½-yd. dipper.

### DUMP CARS

17—[illegible] Standard Gauge Western All-Steel A Dump Cars, 50,000 lb. cap., vertical sides, [illegible] Practically new.
21—16-yd. Standard Gauge Western Air Dump Cars, steel underframe, I-A girder dr[illegible]
90—12 yd. Standard Gauge Western Air Dump Cars, steel underframe, 18-ft. beds, box [illegible]
1—Western 36-in gauge Spreader Car.

### LOCOMOTIVES

1—Standard gauge 11 x 20 cylinder 4-wheeled Vulcan saddle tank [illegible] Shop No. 1501 Built 1910. Weight [illegible] air brakes; 1-to lb. [illegible]
1—Standard gauge 18 x 24 45-ton 6-wheeled, sweeping Locomotive with [illegible] tender, weight 50 [illegible] on [illegible]
1—Standard gauge 10 x 16 cylinder 4-wheeled Porter saddle tank Locomotive, Shop No. 2506, wt. 17 tons. Air brakes, [illegible] couplers.
2—56 in. gauge, 12 x 18 cylinder Porter 6-wheel switchers, with [illegible] tender. Weight [illegible] on drivers, 48,000 lb., 9 ft. rigid wheel base, 180 lb. steam pressure, air brakes. Built in 1918, never used.
1—36-in. gauge 10 x 16 cylinder American 18 ton 4-wheel saddle tank Locomotive.
2—24-in. gauge, 7 x 12 in. cylinder, Baldwin 4 wheeled saddle tank Locomotives. Shop Nos. 31798 and 34820. Wt., 8 tons.

### DRAGLINE EXCAVATORS

1—No. 2 Monighan Steam Operated All-Steel Dragline; 60 ft. boom; 2 yd Page bucket, mounted on skids and rollers.
1—Class 14 Bucyrus dragline; 60 ft. boom, 2 yd. Page bucket; skids and rollers.
1—No. 1-A Monighan All-Steel Steam Operated Dragline, mounted on traction wheels, 40-ft. boom, 1-yd. bucket.

### MISCELLANEOUS

1—25-ton Industrial Locomotive Crane, No. 3261, new in 1918; 50-ft. boom with 20 ft. extension; M.C.B.
7—Dump Cars, 18 ft. long, 60,000 lb capacity.
1—Stiff leg Derrick, brand new, 60 ft. boom complete with all fittings and 14 ft. bull wheel, no cable. Bargain.
1—1 yd. Owen Clam-shell Bucket.
1—¾ yd. New Owen Clamshell Bucket.
Industrial Track 1800 ft. 36 in gauge track made up of 25 lb. rail in 15 ft. sections with 6 and 7 steel ties to section; curve included.
9—2-ton Kelly-Springfield Trucks, standard box bodies with removable sides. Practically new.
20—Sets Standard Chain Tug Harness, with collars, brand new.

**Clapp, Norstrom & Riley Equipment Co.**
**12 and 14 So. Canal St., Chicago**

# Equipment Bargains

### COMPRESSORS

210 cu. ft. Chicago Pneumatic [illegible]-driven.
160 cu. ft. Ingersoll-Rand [illegible] driven.
800 cu. ft. Ingersoll-Rand [illegible] driven.
111 cu. ft. Ingersoll-Rand portable gasoline driven.

### STEAM SHOVELS

[illegible] Erie Model [illegible]
18-B Bucyrus, Model [illegible] boiler.
70 Marion, Model [illegible] Traction.
No. 4 Keystone, Locomotive.

### MIXERS

[illegible] Koehring engine.
[illegible] Ransome [illegible] driven.
14-E Koehring [illegible] engine.
14-E Koehring Paver on traction wheels.

### HOISTS

6½ x 10 Lambert D.D.D.C. with boiler and [illegible]
9 x 10 Model Morrison D.D.D.C. skeleton, cableway.
8½ x 10 Lambert D.D.D.C. with boiler.
9 x 10 Model Morrison three drum skeleton.
40 HP. American D.D. Electric.
9½ x 12 Lambert 3 drum with boiler.
50 HP. American D.D. Electric, A.C. Motor.

### CRUSHERS

10 x 18 Reliance Gyrasoles.
14 x 30 Farrel [illegible] jaws.
No. 8 Gates gyratory.
No. 5 Austin Gyratory.

### CRANES

15 ton O. & S. Mast Boom.
15 ton Brown Hoist Mast Boiler.
Byers, wheel traction, with bucket.

*These are merely suggestions.*
*Send for our new list of Contractors and Quarry Equipment.*

**THE HUBBARD-FLOYD CO., Inc.**
MAIN OFFICE: Grand Central Palace, New York, N. Y. Vanderbilt 1465.
CHICAGO OFFICE: Old South Dearborn, Main 1253.

Immediate Shipment—Large Tonnage of

**Bridge Girders and I Beams**

Also STEEL RAILS—New and Relaying

M. K. FRANK
Frick Building, Pittsburgh, Pa.

---

FOR SALE—4—70 ft.

**TURNTABLE GIRDERS**

Will sell separate or combined for Turntable use.
Full information upon request.

WALSH CONSTRUCTION CO.
Shickshinny, Pa.

---

## Steel Sheet Piling

Lackawanna and United States in various lengths for immediate shipment.

**BROWN & SITES CO.**

Main Office:
30 Church St., New York City

---

**I BEAMS**

[illegible] of Steel, 12½ lb. Steel Beams, 15 ft. 9 [illegible]

[illegible] tons of 10-in. 25-lb., 14 to 16-ft. Beams.

**HOISTING ENGINE**

1 Two Drum Cop. Hoist, made by G. Harris Mfg. Co., N. Y. Cylinder 8x12, drums 21-in. dia. 14-in. face, 37-in. dia. flanges, 10 hp.; grab ½ ton.

**BOILERS**

1 Manning Vertical Boiler, 500 hp., will insure 125 lbs. [illegible] delivery.

1 H.R.T. Boiler, 72-in. dia. x 16 ft. 2 [illegible] 125-lb. [illegible]

72 [illegible] H.R.T. Boilers, 19 ft. 6 in. long, [illegible] lb. pressure.

1000 ft. 1 1/4-in. 6 x 19 C. S. Hauling Wire Cable. Also some 1 in. and 1¼ in. 6x19 Manila Cable.

**TANKS**

All sizes of Tanks, open and closed, suitable for storage of gasoline or oil, in stock at our Boston Yard.

**DRUMS**

200 [illegible] 110-gal

**The Perry, Buxton, Doane Company**
211 West First St., South Boston 27, Mass.

---

We specialize in

# STEEL SHEET PILING

GET OUR PRICES BEFORE YOU BUY OR SELL

**ZELNICKER IN ST. LOUIS**

Rails, Cars, Locomotives, Boiler Tanks, Pipe

---

# STEEL PILING

BOUGHT AND SOLD

**UNIVERSAL EQUIPMENT COMPANY**
Niagara Falls, N. Y.

---

1—TRENCH EXCAVATOR, Parsons, Model F (78 in.), steam, wheel traction, complete in working order, f.o.b., Wisconsin, $2600.

2—BACKFILLERS, Parsons, Model 10, one year old complete in working order, each $1600.

1—PAVING MIXER, Foote, 13-E, steam, 2 Bag Batch, chute, $850.

9—TRAILER WAGONS, Troy, 3½ yard, reversible, bottom dump, 8 in. steel wheels, $1900.

**H. Y. SMITH CO.**
Milwaukee, Wis.

---

FOR SALE

**Floating Pile Driver**

PRACTICALLY NEW
WONDERFUL BARGAIN
WRITE FOR PRICE, FULL PARTICULARS AND PHOTOGRAPH

**GEO. F. WALKER**
Box 18, Hampton, Virginia

---

## STEEL SHEET PILING

Immediate Shipment

175 pcs. 25 ft. Larsen 14 in. arched.
250 pcs. 30 ft. Larsen 14 in. arched.
First class driving condition

**MID CONTINENT EQUIPMENT AND MACHINERY CO.**
[illegible] Bldg. St. Louis, Mo.

---

FOR SALE

**Floating Pile Driver**
**Orange Peel Bucket**
**Rock Crusher**
**Miscellaneous Contractors Plant**

**JARRETT-CHAMBERS COMPANY**
30 East 42d St., New York

---

**TRENCHING MACHINES**

1 Parsons Model No. 10, steam; digs 20 ft. deep, [illegible]

1 Austin-Western No. 1, 15 h.p.; digs 20 ft. deep, up to 30 in. wide.

1—Austin No. 60, steam, digs 10 ft. deep, 24 to 30 in. wide.

1 Austin Backfiller, gasoline; 35 ft. boom.

**JAMES McELROY**
11 S. LaSalle St., Chicago

---

FOR SALE

**PARSONS' TRENCHING MACHINE**

For Immediate Delivery

**JOHN B. McLANE & COMPANY**
Newport, Kentucky

---

# RAILS

---

# RAILS

---

# RAILS

---

## RELAYING RAILS

of all weights. Write us for prices. Track material and equipment.

H. M. FOSTER COMPANY
Continental Bldg., Baltimore, Md.

---

## 60-lb. Relaying Rail

Two hundred tons with angle bars. First-class. Pennsylvania delivery other sections in stock.

E. H. WILSON & COMPANY
COMMERCIAL TRUST BUILDING
PHILADELPHIA

---

## RAILS and TRACK

**150 tons Relaying 60-lb. Rails**
**75 tons Relaying 75-lb. Rails**
**200 tons Relaying 80-lb. Rails**
**16-lb. 24 in. gauge Portable Track**

**HENRY LEVIS & CO.**
Commercial Trust Bldg., Philadelphia

---

## *Notice to Advertisers!*

Owing to the holiday—Monday, January 2nd—the "Searchlight" pages of the January 5th issue of **Engineering News-Record** will close for press earlier than usual. Copy should reach us as follows:

***For January 5th issue:***

**Display Ads**
Copy required by 5 P.M. Friday, December 30th

**Want Ads**
Copy required by 10 A.M., Saturday, December 31st

**Proposal Ads**
Copy received as usual up to 11 A.M., Tuesday, Jan. 3rd

---

## 56-LB. RAILS

1000 tons 56 lb Relayers with Angle Bars
Immediate shipment from stock

MERCHANTS STEEL & SUPPLY CO.
208 S. La Salle St., Chicago, Ill.

---

GET OUR STOCK LIST OF

## RAIL BARGAINS

**THE MORRISON & RISMAN CO.**
Buffalo Philadelphia
Pittsburgh New York

---

## RELAYING RAILS

15,000 tons 30 lb. to 100 lb. Sections with necessary Bars

**LURIA BROS. & CO., INC.**
OFFICES: Reading, Pa.; Lebanon, Pa.; New York, N. Y.; Pittsburgh, Pa.; Boston, Mass.
YARDS: Reading, Pa.; Duncannon, Pa.; Lebanon, Pa.; Pittsburgh, Pa.

---

BUYERS—Send me your inquiries

## STEEL TEE RAILS

LOCOMOTIVES
STEAM SHOVELS
CARS

Sell me your surplus

**E. C. SHERWOOD, 50 Church St., New York**

---

# YOUR RAIL if advertised here, will reach a field of over 30,000 readers including many big BUYERS

# EQUIPMENT BARGAINS
## At
# Old Hickory

**Machinery, of all kinds, from the World's greatest Powder Plant, now offered to American Industry at prices far below present cost.**

***Just a few of the offerings:***

41—823 hp. Stirling Boilers.
3—500 hp. Keeler Boilers.
27—350 hp. Corliss Engines.
1—3000 kw. Generators.
2—630 ft. Air Compressors.
2—2570 ft. Air Compressors.
10—14 in. 8,600 g.p.m. Pumps.
2—10 in. 3,750 g.p.m. Pumps.
4—14 in. 7,500 g.p.m. Pumps.
6—16 in. 8,500 g.p.m. Pumps.
6—14 in. 8,100 g.p.m. Pumps.
2 Underwriters Fire Pumps.
16—Hydraulic Pumps.
200—Boiler Feed Pumps.
200—Blowers.
2000—Steel Tanks, all sizes.
1—50 ft. 20 ton. R.R. Crane.
1—110 ft. Fixed Radius Crane.
1—2 6 0 Locomotive.
2000—Wood Tanks, all sizes.
35—Electric Locomotives.
5000—Narrow Gauge Cars.
500—Electric Motors.
11—Sulphuric Acid Plants.
5—Nitric Acid Plants.
Transmission Equipment.
Process Equipment.
Chemical Equipment.
Miscellaneous Equipment.
Etc. Etc. Etc.

***Write for Special Bulletins as follows:***

No. 7—Tanks, all kinds.
No. 8—General Equipment.
No. 10—Pumps.
No. 11—Blowers.
No. 12—Industrial Cars.
No. 14—Chemical Equipment.
No. 15—Transmission.
No. 16—Building Material.

**Nashville Industrial Corp.**
Jacksonville, Tenn.

**Contractors' Guaranteed**
# EQUIPMENT
***Immediate Shipment!!***

### LOCOMOTIVES

1 [illegible] 2 6 0 Mass. Type Standard-Gauge Locomotive [illegible] Diameter 24-in. [illegible] 140 lb. Mass. [illegible] Locomotive Works.

1 [illegible] S.W. 0-4-0 Standard Gauge Locomotive [illegible] 24-in. diameter [illegible] 200 lb. Pressure [illegible] 150 lb. Mass. [illegible] Locomotive Works.

[illegible] Locomotive [illegible] 24-in. [illegible] Standard Gauge [illegible] 4 [illegible] 9 [illegible] 11 [illegible] charging pressure 1200 lb. pressure at throttle 250 lb. tractive force 1450 lb. Complete with [illegible] headlight.

1 [illegible] Diesel Standard Gauge Locomotive; saddle tank, cylinders 10-in. diameter, 16-in. stroke, working steam pressure 110 lbs. [illegible] Manufactured by Rhode Island Locomotive Works.

### HOISTING ENGINES

1—9 x 12-in. Russel double cylinder, double drum Hoisting Engine, heavy duty type, with [illegible] boiler.

1—7½ x 10-in. double cylinder single geared drum Hoisting Engine, with reversing throttle valve.

1—9 x 12-in. double double cylinder, double [illegible] Hoisting Engine, with two [illegible] 14-in. diameter, 20-in. between [illegible] with fittings. (No Boiler). [illegible] for boiler.

### ELECTRIC TRAVELING CRANES

2—Brand New 10-ton Overhead Electric Traveling cranes, 31 ft. 9-in. span; 3 motor type, 440 volt, A. C. 60 cycle, 3 phase.

Brand new 5-ton Overhead Electric Traveling Crane, 35 ft. span; 2 motor type; 220 D. C.

### DUMP CARS

150—12 yd. Western & Other all steel, two-way Dump Cars, standard gauge.

50—1½-yd. 20-in gauge, wood body, two-way Dump Cars.

3—36-in. gauge, 8-wheel Flat Cars, 10,000-lb. cap., 7 ft. wide, 20 ft. long, wheels 24-in diameter.

### STEAM SHOVELS

6—95-ton Bucyrus Railroad Type, 5-yd. dipper; 50 per cent new.

10—70 ton Bucyrus Railroad Type, 2½ to 3-yd. dipper; 90 per cent new.

### BOILERS

3—150 hp. Triple Riveted Return Tubular Boilers, 66 in. diameter, 20 ft. long, 125-lb pressure.

2—125-hp. Triple Riveted Return Tubular Boilers, 66-in. diameter, 18 ft. long, 100 lb. pressure.

2—100-hp. Triple Riveted Return Tubular Boilers, 60-in. diameter, 16 ft. long, 100 lb. pressure.

1—60-hp. Locomotive Firebox Boiler, 48 in. diameter, 14 ft. 8 in. long overall; 100 lb. pressure.

[illegible] hp. Vertical Tubular Boiler; 85 lb. pressure.

1—25-hp. Vertical Tubular Boiler, 85 lb. pressure.

### AIR COMPRESSORS

1—1,500 ft. cap. Ohio W.B.2 Sullivan Steam-Driven Air Compressor, 100 lb. pressure.

1—[illegible] Ingersoll-Rand [illegible] Steam Driven Air Compressor, 100 lb. pressure.

1—[illegible] Imperial Type O Duplex Compound Steam Driven Air Compressor, 100 lb. pressure.

1—[illegible] Chicago Pneumatic Tool Co. No. S. 9-5, 600 cu. ft. capacity.

1—[illegible] Ingersoll-Rand [illegible] Type [illegible] Air Compressor, 555 cu. ft. 100 lb. pressure. Belt-driven.

### GENERATORS and MOTORS

[illegible] Westinghouse Type [illegible] 110 volt, 60 [illegible] speed 1145 r.p.m. [illegible] direct connected to [illegible] with 3-bearing [illegible] coupling.

1—[illegible] Type [illegible] 100 K.W. D.C. Generator.

1—100-kw. G. E. Rotary Converter, 25 cycle

1—30-hp. Northern 110-volt, D.C. Motor.

### CENTRIFUGAL PUMPS

[illegible] Type [illegible] Centrifugal Pump.

1—[illegible] Horizontal Centrifugal Pump.

1—12" Worthington Horizontal Centrifugal Pump.

1—24" Ingersoll-Rand Horizontal Centrifugal Pump.

**Our Free Bulletin No. 205 lists over 100 pages of Industrial Plant Equipment and General Supplies from our latest purchase.**

***Your copy is waiting! Ask for it now!***

**HARRIS BROTHERS CO.**
35th and Iron Sts., Chicago, Ill.

# READY FOR SERVICE
**RAILROAD—CONTRACTORS**

**INDUSTRIAL EQUIPMENT CARS**
Standard-Narrow Gauge
**COAL—FLAT—GONDOLA—DUMP—BOX**
All Capacities
**LOCOMOTIVES**
**ELECTRIC—STEAM—GASOLINE**
**LOCOMOTIVE CRANES**
**STEAM SHOVELS**
**THOMAS F. CAREY CO.**
120 Liberty Street, New York, N. Y.

# P. E. Francis & Co.
*Railroad and Industrial Equipment*
Marquette Bldg., Chicago, Illinois

**ASPHALT PLANTS**
**BOX CARS**
**FLAT CARS**
**GONDOLA CARS**

### FOR RENT AND SALE

[illegible] yd. robbit dump cars, std. gauge.
20 [illegible]-yd Westerns, like new, std. gauge.
50 [illegible]-ton flat and box cars.
1 Western standard gauge stradler.
1—Osgood 18 traveling hoist, traction wheel, No. 7-11, ¾ yd. bucket, used 8 months.
1 Marion 50 combination shovel and dragline, No. 1725, caterpillar traction 1½ yd. bucket, used 1 month, built March, 1921.
1—Marion 76 steam shovel, No. 3503, standard gauge.
1 P. & H. gasoline dragline and crane, caterpillar 10 ft. boom, ½ yd. bucket, new 1921.
1 Northwest gasoline dragline and crane, caterpillar 10 ft. boom, ½ yd. bucket, new 1921.
1 No. 2 Brownhoist four wheel, gasoline crane, std. ga., 10 ft. boom, ½ yd. bucket, new 1921.

### LOCOMOTIVES

1 [illegible]-ton 17 x 24 in. four wheel switcher.
2—New 25 ton six wheel Porters, separate tender, std. gauge.
2—18, 11 and 10-ton Vulcans, 36 in. gauge.

**INDUSTRIAL EQUIPMENT CO.**
Marquette Building, Chicago, Ill.

# CLAM SHELL BUCKETS

and [illegible] cu. yd. Rate per day $3.50
1 and 1 [illegible] " " 4.50

FOR SALE [illegible] AND REBUILT **HAISS**
*For All Purposes*
Digging and Rehandling
[illegible]
THE GEO. HAISS MFG. CO., Inc.
Fifth St. and Ryder Ave. New York, N.Y.

# STEAM SHOVEL
FOR SALE
Marion 28 on traction wheels, 3½ yd. dipper, can be seen at Jamestown, N. Y., in good working order.
**JAMESTOWN CONSTRUCTION CO.**
Jamestown, New York

# SHOVEL
Type "O" Thew on traction wheels
Fine condition Immediate Delivery
Bargain Price
**L. A. GREEN,**
First National Bank Bldg. Pittsburgh, Pa.

# Brains Always Go Together!

So to speak:

The Curtis Publishing Co., The Ladies Home Journal, Saturday Evening Post, Country Gentleman, Philadelphia Public Ledger people—

Are exploiting the Man-of-Brains who has made such a great success of—

**The Barrett Co.** (Congoleum and Coal Tar Products)

**The Bon Ami Co.** (Orford Soap Co.) "Hasn't Scratched Yet"

The Man-of-Brains is Mr. William Hamlin Childs. Mr. Childs is quoted by the Ledger of Nov. 21st, as follows:

"One business I began with the purchase of a trade mark for $5000.00. Recently we refused $3,000,000. for that trade mark. Another corporation at the time I joined it, had a volume of business of about $5,000,000. Now it has a volume of around $80,000,000. a year."

**Bon Ami, "Hasn't Scratched Yet," the soap;**

**"Congoleum," Roofs, etc., the Coal Tar Products, etc.,**

Now listen and you'll know how Brains go together:

THE BARRETT CO., equipped their plants at the beginning WITH RIDGWAY ELEVATORS.

As the business grew from $5,000,000. to $80,000,000., RIDGWAY ELEVATORS WERE ADDED. Go down to Marcus Hook, Pa., some day and see a big bunch of Ridgway Elevators in the Congoleum plant. Also at Erie, Pa., and elsewhere.

THE ORFORD SOAP CO. at Manchester, Conn., make the Bon Ami soap.

THE ORIGINAL FACTORY WAS EQUIPPED WITH RIDGWAY ELEVATORS.

As the Trade Mark "Bon Ami, Hasn't Scratched Yet" grew from $5000 to $3,000,000 in the hands of Mr. Childs

RIDGWAY ELEVATORS WERE ADDED TO THE GROWING FACTORY.

Isn't it funny, that all the Great Successes in the Long seem to be those which are run with sort of brains that

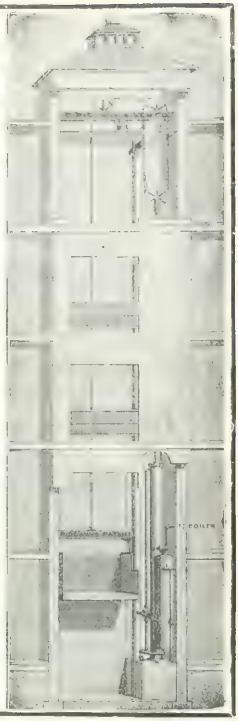
**"HOOK 'ER TO THE BILER"**

**CRAIGE RIDGWAY & SON CO., Coatesville, Pa.**
ELEVATOR MAKERS TO FOLKS WHO KNOW

**Direct Acting**

**Over 3000 in Daily Use**

**Double Geared**



*Special*

## HIGHWAY NUMBER

**January 12, 1922**

Publishing at the time of the 12th annual Good Roads Convention to be held at the Coliseum, Chicago.

Representing Engineering News-Record and its associated papers.

Offering unsurpassed opportunity for publicity to the purchasing agents for highway departments of State, County and Municipal governments.

At a time when they are placing contracts and receiving bids for road materials.

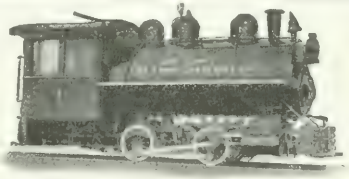
Send space reservations and copy instructions early.

**Engineering News-Record**

Member ABP — Member ABC

Tenth Ave. at 36th St., New York





All sizes and types of light steam

## LOCOMOTIVES

**ROD AND GEAR-DRIVE**

**Davenport Locomotive Works**

**Davenport, Iowa**

**Ramapo**

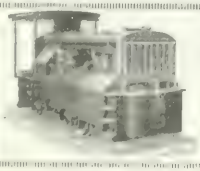
**Automatic Safety Switch Stands**

**Ramapo Iron Works**
HILLBURN - NEW YORK

NEW YORK OFFICE: 50 Church Street — PLANT: Hillburn, New York, Niagara Falls, New York

Switches, Frogs, Crossings, Derails, Stands, Switch Stands, Switch Rods, Rail Braces, Adjustable Rail Braces, Guard Rail Clamps, Rail Bonds, Sand Plates, Rail Joints, Tie Plates, Industrial Cars, etc.





## PLYMOUTH

*Gasoline Locomotives*

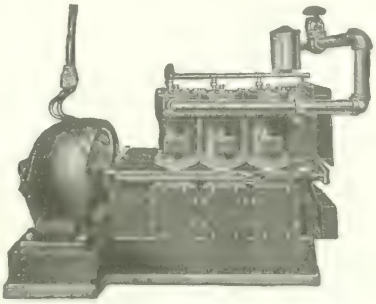
For all Industrial Haulage

Ask for Bulletins

THE FATE-ROOT-HEATH CO.
Plymouth, Ohio, U. S. A.

# KEEP PRODUCTION COSTS DOWN

Adapt compressed air to your factory operations. Install a WESTINGHOUSE-NATIONAL compressor to insure steady, profitable results from your pneumatic machinery.



**Westinghouse-National Air Compressors**

Cut down electric bills, save floor space, reduce maintenance costs, require minimum attention.

They make hard jobs easy and increase plant capacity.

*We specialize in a line of motor-driven air compressors peculiarly adapted to modern factory requirements. Sizes up to 550 cu. ft.*

**Westinghouse Traction Brake Company**

General Offices and Works: Wilmerding, Pa.

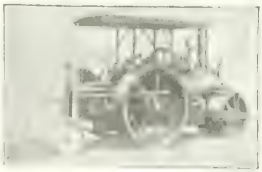
OFFICES:

Boston, Mass.
Chicago, Ill.
Columbus, O.
Denver, Colo
Houston, Tex.
Los Angeles
Mexico City
St. Paul, Minn.
St. Louis, Mo.
New York
Pittsburgh
Washington
Seattle
San Francisco

# QUALITY ROLLERS

**"Buffalo-Pitts" and "Kelly-Springfield"**

In all types and sizes, steam and motor. Buffalo - Springfield Pulverizing Crushers. Scarifiers can be built on new rollers or attached in the field to rollers already in service.



*Inquiries Invited*

**The Buffalo-Springfield Roller Co.**

Springfield, Ohio

DEPENDABLE DUMP CARS

Western

It is staying power that counts in the long run. Western Dump Cars stand up under hard work. You will find that they will stick to an imperfect cut, fill, or haul better than other cars.

All capacities from 1 cu. yd. to 3½ cu. yd. capacity

WESTERN WHEELED SCRAPER COMPANY

*Earth and Stone Handling Equipment*

Aurora, Illinois

**Spencer, White & Prentis**

**100 West 40th St., N. Y. C.**

***Foundation Specialists***

***Steel Tubes to Rock*** ***"Pretest" System***

GEAR AND FRICTION DRIVEN GASOLINE LOCOMOTIVES—2½ TO 25 TONS ON DRIVE WHEEL

# WHITCOMB LOCOMOTIVES

IT WILL PAY YOU TO GET OUR PROPOSITION BEFORE YOU BUY

## GEO. D. WHITCOMB CO.

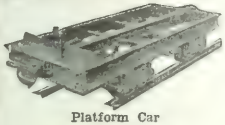
MAIN OFFICE AND WORKS

ROCHELLE, ILLINOIS

U. S. A.

STORAGE BATTERY LOCOMOTIVES—1 TO 8 TONS ON DRIVE WHEELS

# EASTON CARS



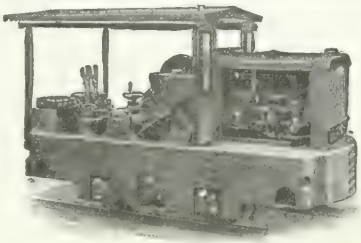
Platform Car

Ruggedly constructed Easton Rail Cars, cars of all types, standard or special, and complete narrow gauge railway equipment from track up—built for enduring service and backed up by thirty years of Easton experience—are available for every contracting and industrial car haulage requirement.

## EASTON CAR & CONST'N CO.

48 Church Street, New York Works: Easton, Pa.

Atlanta Chicago Dallas Los Angeles Pittsburgh
Boston Cleveland Detroit Philadelphia Salt Lake City



The American Gasoline Locomotive

## light on gas!—
## easy on the operator!—
## STRONG on pulling!—

American "Gas-O-Motive has Hercules motor, friction drive, efficient cooling system, telescopic coupling in transmission housing, self-aligning axle, direct full vision ahead, positive 4-wheel sander, and 4-wheel brake, all parts accessible. Low types for tunnel work.

Remember—1,600 pounds drawbar pull—and all it needs is the track to run on! You can treat it rough—neglect it—but when the call comes, it's there.

Details on request—send for catalog

The Hadfield-Penfield Steel Co.

Bucyrus, Ohio

*Specialists*

in the

DESIGN AND MANUFACTURE

of

## Standard—Insulated
## Compromise Rail Joints

THE RAIL JOINT COMPANY

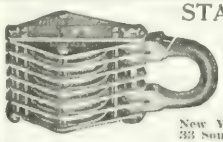
61 Broadway, New York City

# cars·track·switches

KOPPEL

New York · Pittsburgh
Chicago · Detroit
Philadelphia · San Francisco

Koppel Industrial Car & Equipment Co.
Koppel, Pa.



## STAR BRAND BLOCKS

Are Standard

For any lift or difficult working condition they are safest, strongest and most durable

Boston & Lockport Block Co.
108 Condor St., East Boston, Mass.

New York City 33 South St. Chicago 113 Fort Dearborn Bldg.

MYERS-WHALEY SHOVELS are used on two of the most famous tunnel jobs in the country—at Shandaken, N. Y. and Hetch Hetchy, California. Why? Ask for Catalog.

MYERS-WHALEY CO.
Knoxville, Tenn.

## JANUARY 12TH

## Good Roads Show Issue

# CREDITABLE

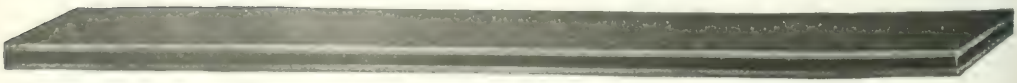
A SIDEWALK job in which Elastite is used is a creditable job long after many other walks laid at the same time go bad.

Elastite absorbs expansion due to excessive heat, and prevents the walk from buckling.

When contraction takes place in cold weather instead of opening an irregular crack that is later widened by water and frost action, the contraction shows itself at the joint—no irregular crack occurs and the Elastite keeps the joint filled with a water-tight, frost-tight, damage-proof seal.

For particulars about this widely adopted defense for sidewalks, write

THE PHILIP CAREY COMPANY
18 Wayne Ave., Lockland Cincinnati, Ohio



# CHICAGO AND TEXACO

**TEXACO Asphaltic Concrete being laid on Grand Boulevard, Chicago, Illinois, in 1912.**

This is what the Chief Engineer of the South Park Commission, Chicago, wrote to the Mayor of Trenton, New Jersey, about TEXACO ASPHALT:

"Have laid many thousands of square yards of TEXACO with very satisfactory results and consider same one of the highest grade asphalts on the market."

**Finished TEXACO Asphaltic Concrete pavement on Grand Boulevard, Chicago, Illinois.**

The excellent streets and boulevards in leading cities prove the expertness of the engineers who planned their construction.

These experienced engineers demand the highest quality of paving materials, and that is why TEXACO ASPHALT is used so extensively in the great cities as well as in the smaller ones!

## The Texas Company

**Asphalt Sales Dept., 17 Battery Pl., New York City**

New York Richmond Jacksonville New Orleans Chicago Oklahoma City Minneapolis Houston
Philadelphia Boston Tampa Memphis Cleveland Kansas City Wichita Des Moines

# STANDARD ASPHALT BINDER B

## *For Penetration Work*

Atlantic Ave., Swampscott, Mass., after application of Standard Macadam Asphalt Binder B, 1½ gals. to the sq. yard by three SOCONY Asphalt Sprayers, full width—27 feet, at one time.

SOCONY ASPHALTS AND ROAD OILS

## *Standard Asphalt Products*

Standard Asphalt Binder A *for surface treatment.*

Standard Asphalt Binder B *for penetration work.*

Standard Asphalt Binder C *for the mixing method.*

Standard Refined Mexican Asphalt *for sheet and asphalt paving.*

Standard Asphalt Joint Fillers *for brick or block pavements.*

Standard Paving Flux, Standard Bridge Asphalt and Preserving Oils.

*Specifications and all other particulars furnished on request*

STANDARD OIL CO. OF NEW YORK

26 Broadway

Winnipeg
Denver
Seattle
Hartford
Dallas
Fort Worth
Philadelphia
Norfolk
Baltimore
Kansas City
Milwaukee
Cumberland
St. John, N. B.
etc., etc., etc.

WHEN such Cities as these use Lock Joint Reinforced Concrete *Pressure* Pipe and get perfect satisfaction, (with *Every Joint* an *Expansion Joint*), you can definitely say that it is the equal of any pipe of any material.

## LOCK JOINT PIPE COMPANY

Main Office and Manufacturing Plant: Ampere, N. J.

Denver Kansas City Seattle St. John, N. B.
Toronto, Ont., Canada

# Independent Concrete Pipe

**Local Materials**
**Local Labor**
**Local Banks**

WE purchase the first. We employ the second. We deposit our funds in the third. Can you not readily see the advantage to your community?

**INDEPENDENT CONCRETE PIPE CO.**
INDIANAPOLIS, IND.

**Reliance**
**Road Building and Quarry Equipment**

Have established a reputation for continuous SERVICE and satisfaction.

We manufacture a complete line including *Crushers, Elevators, Screens, Bin Scrapers, Car Unloaders, etc.* Write for Catalogue.

**UNIVERSAL ROAD MACHINERY CO.**
Kingston, N. Y.
41 Park Row, New York 111 Liberty St., New York, N. Y.
"RELIANCE" LABOR SAVING MACHINERY

CLAY DELAWARE PRODUCTS

**Let's Prove This Mark**

Our record will tell you that this trade mark stands for quality, service and price. Let us send you a catalog.

Sewer Pipe 3-in. to 24-in. and 2 to 6-ft. Culvert Pipe, Flue Lining, Drain Tile, Hollow Brick, Fire Clay Block, Fire Clay Lumps.

You can depend upon the quality of our product. Our low price and low ideal freight rates will enable you to get the most for your money.

Place your order now to get the benefit of the largest and best equipped Pipe plant in the world, and have it delivered QUICK by the shortest route. Our product is backed by twenty years of honest quality products at fair prices.

*Write or write*

**The Delaware Clay Products Company**
807 Westinghouse Building, Pittsburgh, Pa.

*Standard Since 1885*

*Consistent Unfailing Service*

UNITED

**HIGH PRESSURE**
**Reinforced Concrete Pipe**

Light weight, strength to resist shock and with Lasting Qualities. Made by Special Process. Stands high pressure. Water tight double ring joint. Can be connected with Sewer Pipe joint.

*Send for Literature*

**United Concrete Pipe Co.**
9 Broadway, New York

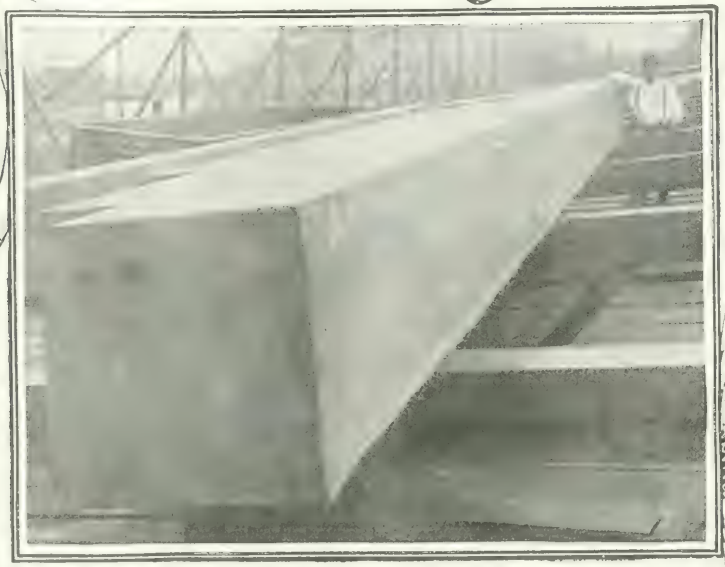
**NEWPORT CULVERTS**

of Genuine Open Hearth Iron with a proper admixture of Copper and protective coating of Spelter are daily making new friends and proving our claims for superior strength and durability

**THE NEWPORT CULVERT CO., INC.**
641 West Tenth St., Newport, Ky.

# Better Southern Pine

## *was never cut than we are cutting now*



PHOTOS AMERICAN LUMBERMAN

IN construction that puts unusual strain and wear upon the materials used, Southern Pine lumber and timbers have been *standard* among careful builders for a century.

The nine great mills, which supply the products marketed by Exchange Sawmills Sales Company, never milled better Southern Pine than they are cutting now. To splendid virgin timber, these mills add a thoroughly modern manufacturing process and insist above all upon adhering to the strictest grading rules. This accounts for the outstanding uniformity of lumber and timbers from our sales offices.

LONG AND SHORT LEAF SOUTHERN PINE
Yard and Shed Stock and Heavy Structural Materials.

EXCHANGE SAWMILLS SALES COMPANY

**For Railroads**

**For Factory Builders**

**EXCHANGE SAWMILLS SALES CO.**

Long Building — Formerly Missouri Lumber & Land Exchange Company. — Kansas City, Mo.

*Sales Department for*

Louisiana Central Lumber Co. — Louisiana Sawmill Co., Inc.

*The Most Efficient Timber Handling Plant in the World.*

LAWSON & MacMURRAY
LUMBER & TIMBER
HOBOKEN Offices, Mills & Yards NEW JERSEY

**15,000,000. feet always in stock for immediate delivery**

Kreodone EVERLASTING
WOOD BLOCK FLOORS

**Everlasting because they are treated with PURE CREOSOTE OIL. Let us tell you why Kreodone Creosote Oil is free from adulteration.**

REPUBLIC CREOSOTING CO., Indianapolis, Ind.
Plants: Indianapolis Minneapolis Mobile Seattle Norfolk
*See our full page next week*

CREOSOTING
EPPINGER & RUSSELL CO.
**Office: 165 Broadway, New York**
TREATING PLANTS at JACKSONVILLE, FLA., and LONG ISLAND CITY, NEW YORK.

MANUFACTURING PLANTS in FLORIDA. PRODUCTS, Yellow Pine Lumber, Timbers, Ties, Piles, Telegraph Poles, etc., also Cypress.
LARGE STORAGE YARDS and DOCKS, free WHARVES.

**WE SOLICIT YOUR INQUIRIES**

For City Streets and Country Roads
WIRE-CUT LUG BRICK
*Best by Government Test*
Made by reputable paving brick manufacturers and available everywhere.
THE DUNN WIRE-CUT LUG BRICK COMPANY
Conneaut (Licensors) Ohio

SPF CARBOLINEUM
CARBOLINEUM
For brush, spray and open tank treatment
**S. P. F. Wood Preserving Co., Inc.**
76 Wall St., New York City
Telephone Hanover 1971

Annual Charge Against Treated Timber
Protexol
PROTEXOL CORPORATION
Works: Kenilworth, N. J. CARBOLINEUM WOOD PRESERVING COMPANY 35 Barclay St., New York, N. Y.

WE CREOSOTE railroad ties, piles, poles and wood paving blocks in any quantity at our NEWARK, N. J., plant. We can make deliveries at the buyer's convenience, as we keep a large stock of untreated material on hand. Our prices will satisfy you. American Creosoting Company, 17 Battery Place, New York.

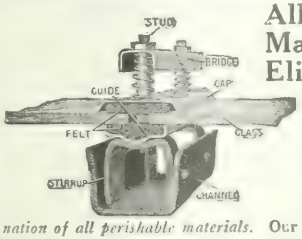
Pulverized Coal Installations
ENGINEERING
*Plans, Estimates, Construction*
F. L. SMIDTH & COMPANY, Engineers
50 Church Street, New York

American Creosote Works
INCORPORATED
New Orleans, La. (Station B)
Creosoted cross arms Lumber, Paving Blocks Piles Poles and Ties
Private dock wharf for ocean vessels at New Orleans
Capacity 100 million feet lumber annually
Plants at New Orleans, La., Louisville, Miss., and Winnfield, La

Has Made Good
LETTENEY
REG. U.S. PAT. OFF.
WOOD PRESERVATIVE
For 53 Years
Carbolineum
THE NORTHEASTERN COMPANY
New York

**The Wyckoff Pipe & Creosoting Co., Inc.**
**General Creosoters—Established 1881.**
Creosoted Wood Block Covering, Cross Arms, Anchor Blocks, Crossing Plugs, Wharf Timbers, Bridge Timbers, Lumber, etc. Wood Pipe, Steam Pipe Casings, Logger Log.
**Main Office: 17 East 42nd Street, New York, N. Y.**
Factory: Portsmouth, Virginia

Sash Operating Apparatus
For every office or purpose. We know it or will promptly investigate. Send along your requirements.
Representatives in All Principal Cities
Lord & Burnham Co.
Irvington, N.Y.




## All Perishable Materials Eliminated

The basic idea behind the Anti-Pluvius Puttyless skylight, since the day it was patented, has been *the elimination of all perishable materials.* Our new catalogue, 20-E, describes it in every detail. A copy on request.

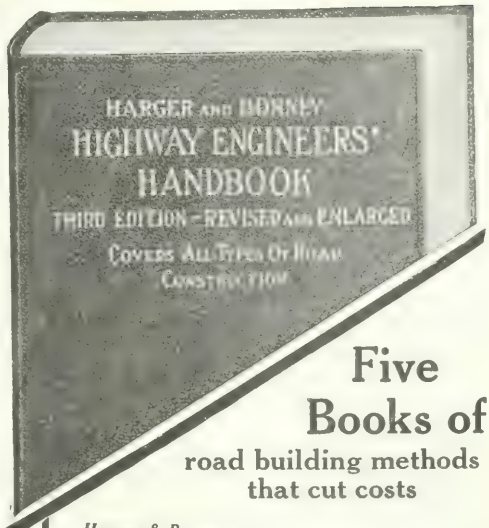
**The G. Drouvé Co.**
Bridgeport, Conn.

## ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world-famous BELL ASBESTOS MINES, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to

**KEASBEY & MATTISON COMPANY**
**Dept. S-4. AMBLER, PENNA., U. S. A.**
***Owners of the world's largest Asbestos Mines***


HARGER AND BONNEY
HIGHWAY ENGINEERS' HANDBOOK
THIRD EDITION—REVISED AND ENLARGED
COVERS ALL TYPES OF ROAD CONSTRUCTION

## Five Books of road building methods that cut costs

1 *Harger & Bonney—*
**Highway Engineers' Handbook**
***New Third Edition, 986 pages, pocket size, flexible, $5.00 net, postpaid.***
The new third edition of this well known and widely used handbook gives you the best practical data on road building. It is a field book—pocket size.

2 *Harger—*
**The Location, Grading and Drainage of Highways**
***294 pages, 6 x 9, illustrated, $3.50 net, postpaid.***
A discussion of general principles governing the policy of highway programs. The book covers scope of the program, general character of the system, classification, layout, appropriation, estimates, fundamental principles of design, and reasonable economy in design. It develops the detail theory of economic location and grade line design from the standpoint of both horse and motor traffic.

3 *Ketchum—*
**Design of Highway Bridges of Steel, Timber and Concrete**
***New Second Edition, 566 pages, 6 x 9, flexible, 340 illustrations, 7 folding plates, 140 tables, $6.00 net postpaid.***
In this new, completely revised edition of this standard treatise on highway bridge construction, the scope of the work has been extended so that the book now covers the design of concrete and timber highway bridges as well as steel highway bridges.

4 *Agg—*
**Construction of Roads and Pavements**
***463 pages, 6 x 9, illustrated, $4.00 net, postpaid.***
A concise presentation of approved practice in the construction of roads and pavements and of the principles involved. It covers selecting, testing and assembling materials, and incorporating them in the roadway surface.

5 *Agg—*
**American Rural Highways**
***138 pages, 5½ x 8½, illustrated, $2.00 net.***
Covers road location, construction and maintenance.

## Free Examination Coupon

McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York
You may send me on 10 days' approval—

.....

.....

.....

I agree to pay the [illegible] or return them postpaid within 10 days of receipt.

Member Am. Soc. C.E.?.... Subscriber to Eng. News-Record?....

Name .....

Address .....

Official Position ...

Name of Company .

Postage free on approval purchases in U. S. and Canada only. N.R. 12-29-21

QUALITY SERVICE

**VULCANITE PORTLAND CEMENT CO**
PHILADELPHIA BOSTON NEW YORK

Why not clean Cement Bags scientifically and save all the cement?

Ascertain the condition of each bag as cleaned.
Bale them at the same time.
THE NET RESULT is cleaner bags at a lower cost, hence a greater saving.
The improved working conditions are appreciated.
We supply hand or power operated machines. A light socket is all that is needed for power machine.
Several years of success as evidenced by repeat orders from substantial firms.

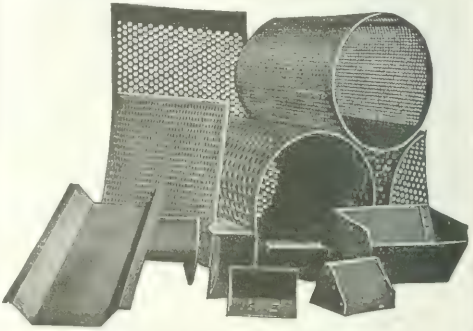
*A descriptive circular giving prices and further information will be mailed you upon request*

**The Willsea Works**
Successor to
CENTURY CEMENT MACHINE CO.
*Manufacturers of*
*Special Machinery and Machines For Making Concrete Blocks and Trimming Stones.*

60 Brown's Race
Rochester
N. Y.

Style A Hand or Belt Driven

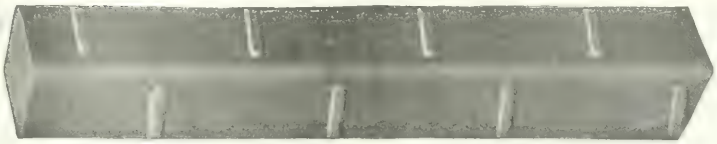
**Perforated Metal Screens**
*for*
**Stone, Gravel, Sand, Etc.**



**ELEVATOR BUCKETS**
**TANKS, SMOKESTACKS**
**Conveyor Trough and Flights**
**GENERAL SHEET AND LIGHT STRUCTURAL WORK**
**Light and Heavy Steel Plate Construction**
*Write for your copy of our Hand Book*
**Hendrick Manufacturing Co.**
73 Dundaff Street, Carbondale, Penna.
New York Office: 30 Church Street
Pittsburgh Office: 915 Union Bank Bldg.
Hazleton, Penna.; 705 Markle Bank Bldg.

**PENNSYLVANIA**
**PORTLAND CEMENT**
**Highest Quality**
Manufactured by
**Pennsylvania Cement Co.**
New York Boston Philadelphia Buffalo

Business Established 1832
**The Lawrence Cement Co.**
No. 302 Broadway New York
Selling Agents for
**Dragon**
**PORTLAND CEMENT**
**In Successful Use Nearly a Third-Century**



# STEEL BARS

FOR

REINFORCING CONCRETE

WE MANUFACTURE

PLAIN, TWISTED AND DEFORMED SQUARES—ALSO PLAIN AND DEFORMED ROUNDS

BARS CUT TO EXACT LENGTHS WITHOUT EXTRA CHARGE
BENDING DONE AS REQUIRED

*IMMEDIATE DELIVERIES ASSURED—ALL SIZES CARRIED IN STOCK*

## BUFFALO STEEL COMPANY

TONAWANDA, NEW YORK

## MISSISSIPPI WIRE GLASS

For protection against Fire and Breakage

Mississippi Wire Glass Co.
218 Fifth Ave.,
New York

Chicago St. Louis

## M & M

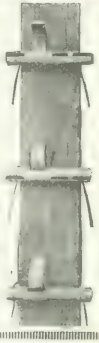
ADJUSTABLE FORM CLAMPS
for wall or column forms
SIMPLE—DURABLE—LABOR SAVERS

Use Them on Every Job
and Make More Money

*A free sample and illustrated catalog will be sent on request.*

M & M Clamps are made in two sizes No. 1 for 4 x 4's or 4 x 6's—No. 2 for 2 x 4's or 2 x 6's.

M & M FORM CLAMP CO.
2 Fifth St., S. E. Minneapolis,, Minn.



## ANTI-HYDRO

FOR PERMANENT CONCRETE
HARDENS WATERPROOFS

FOR HARDENING & WATERPROOFING CONCRETE

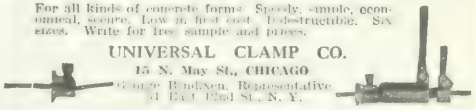
A liquid integral [illegible] and water proofer. Used [illegible]

ANTI-HYDRO WATERPROOFING COMPANY
New York Office, 299 Broadway Laboratory, Newark, N. J.

## UNIVERSAL FORM CLAMPS

For all kinds of concrete forms. Speedy, simple, economical, secure. Low in first cost. Indestructible. Six sizes. Write for free sample and prices.

UNIVERSAL CLAMP CO.
15 N. May St., CHICAGO
George Rudkin, Representative
41 East 42nd St., N. Y.



## LACLEDE STEEL COMPANY

St. Louis, Mo.
CONCRETE REINFORCING BARS

Works:
Madison, Illinois
Alton, Illinois
East St. Louis, Ill.

General Offices:
1317 Arcade Building
St. Louis, Mo.
Chicago Office: 208 S. La Salle Street
Kansas City Office: 228 Scarritt Bldg.

LIVING—STONE

CEMENT BOND

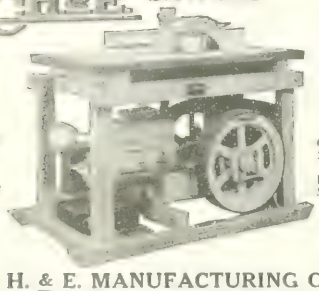
**The Perfect Bond**
for Concrete

Contains no steel. Therefore cannot [illegible] outside of [illegible] bond through than the concrete itself

Catalog on request

THE LIVING-STONE CO.
1 East Lee St., Baltimore, Md.

C. H. & E. SAW RIG



Write for Folder

6 Sizes

Immediate Shipment

C. H. & E. MANUFACTURING CO.
250 Mineral St., Milwaukee, Wis.

SONNEBORN PRODUCTS

Concrete dust ruins machinery and merchandise. It shows that the concrete floor is disintegrating.

LAPIDOLITH
TRADE MARK

Makes Concrete Floors Dustproof and Wearproof

Over 200,000,000 square feet of concrete floors lapidolized thus far.

*Write for samples and testimonials to Dept. 6*

L. SONNEBORN SONS, Inc.
264 Pearl St., New York

SONNEBORN

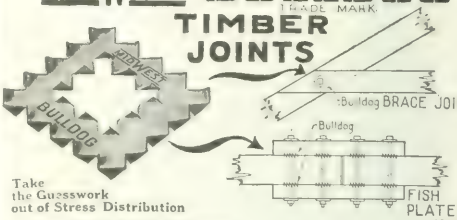
*The Hard-n-tyte Specification*

HARD-N-TYTE for CONCRETE and MORTARS

is a valuable guide for the contractor, engineer or architect in producing dustless, wear-resistant concrete floors. It covers every detail of construction, and will be sent at your request.

General Chemical Company
25 Broad Street New York
GC-28

MIDWEST BULLDOG
TRADE MARK
TIMBER JOINTS




Take the Guesswork out of Stress Distribution

*Descriptive Matter on request*

MIDWEST STEEL & SUPPLY CO., INC.
Box 1601, 26-28 W. 44th Street, New York City

Steelcrete
CONCRETE REINFORCEMENT

FLAT SHEETS, readily handled quickly placed — Steelcrete, the ideal reinforcement.

The Consolidated Expanded Metal Co's
BRADDOCK, PA.
Pittsburgh Chicago Philadelphia New York

—Will Outlast the Building—
American Cement Tile Roofing

is being used wherever durability and ultimate economy are considered.

We can satisfy your roofing requirements.

AMERICAN CEMENT TILE MFG. CO., Oliver Bldg., Pittsburgh, Pa.
New York Philadelphia Cleveland Birmingham

NEMCO PRODUCTS
Kno-Burn
EXPANDED METAL LATH
Northwestern Expanded Metal Co
900 Old Colony Bldg. Chicago

SIDE WALL STEEL SASH

All types for factory, power house and office. Continuous steel sash for monitors and sawtooth construction. Operating devices for all types of monitor sash and windows. Steel skylight and ventilators, steel office partitions, hinged steel doors, sliding steel doors.

STEEL CONSTRUCTION FOR LIGHT AND VENTILATION IN BUILDINGS

ALLISON STEEL PRODUCTS CO.
CHESTER, PA.

The Underpinning & Foundation Co.
290 Broadway, New York City

Difficult Foundations

Piers; Underpinning Heavy Buildings

"HERCULES" STEEL PILES

Parsons, Klapp, Brinckerhoff & Douglas
84 Pine St., New York Hanna Bldg., Cleveland
WM. BARCLAY PARSONS HENRY M. BRINCKERHOFF
EUGENE KLAPP WALTER J. DOUGLAS

*Engineers—Constructors—Managers*

Design, Estimates, Supervision, Operation and Management, Examination and Reports

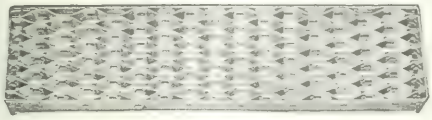
"The Pile With a BIG Foot"
MAC ARTHUR PEDESTAL PILE

Mac Arthur Concrete Pile & Foundation Co.
[illegible] Street, New York City

Smith, Hauser & MacIsaac, Inc.
CONTRACTORS
18 East 41st Street, New York, N. Y.

*Aqueducts, Subways, Dams, Railroad Work, Docks and Piers, Shafts and Tunnels.*

# UNIVERSAL Safety Grating



**Greater Strength—Greater Rigidity**
**Lighter Construction**

A hexagonal mesh-work of iron bars firmly attached at all points of contact by a special method of clamping members to each other and to the outside framework.

*No loss of tensile strength* or weakening of members.

The tongues or flanges that clamp the members *fill the vertical openings.* By this form of attachment all rivets *are eliminated* and the entire platform or step surface is firmly interlocked and held rigidly at all points.

No rivets to work loose. Entire step surface stays rigid and firm at all points. For spans of great length, transverse bars may be embodied as reinforcement.

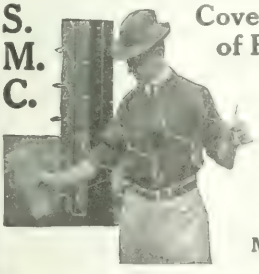
Wherever you want a firmer, more rigid, *troubleproof* grating—use the UNIVERSAL rivet-less.

***Write for pamphlet***

**Universal Safety Tread Co.**
**40 Court St., Boston, Mass.**

## Small Stock of S. M. C.

**S. M. C.**



**Covers a wide range of Beam Flanges**

Two sizes fit all beam flanges up to 9¼ in. wide which greatly simplifies installing. Contractor can keep a small stock of S.M.C. instead of a large assortment of sizes. S.M.C. is the solid material that anchorsteady locks in place embedding well beyond the beam flange. Does not leave leak of concrete. Renders easy application to beams in case of fire. Prompt shipments.

**Mitchell-Tappen Co.**
15 John St., New York City

Barriers of Steel
# Afco Fences

See our full page advertisement in the first issue of each month.

**American Fence Construction Co.**
**130 W. 34th Street, New York, N. Y.**

# SHEETS

KEYSTONE COPPER STEEL

*American Bessemer—Open Hearth—Keystone Copper Steel*
Black Sheets, Galvanized Sheets, Special Sheets, Corrugated Sheets, Painted Roofing, Long Terne, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, PITTSBURGH, PA.

IRVING SUBWAY
THE FIREPROOF VENTILATING FLOORING

TRADE MARK
# IRVING SAFSTEP
(PATENTED) REG. U.S. PAT. OFF.
ABSOLUTELY NON-SLIPPING ALWAYS

## Safe, Comfortable, Serviceable

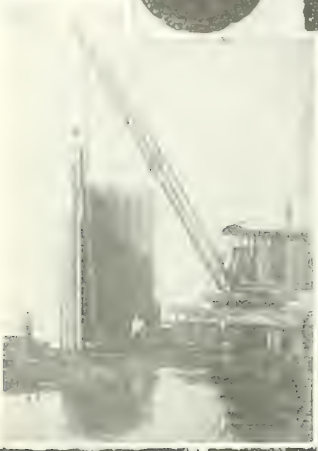
Your foot won't slip on a **Safstep**—even with water, oil or grease upon it. You can use a stair or ladder of **Safsteps** with confidence and comfort—you can hurry, up or down. And each **Safstep** is a self-contained unit with its own carrier, easily installed in any type of construction. Its non-slipping quality is a permanent inbuilt feature, lasting as long as the step itself. And the life of a **Safstep** is the life of steel—which means serviceability. Write us for Catalog 3A5.

**IRVING IRON WORKS CO.**
**LONG ISLAND CITY, N.Y., U.S.A.**

Manufacturers of

TRADE MARK
# IRVING SUBWAY
(PATENTED) REG. U.S. PAT. OFF.
THE FIREPROOF VENTILATING FLOORING

# UNION



"Your No. 3 UNION is again proving its advantage over the drop hammer and follower"—

wrote the contractor on the job pictured—name on request. Yes Sir! Unions use air or steam, and drive and PULL

*Agents in Principal Cities*

## Union Iron Works, Inc. Hoboken, N.J.

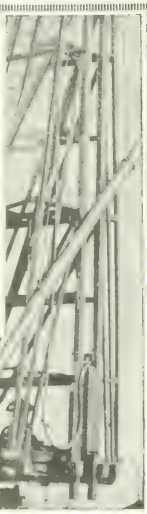
### Here's an example of Real Driving

Listen!

Doullut & Williams, Inc., New Orleans Contractors, have this to say about the McKiernan-Terry No. 11-B Hammer:

"Our work on the Standard Oil Co. Wharf, Baton Rouge, La. has progressed very successfully. We have driven all our 110 ft. to 130 ft. piles without difficulty."

[illegible] locality but everywhere throughout the world. You'll find a few reasons why in [illegible]

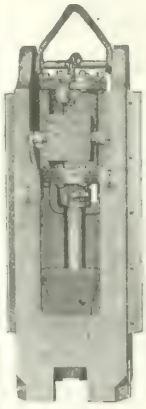


McKIERNAN-TERRY DRILL COMPANY

[illegible] Hammers, Drop Hammers, Steam Hammers, Machinery

15 PARK ROW, NEW YORK

Works at Dover, N. J.



*No Sir, No Hammer Has More Features*

### National Hammers

**The Greatest Penetration in the Shortest Possible Time**

In every kind of work where materials of one form or another must be driven, National Hammers will give the greatest penetration in the shortest possible time.

It is not unusual for our hammers to drive 80 foot Batter Piles to a depth of 50 feet penetration in 10 minutes.

For a time saver and a profit increaser, there is but one answer—National Pile and Sheeting Hammers.

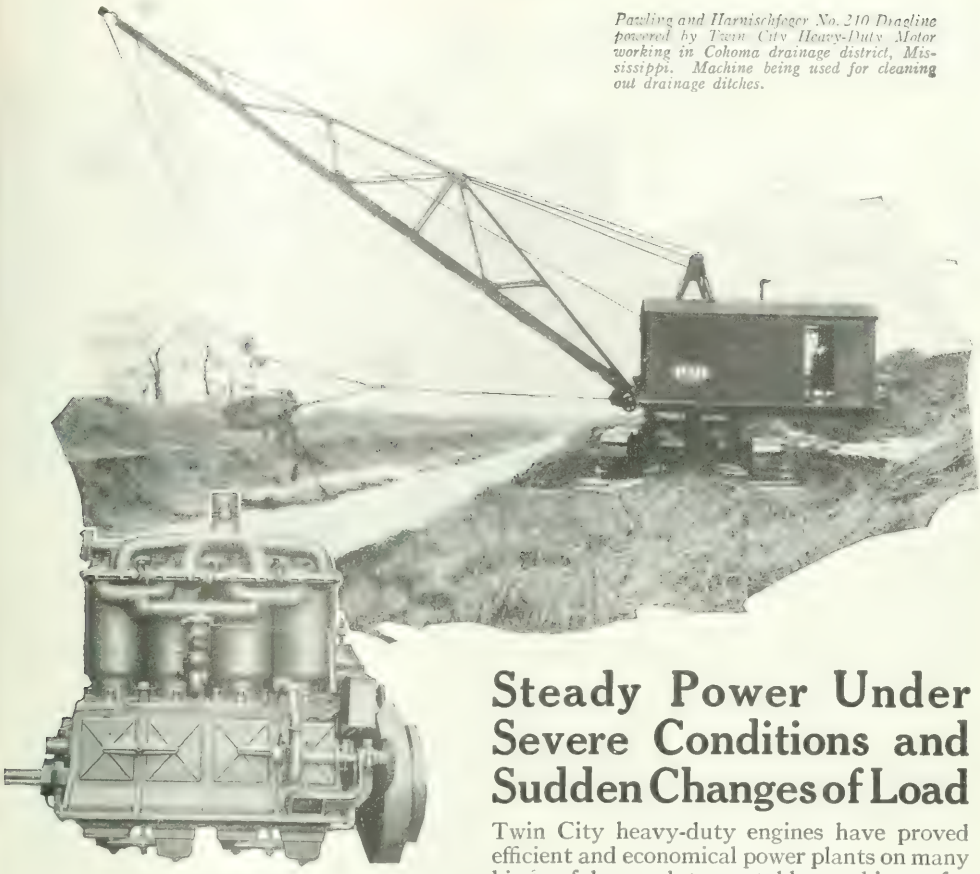
***Send for new complete catalog.***

HOISTING ENGINES, TOO!

**National Hoisting Engine Company**

*Office and Works:*
*Harrison, New Jersey*

## NATIONAL



*Pawling and Harnischfeger No. 210 Dragline powered by Twin City Heavy-Duty Motor working in Cohoma drainage district, Mississippi. Machine being used for cleaning out drainage ditches.*

**A Few Manufacturers Whose Machines Are Powered With Twin City Engines**

Industrial Works, Bay City, Mich. Crawler Type Cranes.
Clyde Iron Works, Duluth, Minn. Hoists.
Buckeye Traction Ditcher Co., Findlay, Ohio. Trenching Machines.
Brown Hoisting Machinery Co., Cleveland, Ohio. Locomotive Cranes.
Bay City Dredge Works, Bay City, Mich. Material Handling Cranes.
Armstrong Mfg. Co., Waterloo, Iowa. Well Drilling Machines.
American Hoist & Derrick Co., St. Paul, Minn. Locomotive Cranes.

# Steady Power Under Severe Conditions and Sudden Changes of Load

Twin City heavy-duty engines have proved efficient and economical power plants on many kinds of heavy-duty portable machinery for the past twelve years. Twin City engines deliver a continuous and dependable flow of power even under sudden load changes.

***Sizes:***

| | |
|---|---|
| 4¼x6 four-cylinder | 6¼x8 four-cylinder |
| 5x7½ four-cylinder | 7¾x9 four-cylinder |
| 5½x6¾ four-cylinder | 7¼x9 six-cylinder |

**Minneapolis Steel & Machinery Co.**
*General Offices and Works*
**MINNEAPOLIS, U. S. A.**
**In Writing Address Dept. M**
Eastern Office—Woolworth Bldg., New York
Sales Offices in Leading Cities in United States

**TWIN CITY**
**Heavy-Duty Gasoline Engines**

# Core Drilling by Contract

—with Sullivan Diamond Drills,—

will answer the question "where's the Bedrock—and what is it like?"—before you set your bridge piers or start work on your new dam.

The Sullivan contract drilling department has modern outfits and skilled crews ready to drill anywhere, in any formation. 37 years' experience.

*Booklet 4122.*

Sullivan Contract Drill Making Test Borings at the Wilson Dam Site, Widow's Bar, Tennessee River

Sullivan Diamond Drill in Southern Illinois (From U. S. Bureau of Mines Motion Picture "The Story of Coal")

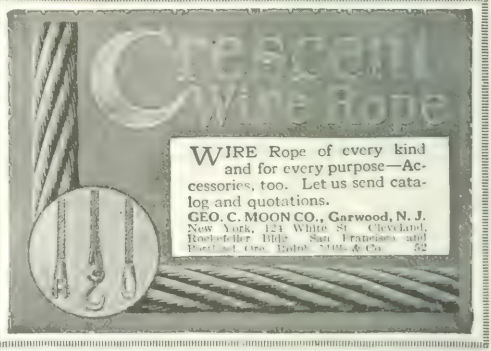
Sullivan Diamond Drill testing for dam foundations in the River at Cedar Rapids, Iowa

**Sullivan Machinery Company**

124 So. Michigan Ave., Chicago 30 Church St., New York

# PARSONS

The Parsons Company
Newton, Iowa


Crescent
Wire Rope
WIRE Rope of every kind and for every purpose—Accessories, too. Let us send catalog and quotations.
GEO. C. MOON CO., Garwood, N. J.
New York, 121 White St. Cleveland, Rockefeller Bldg. San Francisco and

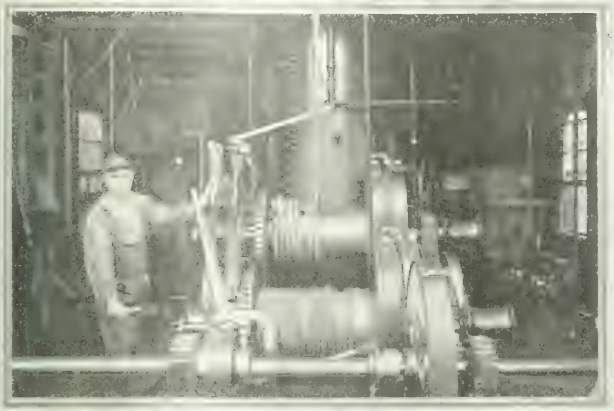
# P&H

TRENCH & DRAGLINE EXCAVATORS
PORTABLE CRANES
PAWLING & HARNISCHFEGER CO.
MILWAUKEE, WIS.

VULCAN IRON WORKS
327 NO. IRVING AVE. CHICAGO
PILE DRIVERS

# LIDGERWOOD HOISTS

STEAM — ELECTRIC
GASOLENE

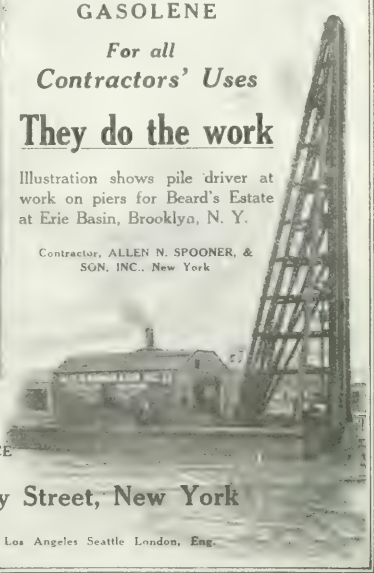


*For all*
*Contractors' Uses*

**They do the work**

Illustration shows pile driver at work on piers for Beard's Estate at Erie Basin, Brooklyn, N. Y.

Contractor, ALLEN N. SPOONER, & SON, INC., New York



DERRICKS—PILE DRIVERS—CABLEWAYS

OUR ENGINEERS ALWAYS AT YOUR SERVICE

*Catalogues upon request*

LIDGERWOOD MFG. CO., 96 Liberty Street, New York

BRANCHES

Philadelphia Pittsburgh Chicago Cleveland Detroit Charleston, W. Va. Los Angeles Seattle London, Eng.

# Dredging

**Filling, Land Reclamation, Canals and Port Works**

**River and Harbor Improvements**
**Deep Waterways and Ship Channels**

We are equipped to execute all kinds of dredging, reclamation and port works anywhere in the United States.

CONTRACTORS to THE FEDERAL GOVERNMENT

*Correspondence Invited from Southern Officials and Corporate and Private Interests Everywhere.*

**Largest Plant** **Longest Experience**

**Atlantic, Gulf and Pacific Co.**

New York
27 Park Row

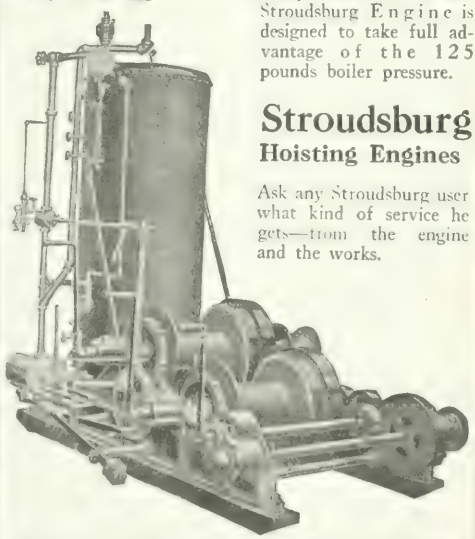
Houston, Texas
Scanlon Bldg.

# Proportioned for Fast Work

Every detail of the Stroudsburg Engine is designed to take full advantage of the 125 pounds boiler pressure.

**Stroudsburg**
**Hoisting Engines**

Ask any Stroudsburg user what kind of service he gets—from the engine and the works.

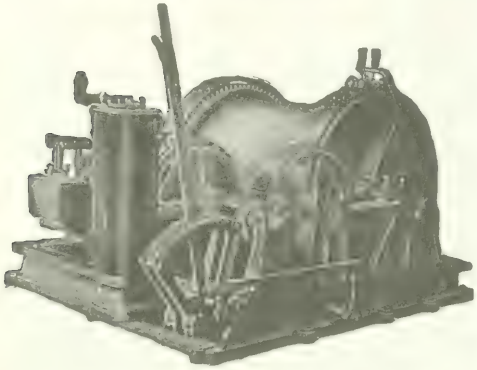


STROUDSBURG ENGINE WORKS

66 North 3rd Street, Stroudsburg, Pa.

For the Important Jobs—

**Flory Hoists**



*A Flory Hoist for every purpose*

In the shaft equipment for the construction of the 18-mile Shandaken tunnel, Flory Hoists were chosen.

The Catskill Aqueduct jobs generally have shown the reliability and durability of Flory equipment. Many of the hoists in that work are still in use.

***Write to the nearest Flory Engineer in regard to your Hoisting Problems. And get the Flory catalog—on request.***

**S. FLORY MFG. CO., Bangor, Pa.**

New York: 95 Liberty St.; Chicago: Monadnock Bldg.; Pittsburgh: House Bldg.; Hartford, Conn.: K. B. Noble Co.; Birmingham, Ala.: Chas. T. Lehman.

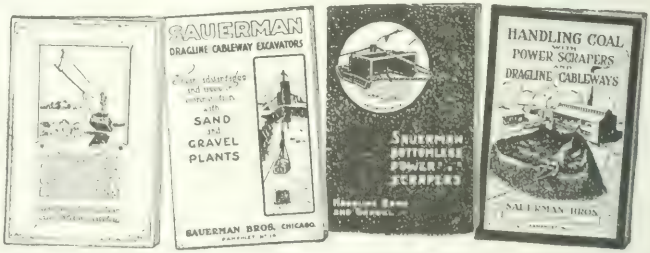
# FLORY HOISTS

## Any of these pamphlets sent to you FREE on request

If you have a material-handling problem, whether in excavating gravel, moving dirt or storing and reclaiming coal, write for our booklets, naming the class of work on which you wish information.

**SAUERMAN BROS.**
**53 W. Jackson Blvd., Chicago**

*Don't forget the dates of the National Good Roads Show, Jan. 17-20, Chicago*



Plain Clip for Wire Rope and joining square or distorted bars. Universally used and recommended.

*This Mark*

**On a Casting**

[illegible] that it's made of [illegible] malleable iron, [illegible] to [illegible] and [illegible] to [illegible] or dry location.

*Malleable iron castings for every purpose*

**The Marion Malleable Iron Works**
Marion, Indiana

**ROBINS CONVEYING MACHINERY**

Our bulletins describe the successful solution of many materials handling problems. Let them help you.

**ROBINS CONVEYING BELT COMPANY**

New York, 14 Park Row — Chicago, Old Colony Building
Salt Lake City, Newhouse Bldg. — Birmingham, Ala., C. B. Davis Co.
San Francisco, The Griffin Co. — Toronto, Gutta Percha & Rubber, Ltd.

**GRAY STRAND WIRE ROPE**
**ELECTRICALLY WELDED WIRE**

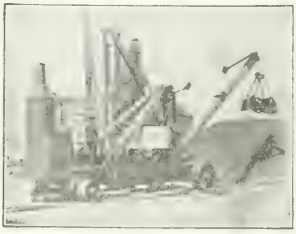
**Wickwire Spencer Steel Corporation**
Worcester, Mass. — Buffalo, N. Y.

District Offices and Warehouses
New York — Philadelphia — Detroit — Chicago — Boston
San Francisco — Tulsa, Okla.

# TERRY

**Builders of the highest type**

DERRICKS and CRANES



**TERRY** Manufacturing Company

Grand Central Terminal, New York City

Plant—Kearny, Newark, N. J.

# American Wire Rope

AND

AERIAL WIRE ROPE TRAMWAYS

Send for Illustrated Catalogue

American Steel & Wire Company

Chicago-New York

## Dobbie Derricks and Hoists

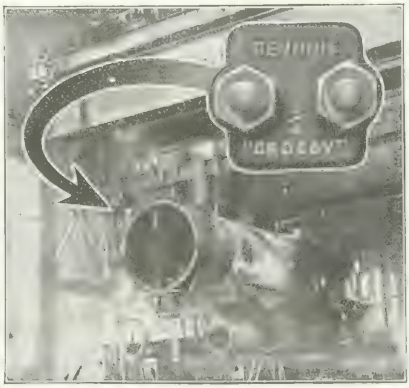
Stock of Fittings, Blocks, Sheaves, Winches, etc., carried by our agents—

G. S. Green Co., New York.
Beckwith Machy. Co., Pittsburgh.
Beckwith Machy. Co., Cleveland.
P. I. Perkins Co., Boston.

**DOBBIE Foundry & Machine Co.**

*Manufacturers*

Niagara Falls, N. Y.




## *They Have Held Safely for Fifteen Years — Still on the Job*

In the Great Northern Railway Shops at St. Paul, Minn., they lift locomotives with a 100-ton overhead crane. Six strands of $\frac{3}{4}$-inch cable fastened with Genuine "CROSBY" Clips is used for a lifting sling. The same six Genuine "CROSBY" Clips which were put on this sling fifteen years ago are still there, having held safely at all times, although the weight of the engines lifted runs from 60 to 100 tons.

Every Genuine "CROSBY" Clip is a perfect vise of drop forged steel. Its grip is sure, but does no injury to the rope. Can be inspected at a glance and tightened to take care of rope shrinkage under tension; galvanized.

The safest wire rope fastening.

*We want your inquiries. An "American" representative can reach you in 24 hours*

American Hoist & Derrick Co.

St. Paul Minnesota

Builders of "AMERICAN"

Hoisting Engines, Locomotive Hoists, Derricks, Locomotive Cranes, Revolving Derricks, Locomotive Crabs, Steam Coal Marketing Machinery and Tramways, the Genuine "CROSBY" Wire Rope Clip

New York Chicago Pittsburgh Seattle
New Orleans Detroit

AMERICAN HOIST & DERRICK CO.

# MONIGHAN WALKING DRAGLINES

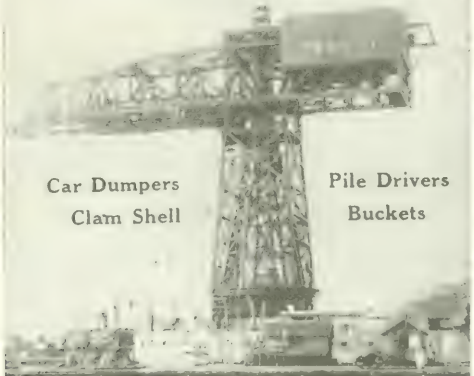
While other excavators are laying to rest to give the Monighans the walking Type travel over any ground that will carry a walking horse—boss, go down one side to the other, extend, contract, dig and travel at the rate of one foot a minute.

You will want to know more about the Monighan—your copy of our catalog is ready—ask for it.

**Monighan Machine Company**
**2024 Carroll Ave.**
**Chicago, Ill.**

LOCOMOTIVE CRANES
CLAM SHELL BUCKETS - STANDARD TYPES OF CRANES
CAR DUMPERS PILE DRIVERS
THE McMYLER INTERSTATE CO.
CLEVELAND, OHIO

**CRANES**
**of all types and sizes**
**from the smallest locomotive crane to the giant shown here.** ***Send for Bulletin***



Car Dumpers
Clam Shell
Pile Drivers
Buckets

The McMyler Interstate Co.
Cleveland, Ohio

# O. S. DEPENDABLE
## 7-Ton and 12-Ton Crawling Tread Cranes

One of the Outstanding Features of the O. S. Dependable Crawling Tread Cranes is the *Initial Economy* effected by their installation.

You don't have to rearrange your yard to accommodate them—
You save the expense of laying a railway track; it is not even necessary to surface the yard with planking or concrete.

***O.S. Dependable Crawling Tread cranes travel on any kind of ground surface.***

*Catalog gladly sent on request.*

ORTON & STEINBRENNER COMPANY
Main Office: Chicago, Ill. Factory: Huntington, Ind.

# LESCHEN
## WIRE ROPE

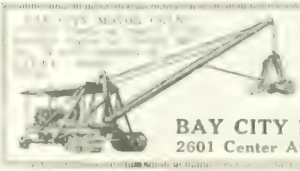
Back of every Leschen Rope are many years of manufacturing experience. We make high-grade wire ropes for all purposes. For heavy service of all kinds we [illegible]

**A. Leschen & Sons Rope Co.**
**St. Louis, Mo.**

BROWNING
LOCOMOTIVE
CRANES

*A Giant's Strength*
*With a Wizard's Deftness*

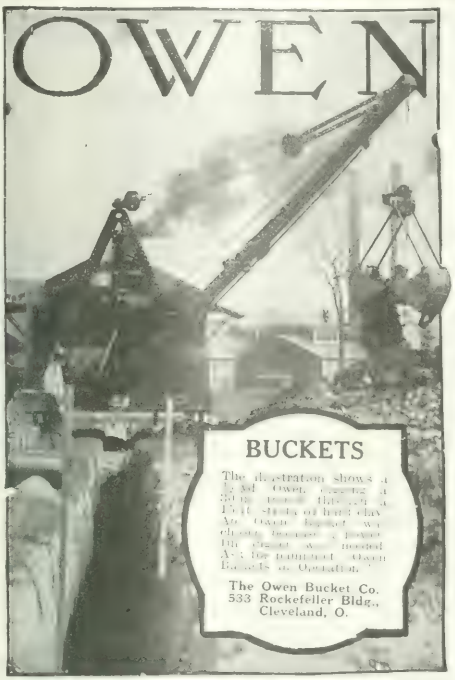
THE BROWNING COMPANY
East 162nd St. & Waterloo Rd
Cleveland, Ohio



CRANES
EXCAVATORS
LAND DREDGES
Walking, Track, Crawler and Floating Type

**BAY CITY DREDGE WORKS**
**2601 Center Ave. Bay City, Mich.**

# OWEN

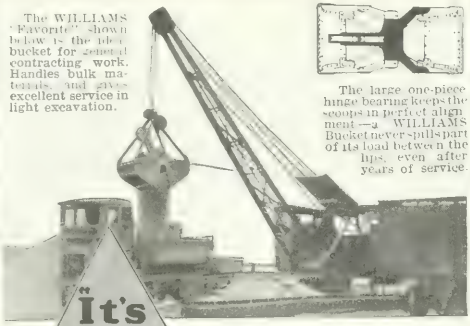


## BUCKETS

The illustration shows a 3/4 Yd. Owen, digging at 30 ft. radius, this 3/4 Yd. Bucket has a 15-16 Yd. of bank clay. An Owen Bucket will exceed this capacity because a power lift chain is mounted A-1 for handling Owen Buckets in Operation.

The Owen Bucket Co.
533 Rockefeller Bldg.,
Cleveland, O.

The WILLIAMS "Favorite" shown below is the ideal bucket for general contracting work. Handles bulk materials and gives excellent service in light excavation.





The large one-piece hinge bearing keeps the scoops in perfect alignment—a WILLIAMS Bucket never spills part of its load between the lips, even after years of service.

**"It's a WILLIAMS"**

***"We have never used any bucket that equals the WILLIAMS."***

*Writes Clarence E. Palmer, of R. H. Evans & Co., Columbus, Ohio.*

The combined speed and power of the WILLIAMS "Favorite" makes it the ideal bucket for handling sand, crushed stone, coal, etc. The tremendous leverage of the WILLIAMS power arm gives an unusually rapid and positive closing action.

There are many other reasons why the WILLIAMS is the bucket for your excavating or material handling. We will gladly send a finely illustrated, 60-page catalog, showing how WILLIAMS Buckets will serve you. Write us.

**G. H. WILLIAMS CO., Erie, Pa., U. S. A.**

# WILLIAMS

**QUICK-ACTING CLAMSHELLS**

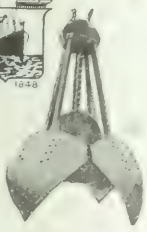
**All Parts Guaranteed Against Breakage**

# VULCAN

**Clamshell and Orange Peel Buckets**

All work from blueprint to finished product done in our own shops.

Dredging Buckets. Hydraulic Dredging Equipment. Complete Dredges. Repairs to all types of Buckets and Dredges. New Catalog—just published—shows in results of 50 years pioneering experience. Send for your copy.



**VULCAN IRON WORKS, Inc., Jersey City, N. J.**

***BYERS*** *Model "10"*

**Full Circle Crane**

OPERATOR can raise or lower the boom *under absolute control* while lifting or dropping bucket, rotating, or traveling. Exclusive Byers feature; many other points just as important—study them *all* in interesting Bulletin, just out.

• • •

**The Byers Machine Co.**
250 Sycamore St., Ravenna, O.
*Agents in Leading Cities*

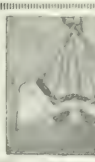
**Aden Grab Buckets**

**The Advance Engineering Co.**
Offices: 651 Mutual Street
Cleveland, O.

**HAYWARD**

Orange Peel Buckets—the fruition of thirty years' experience in building better buckets. Three or four added types—with or without cut-off blades. Ask for Catalog E. 25-27 Y
The Hayward Co., 18-50 Church St., New York

**BUCKETS**



**KIESLER**
**Clam Shell Buckets**

Jos. F. Kiesler Co., Chicago, Ill.

# COMPACT—STURDY

**When it's done with**

**OSGOOD**

**it's done economically**

Steam Shovels ½-6 cu. yds.

**The Osgood Co., Marion, Ohio, U. S. A.**

# "TOLEDO CRANES"

## *Stop Man Power Waste*

"Toledo" standards guarantee latest practice in design; positive engineering and accuracy; smoothness; speed and power with flexibility and economy in operation.

*What are your requirements?*

**THE TOLEDO CRANE CO.**
Bucyrus, Ohio
*Successors to*
The Toledo Bridge & Crane Co.

# INDUSTRIAL CRANES

The Type BC "Industrial" Crawling Tractor Crane presents an ideal solution to the economic [illegible] material handling problems because of their all around utility and surprisingly low cost of owning and operating.

This type of crane is built for gasoline operation. The gasoline crane has nearly as much power in doing work within its capacity. When it has a load at the end of the boom it can travel with the load suspended about 18 inches above the ground. Load can be carried over rough ground, through mud, sand or ordinary snow until the work starts.

Write today for Catalog No. 113.

NEW YORK [illegible] PHILADELPHIA [illegible]

**INDUSTRIAL WORKS**
BAY CITY, MICHIGAN

CHICAGO [illegible] DETROIT [illegible]

[illegible] Equipment Co., [illegible]

# OHIO LOCOMOTIVE CRANES

**Breakage on one of these fine cranes is practically unknown. Why? 90% Steel Castings.**

**Ohio Locomotive Crane Co.**
101 So. Sandusky Ave.
Bucyrus, Ohio

# CLEVELAND CRANES

What's the size of the crane you are figuring on?

[illegible] from 250 lbs. to 500 tons CLEVELAND cranes!

The Cleveland Crane & Engineering Co.
WICKLIFFE, O.

## We Dig and Refill Trenches

For water, sewers, gas, conduits and drains. Pave laid by contract and installation of water systems.

**Trench Machines and Backfillers For Rent**

**W. G. FRITZ CO., INC., *Contractors***
256-260 Valley Road, West Orange, N. J.

WELDING WIRE **ROEBLING** CLIPS

# WIRE ROPE

**John A. Roebling's Sons Co., Trenton, N. J.**

# NEPTUNE

## The Pioneer of Progress

The Trident Oil Enclosed Gear Train Eliminates Corrosion.

Foreign matter cannot lodge in the protected Trident Oil Enclosed Gear Train.

Wear is eliminated by correct lubrication in the Trident Oil Enclosed Gear Train.

The oil around the gears does not freeze in the Trident Oil Enclosed Gear Train.

## Greater accuracy — longer life — increased revenue are assured by the Trident Oil Enclosed Gear Train.

NEPTUNE METER COMPANY
NEW YORK
*Pioneers in Meter Progress*

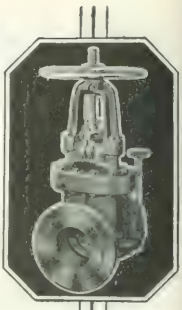
## TRIDENT INTERCHANGEABILITY APPLIES TO EVERY PART OF EVERY TRIDENT METER

# LUNKENHEIMER
## *Valves and Engineering Appliances*

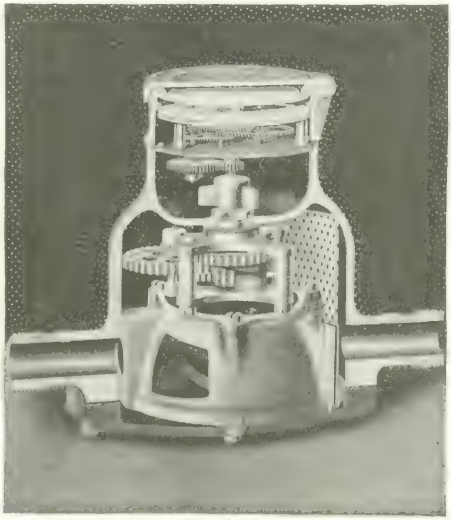
GLOBE, GATE, CHECK, POP SAFETY, BLOW-OFF, THROTTLE, SAFETY NON-RETURN VALVES, ETC.

THE LUNKENHEIMER CO.
CINCINNATI

WATER COLUMNS, COCKS, WHISTLES, INJECTORS, LUBRICATORS, OIL AND GREASE CUPS, ETC.



**SAFETY—ECONOMY—PERMANENCE**



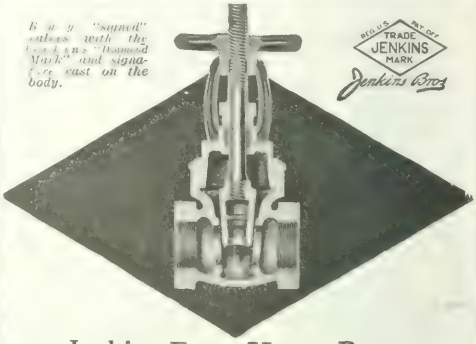
**The Hersey Disc Meter, Model HF, is the product of thirty-five years of experience and refinement in the manufacture of water meters.**

This model in the smaller sizes, together with Model HD in the larger sizes, form a series which excels all meters of all makes in all those essentials which go toward making up an exceptionally desirable meter.

**HERSEY MANUFACTURING COMPANY**

Boston, New York, Chicago, Cleveland, Pittsburgh, Detroit, San Francisco

*Every "Jenkins" valve with the Jenkins Diamond Mark and signature cast on the body.*




## Jenkins Extra Heavy Brass Gate Valves

Fig. 282

Sectional view Fig. 282, outside screw and yoke, rising spindle. These valves are very heavy are suitable for steam and water service of all kinds under heavy pressures and high temperatures. Especially adapted for service in modern high pressure power plants. Suitable 250 pounds steam and 400 pounds water, working pressures.

JENKINS BROS.
New York Boston Philadelphia Chicago
Montreal London Havana
FACTORIES: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada.

**Jenkins Valves** SINCE 1864

Nicholas Engel
## JOHN FOX & CO.
Cast-Iron Water, Gas and Flange Pipe, Special Castings, Fire Hydrants, Valves, General Foundry and Machine Work.
253 BROADWAY NEW YORK CITY

## PITTSBURGH FILTERS
*Complete equipment*
*Consult us*
PITTSBURGH FILTER & ENGRG. CO.
Pittsburgh, Pa. OIL CITY, PA. Kansas City, Mo.

## SLUICE GATES
Shear, Flap and Butterfly Valves
## FLEXIBLE JOINTS
## COLDWELL-WILCOX CO
NEWBURGH N.Y.

## THE VENTURI METER
For Water, Sewage, Gas, Air, Steam—
in fact everything that flows.
*Bulletin on Request.*
BUILDERS IRON FOUNDRY,
Providence, R. I.

Clean Water Mains

National Water Main Cleaning Company.

ROBERTS FILTERS

WATER-*fit for use*

Filtration and Water Softening Plants

ROBERTS FILTER MFG. CO.

DARBY PA

GRAVER *Steel Tank and Plate Work* HEADQUARTERS

Steel Tanks and Steel Plate Work

Water Softeners, Filters and Heaters

GRAVER *Corporation*

East Chicago Indiana

WATER SOFTENING AND FILTRATION PLANTS

INTERNATIONAL FILTER CO.

30 South Dearborn St. Chicago

New York Office: Woolworth Building

WATER SOFTENING AND FILTRATION PLANTS

AMERICAN WATER SOFTENER COMPANY

4th and LEHIGH AVES. PHILADELPHIA, PA.

No affiliation or working agreement with any of our competitors

EBG

Liquid Chlorine

Electro Bleaching Gas Co.

PIONEER MANUFACTURERS of LIQUID CHLORINE

Plant NIAGARA FALLS, N.Y.

Main office 18 East 41st Street New York Chicago office 11 So. La Salle St.

Rensselaer VALVE Company

*Designers and Builders of 72-in. and Smaller*

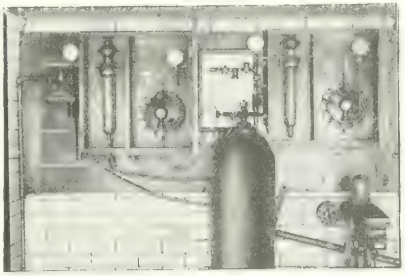
Hydro-Electric Valves for Throttling and Controlling Conditions

RENSSELAER VALVE CO., Troy, N. Y.

Are You Wasting Time

"FAVORITE" Reversible Ratchet WRENCH

Greene, Tweed & Co. 109 Duane St., N.Y.C.



W. & T. Equipment used in sterilizing the Water Supply at Corning, N. Y.

Accuracy Is Essential In Chlorine Control

IN sterilizing water by Liquid Chlorine, it is essential that the control apparatus be absolutely accurate. If it has been determined that a chlorine feed of say five pounds per hour is required, it is fundamental that just five pounds—no more, no less, but precisely five pounds shall be introduced to the water.

This requires that the chlorinator not only feed regularly and continuously, but that the chlorine flow meters be positively accurate.

Absolutely accuracy is obtained by the W & T Chlorinator. All W & T Chlorine meters are hydraulic in principle. If they operate at all, they must operate correctly. The positive accuracy of the W & T Chlorinator is one of the outstanding reasons for its supremacy in the field of water purification.

*Write for interesting free literature*

Wallace & Tiernan Co., Inc.

NEWARK, NEW JERSEY

GRAVITY PRESSURE

# FILTERS

DRY FEED
CHEMICAL MACHINES

*Write for Bulletins* 19-2-3

The total daily capacity
of municipal filtration plants
installed by us is
ONE BILLION GALLONS
Supplying 500 communities

THE NEW YORK CONTINENTAL
JEWELL FILTRATION COMPANY
NUTLEY, NEW JERSEY

111 W. Monroe St., Chicago, Ill.
New Birks Building, Montreal.

*Originators of Mechanical Filtration*

*Member Associated Manufacturers of Water Purifying Equipment.*

## *In These Abnormal Times*

Information in respect to Commercial Credits and Investment Securities is most essential.

A highly developed Credit Department and an Investment Securities Department are only two of the useful features of the service which we render to customers.

**The Coal and Iron National Bank**
of the
**CITY OF NEW YORK**
**Capital, Surplus and Profits, $3,000,000**

Member N. Y. Clearing House Assn.
Member Federal Reserve System

# 1922

## January 12th Issue

will be the

# Road Show Issue

*Send copy in today's mail*

## STEVENS

**Water Level Recorders and Indicators**

for water power plants, tides, irrigation, city water supply, sewers and drains.

***Let Stevens Recorders Plot Your Hydrographs***

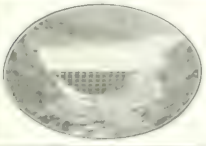
Direct Acting, Long Distance, Duplex and Differential Recorders and Indicators, Transits and Levels.

***Bulletins on request***
Hydrographic and Surveying Instruments
Leupold, Voelpel & Co., 109 E. 70th St., N., Portland, Ore.

# PITTSBURGH METER COMPANY

**Water Meters for all Domestic and Industrial Services**

East Pittsburgh, Pa.
New York
Chicago · Kansas City
Los Angeles · Seattle
Columbia, S.C.



## AMBURSEN DAMS

*Solve Difficult Foundation Problems*
Highest Built, 156 feet.
Lowest Built, 6 feet.
Longest Built, 8,000 feet.
Shortest Built, 25 feet.

**Ambursen Construction Co.,**
New York Atlanta Kansas City

# KENNEDY

**Water Gates, Fire Hydrants, Gate Valves**
have demonstrated their efficiency, reliability and low maintenance cost in installations throughout the country under different water conditions. Send for Catalog.
The Kennedy Valve Mfg. Co., Elmira, N. Y.
New York Boston Chicago San Francisco 211

# CHLORIDE OF LIME

For Purifying Water

Pennsylvania Salt Mfg. Company, Philadelphia, Pa., U. S. A.

# CRANE CO.

No. 7 Brass Globe Valve

No. 461 Iron Gate Valve

**We are Manufacturers of about 20,000 articles, including**

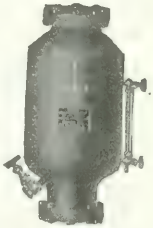
## Valves, Pipe Fittings and Steam Specialties

**made of brass, iron, ferrosteel, cast steel and forged steel, in all sizes, for all pressures, and all purposes, and are distributors through the trade, of pipe, heating and plumbing materials.**

Brass Cock

Malleable Iron Elbow

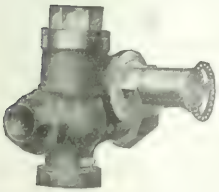
No. 437 Brass Gate Valve



No. 09 Oil Separator

Malleable Iron Return Bend

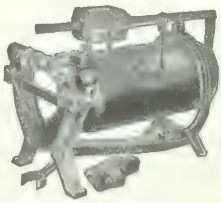
Reducing Flanged Tee



No. 962 Pressure Regulator

No. 20 Horizontal Brass Check Valve

Union



Non-Return Steam Trap

SALES OFFICES, WAREHOUSES AND SHOWROOMS:

BOSTON, SPRINGFIELD, HARTFORD, BRIDGEPORT, ROCHESTER, NEW YORK, HARLEM, ALBANY, BROOKLYN, PHILADELPHIA, READING, ATLANTIC CITY, NEWARK, CAMDEN, BALTIMORE, WASHINGTON, SYRACUSE, BUFFALO, SAVANNAH, ATLANTA, KNOXVILLE, BIRMINGHAM, MEMPHIS, LITTLE ROCK, MUSKOGEE, TULSA, OKLAHOMA CITY, WICHITA, ST. LOUIS, KANSAS CITY, TERRE HAUTE, CINCINNATI, INDIANAPOLIS, DETROIT, CHICAGO, ROCKFORD, OSHKOSH, GRAND RAPIDS, DAVENPORT, DES MOINES, OMAHA, SIOUX CITY, MANKATO, ST. PAUL, MINNEAPOLIS, WINONA, DULUTH, FARGO, WATERTOWN, ABERDEEN, GREAT FALLS, BILLINGS, SPOKANE, SEATTLE, TACOMA, PORTLAND, POCATELLO, SALT LAKE CITY, OGDEN, RENO, SACRAMENTO, OAKLAND, SAN FRANCISCO, LOS ANGELES

WORKS: CHICAGO AND BRIDGEPORT

FOUNDED BY R. T. CRANE, 1855

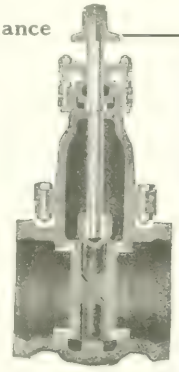
CRANE CO.
836 S. MICHIGAN AVE.
CHICAGO

CRANE LIMITED — MONTREAL, TORONTO, VANCOUVER, WINNIPEG, CALGARY, REGINA, HALIFAX, OTTAWA

CRANE-BENNETT, LTD. — LONDON, ENG.

the Story at a Glance

**Ludlow Double Gate Valves**



¶ Just ask the next Valve Salesman: Do the gates grind and drag shut—or do they wedge shut, tight, like the

**Ludlow?**

He'll have to be a mighty good salesman to answer satisfactorily

*Send for the 1921 Catalog*

**The Ludlow Valve Mfg. Co.**

Troy (LUDLOW) New York

Southern Representative: W. F.

**"WATCH DOG"**

**WATER METERS**

Accurate
Durable
Efficient

**GAMON METER COMPANY**
Main Office and Works:
NEWARK, NEW JERSEY

**SIMPLEX**
Venturi Tube
**METERS**

For checking up reciprocating pump performance and determining slippage due to imperfection or wear in valves; for measuring delivery of centrifugal pumps and figuring pumping station efficiency; for distributing proportionately the cost of water supplied to several districts; for checking up the performance of filter beds; for detecting waste; for recording daily amounts of sewage handled, and planning future extensions, etc., etc.

**SIMPLEX VALVE & METER CO.**
5722 Race St., Philadelphia, Pa.

**POWELL VALVES**

THE WHITE STAR VALVE

The Wm. Powell Co., Cincinnati, O.

*Tycos* temperature instruments

Indicating
Recording
Controlling

*Taylor Instrument Companies*
ROCHESTER, N. Y.

# MICHIGAN PIPE

Municipal Engineers: the moderate cost of "Michigan Pipe" permits lowered estimates, or greater extensions of water main systems. Michigan Pipe can be shipped immediately from stocks on hand.

The permanency and excellent water service of "Michigan Pipe" lines are attested by a wealth of installation data covering more than 10 years of water-works service. Ask for the Michigan Pipe data book.

**The Michigan Pipe Company, Dept. 17, Bay City, Michigan**

New York City, N. Y. ..... 17 E. 42nd St.
Oklahoma City, Okla. ..... 17 N. Dewey St.
Chicago, Ill. ..... 15 E. Van Buren St.
Boston, Mass. ..... [illegible]
Cleveland, Ohio ..... 919 Ulmer Bldg.
Chattanooga, Tenn. ..... 702 James Building
Montreal, Quebec, Canada ..... 204 St. James St.
Philadelphia, Pa. ..... 318 Widener Bldg.

AMERICAN WOOD PIPE

Wire wound and continuous stave wood pipe for—

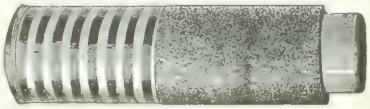
***Irrigation Water Works Railroads, Mines, Etc.***

Water pipe—made of clear Washington Yellow Fir. Steam pipe—stave—made of Washington Coast asbestos or tin lined for [illegible] reinforced beam [illegible].

*Write for Catalog.*

**AMERICAN WOOD PIPE CO., TACOMA, WASH**

*Eastern Office: 50 Church St., New York City*



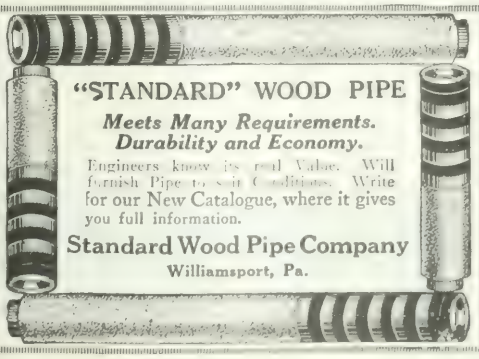
## Wyckoff Wood Pipe

Carries 14 to 20% more water than iron or steel and lasts longer.

Frost and corrosion proof. Send for our Catalog for full details.

**A. Wyckoff & Son Company, Elmira, N. Y.**

H. H. White, 1503 Fourth Natl. Bank Bldg., Atlanta, Ga.; Johnson-Peters Co., Pittsburgh Terminal Warehouse, Pittsburgh, Pa.; Valley Supply Co., Coal Exchange Bldg., Scranton, Pa.



## "STANDARD" WOOD PIPE

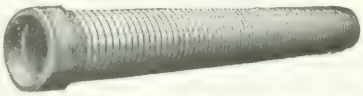
***Meets Many Requirements. Durability and Economy.***

Engineers know its real Value. Will furnish Pipe to suit Conditions. Write for our New Catalogue, where it gives you full information.

**Standard Wood Pipe Company**

**Williamsport, Pa.**

## PACIFIC REDWOOD AND DOUGLAS FIR PIPE



Made in all sizes from 2 inch to 11 feet in diameter

***Write for Catalogue***

PACIFIC TANK & PIPE CO.
THE STANDARD SINCE 66

8 Rector St., New York — 306 Market St., San Francisco
169 Washington St., Chicago

SATISFACTORY RESULTS
RAPID INSTALLATION
ECONOMICAL OUTLAY

For Water Supply Lines for

Mines, Mills, Hydraulic Operations, Hydro-Electric Plants, Dredging, etc.

Furnished Asphalted or Galvanized from 3 to 42 inches diameter and fitted with forged steel connections.

Hydraulic Giants, Flexible Joints, Valves and Fittings for complete installations.

*Ask for Catalogue 5 K.*

AMERICAN SPIRAL PIPE WORKS
CHICAGO

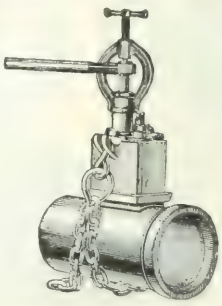
Easily Carried By One Man

This light, durable machine will be sent on approval for 30 days' trial. If not as represented, send it back.

Corporation Tapping Machine

Write for latest bulletins of this and other water-works appliances.

The A. P. Smith Mfg. Co.
East Orange, N. J.



*Every joint tight*

UNIVERSAL CAST IRON PIPE

*no packing no calking no bell holes*

—water supply—fire protection—sewage disposal—sub-aqueous ties—oil distillation—refrigeration—central station heating—low pressure steam. Have you complete data?

THE CENTRAL FOUNDRY COMPANY
30 WEST STREET, NEW YORK
Chicago Atlanta Dallas San Francisco
417

GLAMORGAN PIPE & FOUNDRY CO.
LYNCHBURG, VA.
GENERAL FOUNDERS AND MACHINISTS
Manufacturers of
Cast Iron Pipe
For Water and Gas, Flange Pipe and Fittings
Western Office: 543 The Rookery, Chicago

1803 R. D. Wood & Co. 1921
400 Chestnut St., Philadelphia

Cast Iron Pipe
Special Castings
*For water, Gas and High Service*

Mathews Fire Hydrants
Gate, Foot and Check Valves
Loam Castings
Hydraulic Tools
Gas Producers

ROOT
Spiral Riveted Pipe—
Pipe specialists for 48 years.
Abendroth & Root Mfg. Co.
Works: Newburgh, N. Y.
N. Y. Office: 233 Broadway

Warren Foundry & Machine Company

Manufacturers of

CAST IRON PIPE
SPECIAL CASTINGS

Bell and Spigot—Flanged—Flexible Joint—Culvert—Tubes, Milled and Plain Ends — Cylinders — Manhole Heads and Covers—High Pressure Fire Service Pipe—All Sizes

Works: Phillipsburg, N. J.
Sales Offices: Bowling Green Bldg., New York; 201 Devonshire Street, Boston, Mass.

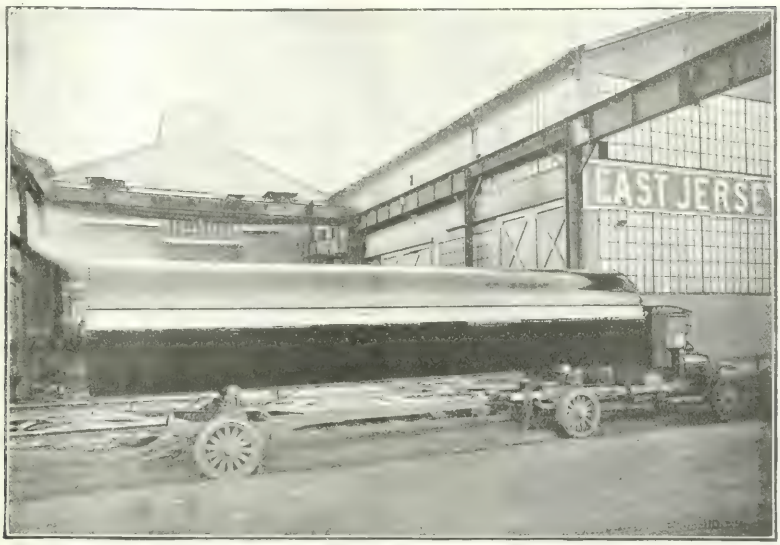
Dredge Pipe

PONTOON AND SHORE
Elbows, Branches, Ball Joints, Valves, Steel Pontoons
MACHOLD & RIDDELL, Stephen Girard Building, PHILADELPHIA, PA.

TRADE "LEADITE" MARK
Registered U. S. Patent Office
FOR JOINTING CAST IRON WATER MAINS
NO CAULKING
Saves 50% to 75%
*Leadite Joints Improve with Age*
THE LEADITE COMPANY, 1232 Land Title Bldg., Phila., Pa.

U. S. PRODUCTS
CAST IRON PIPE
USICAST CASTINGS
United States Cast Iron Pipe & Fdy. Co.
General Offices: Burlington, N. J.

CAST IRON PIPE
AND FITTINGS
American Cast Iron Pipe Company
Birmingham, Ala.
SALES OFFICES IN PRINCIPAL CITIES




*Transporting "Lock-Bar" Pipe by Motor Truck*

LOCK-BAR Pipe is made in 30-ft. lengths—most convenient for shipping and handling. It bears transportation well—especially the tough, tenacious protective coating.

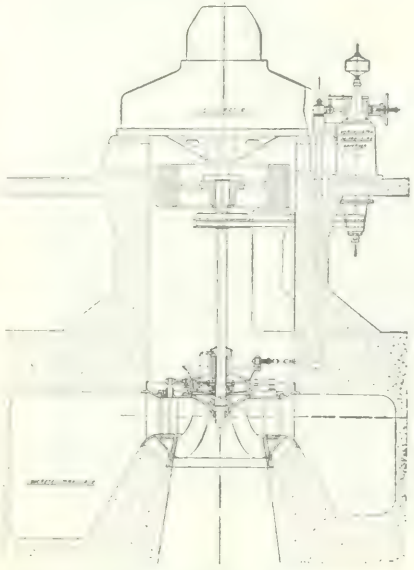
*Upon request accompanied by business card we will be glad to send to Executives our new 200 page "Handbook of Pipe."*

EAST JERSEY PIPE CO., 7 Dey Street, New York City
Works: Paterson, N. J.

LOCK-BAR

*Before* *Closing*

STRONG AS THE PLATE ITSELF



Another of the seven Standard Worthington settings which cover practically every hydraulic power situation. This setting is best for heads from 25 to 50 feet.

## Standardized Means Better Design

The individual parts of Worthington Hydraulic Turbines are standardized throughout, so that each element receives more careful study and more complete testing than is possible in special designs for each occasion.

Building turbines out of standard parts not only eliminates many chances for error in the design of minor details, but also cuts the cost of repairs.

**WORTHINGTON**

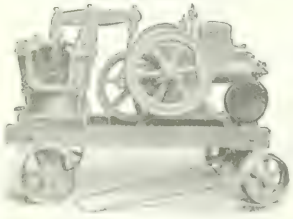
WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
*Branch Offices in 24 Large Cities*

W 43.4

## "DOMESTIC"

Reg. U. S. Pat. Off.

Use Domestic Units and Insure Profits



Power Pump and Hoist Outfits

*Send for Bulletin "B"*

**Domestic Engine & Pump Co., Shippensburg, Pa.**

## FAIRBANKS-MORSE

MANUFACTURERS CHICAGO

*Oil Engines—Pumps—Electric Motors and Generators—Fairbanks Scales—Railway Appliances—Light Plants—Water Systems.*

## EDSON

"Reg. U. S. Pat. Off."

*The World's Standard for*

**DIAPHRAGM PUMPS**

Have you ever required a pump to do the DIAPHRAGM with the BEAD. Most unusual and severe pumping work. None genuine without white diamond bearing our trademark and name in full.

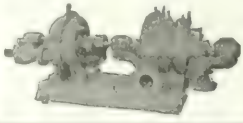
**EDSON MANUFACTURING CORP'N**

Established 1859 373 Broadway, Boston, Mass.

## De Laval

**Steam Turbine Co., Trenton, N. J.**

## LEA-COURTENAY PUMPS



Centrifugal pumping machinery for every kind of pumping service.

**Lea-Courtenay Co**

3 Main Street Newark, N. J.

## WOODWARD WATERWHEEL GOVERNORS

Built in All Types and Size from the Smallest to the Largest

**Woodward Governor Company**

203 Mill Street Rockford, Illinois

Centrifugal **EARLE** Pumps

Cut Gears Lea Simplex Cold Saws

Special and Bridge Machinery

The Earle Gear and Machine Co

4707 Stenton Ave Phila. Pa

# PUMPS

TRIPLEX · CENTRIFUGAL · ROTARY · DEEP WELL HAND

## Pumping Oil and Water Alternately With a Goulds Centrifugal

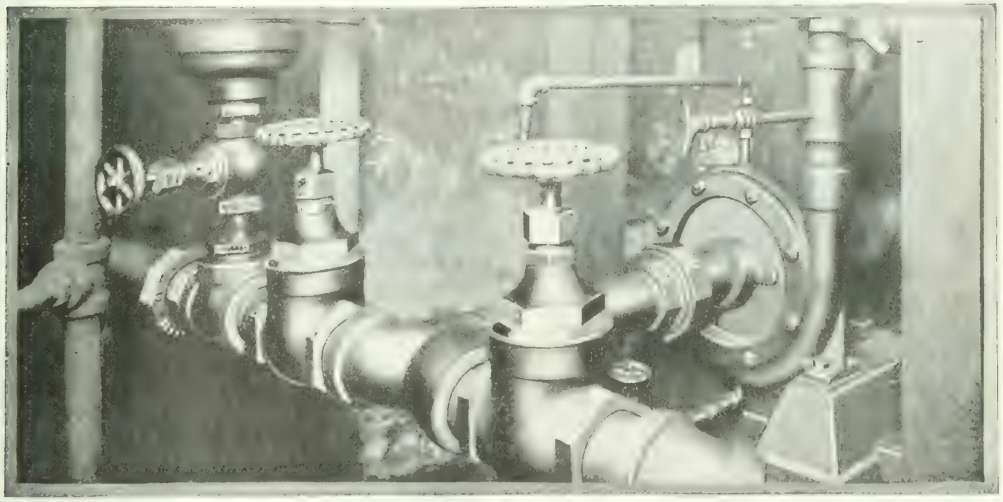
One Goulds Centrifugal Pump in the S. Obermayer Co. plant, 18th and Rockwell Streets, Chicago, pumps oil and water alternately. Through the arrangement of the feed pipes, the loss of oil is reduced to the least possible amount. This Goulds Pump like all Goulds Pump installations gives satisfactory service—because every *Goulds Pump is guaranteed to perform satisfactorily the specific work for which it is sold.*

**Our Engineering service department will be pleased to be of assistance to you on any pumping problem. Every engineer should have a set of our Bulletins—have you one?**

**Plant of S. Obermayer Co., Chicago, Ill.**

**The Goulds Manufacturing Co., Main Offices and Works: Seneca Falls, N. Y.**

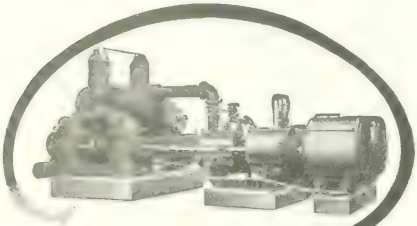
**New York**, 16 Murray St., and 19 Park Place **Boston**, 58 Pearl St **Pittsburgh**, 636 Henry W. Oliver Bldg. **Atlanta**, Citizens & Southern Bank Bldg.
**Chicago**, 12-14 S. Clinton St. **Philadelphia**, 111 North 3rd St **Houston**, 1001 Carter Bldg. **Detroit**, 804 Dime Bank Bldg



# GOULDS

## The John H. McGowan Co.

*Manufacturers*



*The Cost Question*

Duplex Steam Pumps Power

## What Is It—

The cost of installation—of operation—of maintenance—of class of operator necessary?

Is it *not a combination* of all?

**CINCINNATI, OHIO, U. S. A.**

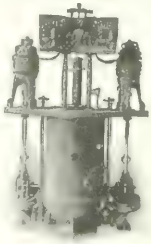
## Automatic Sewage and Drainage Pumps

***also***

**Hot Water Circulation**

***and***

**Condensation Return Pumps**



Sewage Ejector
Duplex Centrifugal

Our apparatus in the most important buildings and power stations in U. S.

**Municipal Sewage Pumping Plants**

**designed and erected**

***The Shone Pneumatic Sewage Ejector***

**YEOMANS BROTHERS CO.**

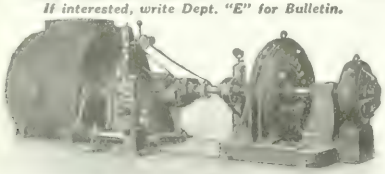
**1431 Dayton St., Chicago**

*Representatives in all large cities*

**TONS OF COAL CAN BE SAVED**

if water-power users would replace their antiquated and inefficient water wheels with SMITH TURBINES

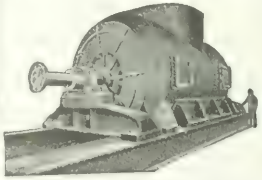
***If interested, write Dept. "E" for Bulletin.***



**S. MORGAN SMITH COMPANY, YORK, PA.**

Branch Offices: 156 Lincoln St. BOSTON; 716 Monroe St. CHICAGO; 405 Power Bldg. MONTREAL

## Leffel Turbine Water Wheels



***High Speed***
***High Efficiencies***
***High Horsepower***
***Vertical***
***and***
***Horizontal Designs***

**The James Leffel & Co.,** Springfield, Ohio, U. S. A.

**BRANCH OFFICES:**

NEW YORK, N. Y. ..... 39 Cortlandt St.
BOSTON, Mass. ..... 161 Devonshire St.
ATLANTA, Ga. ..... Fourth Nat'l Bank Bldg.
MINNEAPOLIS, Minn. ..... Plymouth Bldg.
William Hamilton Co., Ltd.: Peterborough, Ont., Canada.

**A. D. COOK, LAWRENCEBURG, INDIANA**

*Manufacturer of*

Deep Well Pumps, Well Augers, Cook's Patent Double Acting, Cook's Patent Force Pump Shallow Well Outfits, Water Rods and Well Tools, Deep Well Pumping Outfits.

*Write for Catalog No. 11-6.*

Cook Deep Well Pumps are manufactured by A. D. Cook. The Cook Well Company of Peru, Indiana, manufactures the celebrated Cook Rotary Pumps. All Cook Pumps are sold by A. D. Cook, Lawrenceburg, Indiana. All Cook Well Augers are sold by A. D. Cook, Lawrenceburg, Indiana. All Cook Deep Well Pumping Outfits are sold by A. D. Cook, Lawrenceburg, Indiana.

**MANISTEE** TORO.
CENTRIFUGAL PUMPS
ROTARY ICE CONDENSERS

## PELTON

HYDRAULIC TURBINES,
GOVERNORS
AND CENTRIFUGAL PUMPS

**THE PELTON WATER WHEEL CO.**

Main Office: 30 Church St., New York. Branch Office: 120 Fremont St., San Francisco

**MORRIS** CENTRIFUGAL PUMPS

HYDRAULIC

DRIED GES

PUMPING ENGINES

SINCE 1864

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Agencies in Principal Cities

# STEEL TANKS

## CHICAGO BRIDGE & IRON WORKS

**Elevated Steel Tanks, Storage Tanks, Steel Stacks and Heavy Plate Work**

***Catalog No. 10 Gladly Sent on Request***

*SALES OFFICES:*

Chicago, Ill. ..... 2101 Old Colony Bldg.
New York, N. Y. ..... 3111 Hudson Terminal Bldg.
Atlanta, Ga. ..... 1025 Empire Bldg.
Charlotte, N. C. ..... 501 Realty Bldg.
Dallas, Texas ..... 1502 Praetorian Bldg.
San Francisco, Cal. ..... 1020 Rialto Bldg.
Los Angeles, Cal. ..... Wright & Callendar Bldg.
Seattle, Wash. ..... L. C. Smith Bldg.
Montreal, Que. ..... 1114 Bank of Toronto Bldg.

**Shops at Chicago, Ill., Greenville, Pa., and Bridgeburg, Ont.**

# Elevated Water Tanks Standpipes, Stacks Pressure Tanks, Etc.

All kinds of plate steel construction

## TIPPET & WOOD

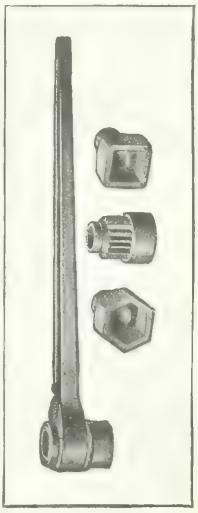
PHILLIPSBURG, N. J.

New York Office: 135 William Street

**The labor situation calls for**

# LOWELL

## Reversible Ratchet Wrenches



As the wage per hour mounts, the work done per hour has to mount — or should mount—in proportion. If it is a job that employs wrenches, the men will work at their highest efficiency if equipped with Lowell Reversible Ratchet Wrenches to fit the exact situation. An outfit of Lowells is a good outfit—pays well—speeds up work and reduces delays and accidents. Write for Catalog R.

**Lowell Wrench Co.**
**50 Commercial St.**
**Worcester, Mass.**

# LOWELL

# Better Welding

Welding efficiency means the highest production of sound welds with lowest gas consumption.

Look up your costs of acetylene and oxygen gases for the past year. Then let us tell you how much the Milburn "Cut-Weld" Torch will save you

Two of America's greatest railroad systems have just adopted the Milburn "Cut-Weld" Torch after years of competitive tests. Send for details, in Catalog 21.

## The Alexander Milburn Company

**1420-1428 West Baltimore St., Baltimore, Md.**

New York, Grand Central Palace Philadelphia, Bourse Building, Pittsburgh, 532 Union Arcade Chicago, 14 E. Van Buren St. San Francisco, 568 Market St.

# P.I.W. SERVICE IS WORLDWIDE

## STEEL PLATE CONSTRUCTION

P.I.W. Steel Plate Products are used in the Petroleum, Gas, Mining, Railway, Iron and Steel, Water Works, Engineering and Allied Industries.

## The Petroleum Iron Works Company

**Sharon, Pa.**

New York St. Louis Houston San Francisco

## Steel Tanks for All Purposes

Also Water Screening Equipment

Steel Tanks, both vertical and horizontal, riveted or welded. Bolted steel erected Storage Tanks. Elevated Tanks, Stacks, Breeching and Steel Roofs.

GRAVER *Corporation*

East Chicago, Indiana

## The Reason Why

A wealth of experience and excellent shop facilities enable DES MOINES to render a service that is more than satisfactory, at a price and with such promptness that is more than gratifying.

Do you specify DES MOINES PRODUCTS by name? This is the only way to be sure of quality. Write for Catalogue No. 50 today.

PLANTS
Pittsburgh, Pa.
Des Moines, Ia.

**Pittsburgh-Des Moines Steel Co.**

850 Curry Bldg., Pittsburgh, Pa.

# TANKS

All kinds of plate construction for power plants, oil and chemical and other industrial purposes. Large capacity, quick service, dependable work.

## NEW YORK CENTRAL IRON WORKS CO. INC.

**MIDDLEBURG DRIVE - HAGERSTOWN, MARYLAND**

*30 CHURCH ST., NEW YORK - 1027 WIDENER BLDG., PHILADELPHIA*

# MEMPHIS

**COMPLETE INDUSTRIAL BUILDINGS**

*Tanks & Towers—Structural Steel Work—Plate Work*

**Memphis Steel Construction Co. of Pa.**

Magee Building PITTSBURGH, PA.

## AMERICAN CHIMNEY CORPORATION

OF NEW YORK

Designers and Builders

**Radial Brick Chimneys**

MAY WE SEND YOU OUR CATALOGUE?

Main Office:

**147 Fourth Avenue, New York**

BRANCHES

Chicago 1101 Security Bldg.
Cleveland 910 Guardian Trust Bldg.
Philadelphia 1421 Chestnut Street Bldg.
Boston 141 Milk Street

## CUSTODIS CHIMNEYS

**Alphons Custodis Chimney Construction Co.**
95 Nassau Street, New York
*Perforated Radial Brick Chimneys*

BUILDERS AND DESIGNERS OF THE TALLEST AND LARGEST CHIMNEYS IN THE WORLD

*Anaconda Copper Mining Company*, Anaconda, Mont. Height 585 ft. above grade. Top diam., 60 ft.

We design and build chimneys of all sizes and for all purposes for boilers, furnaces, chemical plants, destructors, etc.

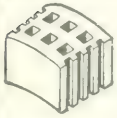
Experts in repairing chimneys.

Lightning Rods installed and repaired.

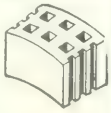
Specifications, plans, designs, and data furnished free upon request.

ATLANTA BOSTON CHICAGO CLEVELAND DETROIT PHILADELPHIA TORONTO PITTSBURGH RICHMOND SEATTLE MONTREAL

Send for free descriptive literature, Set No. 313.



## KELLOGG CHIMNEYS



have proved their ability to stand up under the hardest service conditions. Not one has ever failed. The evenly hard burned radial brick with corrugated sides insure the greatest possible strength of the mortar joints. Leading power plants and smelters are equipped with Kellogg Chimneys.

**Bulletin No. 60 is yours on request. Write.**

**THE M. W. KELLOGG COMPANY**
90 West Street, New York

## H. R. HEINICKE, Inc.

*Designers and Builders*

**RADIAL BRICK CHIMNEYS**

**New York, N. Y., 147 Fourth Avenue**
**Indianapolis, Ind., 540 N. Meridian St.**

SALES OFFICES

Pittsburgh, Cleveland, Chicago, Milwaukee, Boston, St. Louis, Detroit, Louisville, Buffalo, Philadelphia, Charlotte, N. C., Los Angeles, Montreal, Cincinnati, Kansas City, Memphis, New Orleans

Heinicke Chimneys have stood the test for twenty years. They are economical in first cost and fuel consumption. Our Engineering Department is at your service. Preliminary estimates and designs furnished. May we mail you our 1921 circular?

## THE HEINE CHIMNEY CO.

ENGINEERS and BUILDERS

**RADIAL BRICK**
and
**CONCRETE CHIMNEYS**

**Chicago, Ill.**
**123 W. Madison St.**

**New York, N. Y.**
**30 Church St.**

*Branch offices in all principal cities*

## SUMMERHAYS RADIAL BRICK CHIMNEYS *AND* BOILER MASONRY

Put our 60 years of highly specialized training and experience to work on your chimney problems

*Send for data—photographs and names of customers*

**WM. SUMMERHAYS & SONS**
ROCHESTER, N.Y.

## WEBER REINFORCED CONCRETE CHIMNEYS

**More Than Fifteen Hundred in Use**

*Builders of*
**The Highest Masonry Structure in the World**
**at Tokio, Japan**

Inside top diameter 3 ft. 6 in.

Catalog sent free upon request.
**Contracts executed in all parts of the world.**

**The Weber Chimney Company**

## GENERAL CONCRETE CONSTRUCTION CO.

**CONCRETE CHIMNEYS**

CHICAGO
431 S. DEARBORN ST.

NEW YORK
30 CHURCH ST.

## WIEDERHOLDT CHIMNEYS

**for Special Service**

Not confined to gas outlet for boiler or special service HIGH TEMPERATURE ACID GASES OR ANY OTHER UNUSUAL CONDITIONS

**Wiederholdt Construction Co.**
621 Bank of Commerce Bldg. ST. LOUIS, MO.

# THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

**Builders since 1868 of Water Tube Boilers of continuing reliability**

BRANCH OFFICES

BOSTON, 49 Federal Street
PHILADELPHIA, North American Building
PITTSBURGH, Farmers Deposit Bank Building
CLEVELAND, Guardian Building
CHICAGO, Marquette Building
CINCINNATI, Traction Building
ATLANTA, Candler Building
TUCSON, ARIZ., 21 So. Stone Avenue
FORT WORTH, TEX., Flatiron Building
HONOLULU, H. T., Castle & Cooke Building

THE BABCOCK & WILCOX COMPANY — STEAM

WORKS

Bayonne, N. J.
Barberton, Ohio

**Makers of Steam Superheaters since 1898 and of Chain Grate Stokers since 1893**

BRANCH OFFICES

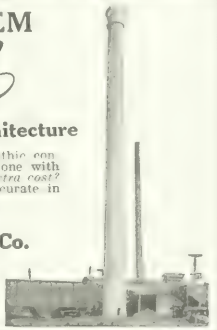
DETROIT, Ford Building
NEW ORLEANS, 521-5 Baronne Street
HOUSTON, TEXAS, Southern Pacific Building
DENVER, 435 Seventeenth Street
SALT LAKE CITY, 708-6 Kearns Building
SAN FRANCISCO, Sheldon Building
LOS ANGELES, 404-6 Central Building
SEATTLE, L. C. Smith Building
HAVANA, CUBA, Calle de Aguiar 104
SAN JUAN, PORTO RICO, Royal Bank Building

## POLK SYSTEM

*Conirib*

**The Chimney with Architecture**

Why pay for a plain, dull monolithic concrete chimney when you can get one with *real architectural value without extra cost?* A "Conirib" Chimney is more accurate in every line and beautifully ribbed.



*Write for details*

**Polk Genung Polk Co.**

*Sales Office:*
Indianapolis, Ind.

*Factory Office:*
Fort Branch, Ind.

## RUST CHIMNEYS

RADIAL BRICK AND REINFORCED CONCRETE

REFRACTORY BRICKWORK

**The RUST ENGINEERING CO.**

ENGINEERS AND CONTRACTORS

PITTSBURGH WASHINGTON BIRMINGHAM

## Watch WEBSTER

See larger advertisements each month. Watch well for what you want to know about Webster Conveying Elevating, Transmitting Machinery

The Webster Mfg Co
1070 Cortlandt St.,
Chicago., Ill.

AIRCO

*PRODUCTS*

*Oxygen*
*Acetylene*
*Welding and Cutting Apparatus and Supplies*
*Acetylene Generators*
*Carbide*
*Nitrogen*
*Argon*

"Airco Oxygen and Acetylene Service is Good Service"

## Airco District Offices and Distributing Stations

An Airco Distributing Station is located in each of the following cities. District Offices are located in cities indicated by a star (*).

Albany, N. Y.
Atlanta, Ga.
556 Marietta St.
*Boston, Mass.
122 Mt. Vernon St.
Dorchester
Baltimore, Md.
Bethlehem, Pa.
Bridgeport, Conn.
Brooklyn, N. Y.
Bronx, N. Y.
*Buffalo, N. Y.
730 Grant St.
Canton, O.
*Chicago, Ill.
2246 So. Lumber St.
*Cleveland, O.
1210 W. 69th St.
Cincinnati, O.
Coatesville, Pa.
Columbus, O.
Defiance, O.
Des Moines, Ia.
*Detroit, Mich.
7991 Hartwick St.
Duluth, Minn.
East Chicago, Ind.
East St. Louis, Ill.
*Emeryville, Calif.
Park Ave. and Halleck St.
Erie, Pa.
Fort Wayne, Ind.
Gloucester, N. J.
Grand Rapids, Mich.
Hartford, Conn.
Indianapolis, Ind.
*Jersey City, N. J.
181 Pacific Ave.
Johnstown, Pa.
Joplin, Mo.
Kansas City, Mo.
Lebanon, Pa.
Louisville, Ky.
Madison, Ill.
Milwaukee, Wis.
*Minneapolis, Minn.
327 25th St., S. E.
New Haven, Conn.
New York, N. Y. (Metropolitan Dist.)
*Jersey City, N. J.
181 Pacific Ave.
Brooklyn, N. Y.
Bronx, N. Y.
Norf lk, Va.
*Oklahoma City, Okla., P. O. Box. 1338
Paterson, N. J.
Peoria, Ill.
*Philadelphia, Pa.
Germantown and Allegheny Aves.
*Pittsburgh, Pa.
2515 Liberty Ave.
Portland, Ore.
*Richmond, Va.
P. O. Box 1192
San Francisco, Cal.
*Seattle, Wash.
3623 E. Marginal Way
Sharon, Pa.
Springfield, O.
*St. Louis, Mo.
115 Plum St.
Tacoma, Wash.
Terre Haute, Ind.
Toledo, O.
Tulsa, Okla.
Warren, O.
Youngstown, O.

## AIR REDUCTION SALES CO.

*Mfrs. of Airco Oxygen, Airco Acetylene, Airco Welding and Cutting Apparatus and other Airco Products.*

Home Office:
342 Madison Ave., New York, N. Y.

## AMERICAN GAS FURNACE CO.

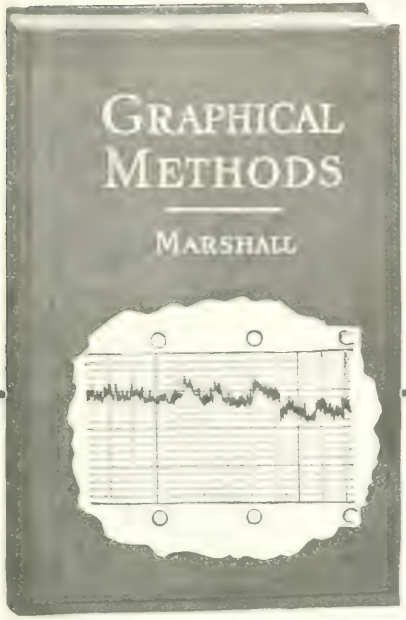
**Main Office and Works, ELIZABETH, N.J.**

EVERY TYPE OF GAS BLAST FURNACE, HEATING MACHINE, BURNER, INCLUDING BLOWERS, ETC., FOR INDUSTRIAL USES

# FOSTER SUPERHEATERS

A necessity for turbine protection, engine cylinder economy, and utilization of superheat for all its benefits

POWER SPECIALTY COMPANY Boston Pittsburgh San Francisco Philadelphia Chicago Kansas City Dallas London, Eng. 111 Broadway, New York




## The Construction and Use of Graphs—

*Just Out*

## GRAPHICAL METHODS

By William C. Marshall

*253 pages, 6 x 9, 229 illustrations, $3.00.*

## Free Examination Coupon

## Norton Self-Lowering Jacks Are the Fastest Jacks Made

They lower the full load with absolute safety by pressing the button—you do not have to pump or crank them down as with other jacks.

25 to 100 tons capacity—Plain and with foot lift. Send for complete illustrated Catalog No. 30.

**A. O. Norton,** Incorporated
440 Brookline Ave., Boston, Mass

## STEELE & CONDICT, INC.

*Manufacturing Engineers—Jersey City, N. J.*
Most Modern Facilities for the
DESIGN, MANUFACTURE and ERECTION of
**MACHINERY and EQUIPMENT**
for all types of **MOVABLE BRIDGES**
*Established 1865*

## BELMONT IRON WORKS

PHILADELPHIA NEW YORK EDDYSTONE

*Engineers · Contractors · Exporters*

STRUCTURAL STEEL AND
STEEL LUMBER
*Complete Industrial Buildings*

## Louisville Bridge & Iron Company

(Incorporated)
Louisville, Ky.

**Bridges Buildings Structural Steel**

Engineers, Fabricators, Erectors of Steel Railroad and Highway Bridges. Structural Metal Work of every description

## PENN BRIDGE COMPANY

Beaver Falls, Pa.

Designers Manufacturers Erectors
Bridges, Buildings, Structural Steel of Every Description
Stock Steel for Prompt Shipment

## MILWAUKEE BRIDGE COMPANY

STEEL FRAMED STRUCTURES

MILWAUKEE, WIS.

## ALLEN RIVETERS

"Whatever the Riveting, there's an ALLEN for the job"

*Let us quote on your present needs*

JOHN F. ALLEN CO.
372 Gerard Avenue (Bronx), New York

# AMERICAN BRIDGE COMPANY

HUDSON TERMINAL 30 CHURCH STREET, NEW YORK

*Manufacturers of Steel Structures of all classes particularly* BRIDGES AND BUILDINGS

SALES OFFICES:

| | | | |
|---|---|---|---|
| NEW YORK, N. Y. | 30 Church St | St. Louis, Mo. | Liberty Central Trust Building |
| Philadelphia, Pa. | Widener Building | Denver, Colo. | First Nat. Bank Building |
| Boston, Mass. | 120 Franklin St. | Salt Lake City, Utah | Walker Bank Building |
| Baltimore, Md. | Continental Building | Duluth, Minn. | Wolvin Building |
| PITTSBURGH, PA. | Frick Building | Minneapolis, Minn. | 7th Ave. & 2nd St., S. E. |
| Buffalo, N. Y. | Marine Nat. Bank | | |
| Cincinnati, Ohio | Union Trust Building | | |
| Atlanta, Ga. | Candler Building | | |
| Cleveland, Ohio | Guardian Building | | |
| Detroit, Mich. | Beecher Ave. & M. C. R. R. | | |
| CHICAGO, ILL. | 208 So. La Salle St. | | |

*Pacific Coast Representatives:*

U. S. Steel Products Co., Pacific Coast Dept.
San Francisco, Cal. ..... Rialto Building
Portland, Ore. ..... Selling Building
Seattle, Wash. ..... 4th Ave. So., Cor. Conn. St.

*Export Representative: United States Steel Products Co., 30 Church St., N. Y.*

# VIRGINIA BRIDGE & IRON CO.

*Steel Buildings & Bridges*

ROANOKE MEMPHIS ATLANTA NEW ORLEANS DALLAS

# KING BRIDGE CO.

CLEVELAND, OHIO

# BERLIN CONSTRUCTION CO.

STEEL BUILDINGS BRIDGES STRUCTURAL WORK

Offices and Works
BERLIN - - CONN.
220 Broadway, New York
Springfield, Mass.

# LACKAWANNA BRIDGE COMPANY

CONSULTING ENGINEERS, DESIGNERS
MANUFACTURERS OF STEEL STRUCTURES
GENERAL CONTRACTORS FOR FIREPROOF CONSTRUCTION

New York, Chicago, Buffalo, Milwaukee, Houghton, Mich.

# WORDEN-ALLEN COMPANY

# BRIDGE OPERATING MACHINERY

Designed and Manufactured for
All Types of Lift Bridges and Swing Draws
The Earle Gear and Machine Co.
PHILADELPHIA, PA.

# FREDERICK SNARE CORP.

*Formerly* THE SNARE AND TRIEST CO.
CONTRACTING ENGINEERS
8 West 40th Street, New York

Harbor Works, Railroads, Bridges, Industrial Plants, Sugar Plants, Steel and Masonry Construction, Tanks, Pipe Lines, Water Works

# The TERRY & TENCH CO. INC

*Engineers and Contractors*
GRAND CENTRAL TERMINAL, NEW YORK CITY

# FORT PITT BRIDGE WORKS

OF PITTSBURGH, PA.
Bridges, Buildings, Ship Fabrication

Shoemaker-Satterthwait Bridge Co.
Fabricated Steel for Bridges and Buildings
New York
Main Office and Works
Pottstown, Pa.
Philadelphia

KENWOOD BRIDGE COMPANY
Engineers, Designers, Fabricators, Erectors of
STRUCTURAL STEEL WORK
Prompt shipments of fabricated or plain sections from stock

MORAVA CONSTRUCTION CO.
ENGINEERS AND CONTRACTORS
Manufacturers of
STRUCTURAL STEEL
For All Purposes STEEL BUILDINGS, BRIDGES, Etc.

KELLOGG
STRUCTURAL STEEL CO.
BUFFALO, N. Y.

The Strauss Bascule Bridge Company—Engineers
Specialists in MOVABLE BRIDGES, Designers of
STRAUSS TRUNNION BASCULE BRIDGES
and
STRAUSS DIRECT LIFT BRIDGES
225 North Michigan Avenue, Chicago

EASTERN
BRIDGE & STRUCTURAL Co.
WORCESTER, MASS.
BRIDGES AND BUILDINGS

RIVERSIDE BRIDGE CO.
STEEL STRUCTURES
MARTINS FERRY, O.

Snead Architectural Iron Works
LOUISVILLE, KY.
STRUCTURAL STEEL and ORNAMENTAL IRON
Large Stock of Standard and Bethlehem Shapes
Immediate Shipment of Fabricated or Plain Material

Works—Phoenixville, Pa.
The Phoenix Bridge Co.
—Bridges and Buildings—
Offices
Phila. New York Boston Rochester Washington

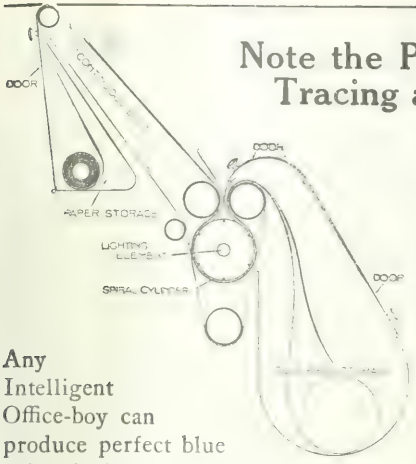
INDEPENDENT
BRIDGE CO.
WORKS:
NEVILLE ISLAND, PA.
and NORTH SIDE
OFFICE:
MAY BUILDING
PITTSBURGH, PA.

The Mount Vernon Bridge Co.
ENGINEERS AND MANUFACTURERS OF
Iron and Steel Mill Buildings and Structural Work
Railway and Highway Bridges, Roofs, Viaducts, etc.
MOUNT VERNON, OHIO

WISCONSIN BRIDGE
& IRON CO.
NORTH MILWAUKEE WISCONSIN
Chicago Detroit Kansas City El Paso

THE
Boston Bridge Works
INCORPORATED
47 Winter Street, Boston, Mass.
Bridges and Buildings

JANUARY 12TH
Good Road Show Issue
Send copy today




## Note the Perfect Contact Between Tracing and Paper—and the other features

This cross-section of the Wickes Blue Printing Machine speaks for itself. Note the lighting element, in particular. The light is projected in a direct radial line through the tracing without intervening glass. In other words, we have eliminated the breakable glass cylinder and substituted an open grill work of bronze wires that cannot overheat. The light is closer to the printing paper than in any other type of machine. This means *cleaner, clearer* prints. Fast, clean work is a Wickes characteristic. There are no complications—no ventilating fans, no series of belts—no high powered motor. Space forbids a listing of all the Wickes advantages.

*Write us and we will convince you that you can save money, eliminate trouble and get better prints the Wickes way.*

Any Intelligent Office-boy can produce perfect blue prints in large quantities

Built by

1856 **WICKES BROTHERS** 1921

**200 Water Street, Saginaw, Mich., U. S. A.**

501 Fifth Ave., New York, N. Y.
736 White-Henry Bldg., Seattle, Wash.

# WICKES
## BLUE PRINT SYSTEM
SAGINAW-MICHIGAN

## The Choice of the Experienced Draftsman

is a paper that is strong, of uniform texture; that takes pencil and ink well, and stands a maximum amount of erasures. For over half a century

## K&E "Duplex" Detail Drawing Paper No. 50

has satisfactorily met the draftsman's want for such a paper.

Made of selected rag, it has unusual durability and strength. Its cream or buff color makes it agreeable to the eye and less subject to soiling. And, last not least, its splendid erasing qualities save many a disagreeable situation where otherwise the drawing would be spoiled and have to be done over again. It is, therefore, a dependable and economic paper to work with.

In price, this paper is only slightly higher than inferior semi-wood pulp paper—and remember the K & E quality guarantee stands back of it.

**Furnished in Sheets and Rolls up to 62 inches wide.**

*Not genuine unless bearing our label and trademark.*

**Send for sample**

## KEUFFEL & ESSER CO.

**NEW YORK, 127 Fulton Street,** General Office and Factories, **HOBOKEN, N. J.**

CHICAGO 616-20 S. Dearborn St. | ST. LOUIS 817 Locust St. | SAN FRANCISCO 30-34 Second St. | MONTREAL 6 Notre Dame St. W.

Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes

## Hamilton Vertical Plan Safe

Provides for filing *vertically* large or small tracings, blueprints or similar records *without* folding, rolling or creasing.

Plans are perfectly indexed and easily removed.

Its net capacity is equal to that of 20 flat drawers. It is fireproof, moisture proof and dust proof.

It will repay the cost of installation in the saving in time over other methods alone.

***May we send you the Hamilton Catalog?***

**Hamilton Manufacturing Co.**
**Two Rivers, Wisconsin**
**Rahway, New Jersey**

**The Hamilton Line Includes**

***Combination Drawing Tables and Filing Cabinets—Steel and Wood Sectional Blueprint Files — Drawing Tables — Folding Horses and Trestles—Typewriter Tables—Straight Edges—T Squares.***

## Your Copy—*free!*

AN abridgement of the Nautical Almanac with Tables of Mean Refractions in Declinations; Culminations of Polaris; Azimuth of Polaris at all Hour Angles; Elongation of Polaris and Azimuth of Polaris at Elongation; Rules for taking the Sun at any Latitude or Longitude with and without Solar Attachment; and Transit, Level and Solar Attachment Adjustments.

**EUGENE DIETZGEN CO.**

Branches: Chicago, New York, San Francisco, New Orleans, Pittsburgh, Philadelphia, Washington
Home Office and Factory: Chicago

GURLEY

The distinctive service features of the instruments comprising

**The Gurley Line**

are presented concisely in a new 32-page illustrated booklet.

*Ask for your copy of M-480.*

**W. & L. E. GURLEY**
Troy, N. Y.

Established 1845

*Quality Endeared Since 1857*

## LIETZ

TRANSITS—LEVELS—ALIDADES
PRECISE—SENSITIVE—STRONG
The A. LIETZ CO., San Francisco, U. S. A

## BERGER

**Monitor Transits and Levels**

**C. L. BERGER & SONS**
BOSTON, MASS., U. S. A.

THE saving in time and waste motion made possible by Universal Drafting Machines is naturally their basic advantage; but there is also corresponding improvement in the quality of work performed by draftsmen thus equipped. Clearer thinking is permitted by eliminating petty distractions and there is encouragement in shortening purely mechanical operations.

Universal Drafting Machines reduce brain fag and keep the mind clear for the main issue. They are used everywhere—in big shops and small.

Let us add your name to the list.

***1921 Catalog for details***

**Universal Drafting Machine Company**
**Cleveland, Ohio, U. S. A.**

**KOLESCH**
**Transits and Levels**

For more than ONE HUNDRED YEARS we have been making the finest line of ENGINEERS' and Draftsmen's instruments in the world.

***Send today for full particulars and prices on your present requirements***

KOLESCH & COMPANY
138 Fulton Street, New York

**LUFKIN**

**TAPES**
ACCURATE
RELIABLE ALL WAYS

**Distinctive in Quality—the Very Best**
*On Sale Everywhere*
*Send for Catalogue*
THE LUFKIN RULE CO.
NEW YORK 106 Lafayette Street SAGINAW, MICH. WINDSOR, ONT.

**BUFF**
62 years of Reputation
*Send for New Catalog No. 2*
BUFF & BUFF MFG. CO., Boston, Mass.

**PERFECTION PAPER CUTTER**
Made in four sizes. Ask for literature on paper cutting devices. We also manufacture the Pease Peerless Automatic Blue Printing Washing and Drying Machine and Pease Simplex Paper Coating Machines.
Literature on request.
The C. F. Pease Co., 836 No. Franklin St., Chicago, Ill.

Send for Catalog BX-10 of
PRECISION
ENGINEERING INSTRUMENTS
Wm. Ainsworth & Sons
THE PRECISION FACTORY
DENVER, COLORADO, U. S. A.

These Exclusive Advantages you will find in
**H. & B. Transits and Levels**
Catalog on Request
HELLER & BRIGHTLY
Since 1870 Cor. Spring Garden St. and Ridge Ave., Philadelphia

# Directory of Engineers

## New England

### Adams, H. S.

### Barbour, F. A.,

Water Supply, Water Purifica-

### L. J. Carmalt

### Main, Charles T.,

Plans and Specifications for Tex-
Power Development. Examina-
Reorganization or Development.

### McClure-Greene Eng. Co.

cations, Supervision

### Metcalf & Eddy,

### Stone & Webster

### Vaughn Engineers

## New York City New York and New Jersey

### Banks & Craig

Design, Operation, Valuation, Investigations Water, Sewage, Industrial Dehydration, Colloids, Research

709 Telegraph Building, Harrisburg, Pa.

### Besselievre-Disher & Miller Inc.

Sewerage, Sewage Disposal,
Service
New York, 50 Church Street

### Bowe, Thomas F.,

Water, Sewerage, Disposal of
Valuations, Reports, Inspection.
Rutherford, N. J., Assoc. Bldg.
30 E. 23rd St., New York City

### Bradley, Walter

Steam Power Plants,
Paper Mills,
Fulton, N. Y.

### City-Wastes Disposal Co.

Reports and Estimates, Surveys, Plans and Supervision.

### Caird, James M.

Expert Testimony: Examinations and Reports upon Proposed Sources of Water Supplies. Tests and Supervision of Filter Plants; Copper Sulphate Treatments for Algae; Sterilization Treatments; Sanitary Investigations, Including Typhoid Fever.

92 Fourth St., Troy, N. Y.

### Cole, Edward S.

### Cooper & Co., Hugh L.,

Hydro-electric power plants.

### Concrete-Steel Engineering Co.

Concrete-Steel Bridges

### Coulter, Waldo S.

### Edwards, Glenn P.

nicipal Water-works and Sewerage Systems. Parks Playgrounds
Correspondence Invited.

### Ellsworth, Barrows & Reeves

Cuthbert E. Reeves
Buffalo, N. Y.

### Fowler, Charles Evan,

Bridges, Foundations, Dredges,
Improvement.
New York City, 25 Church St.

### Ford, Bacon & Davis,

New York, 115 Broadway.

### Roger M. Freeman

*Construction Engineer*
Design and Construction of Industrial Buildings, Steel Plants,
Tel. Murray Hill 0170.

### Fuertes, James H.,

M.Am.Soc.C.E.

Water Supply and Water Purification, Sewerage and Sewage Disposal

New York, 140 Nassau St.

### Fuller & McClintock

Geo. W. Fuller
James R. McClintock

Wellington Donaldson
Myron E. Fuller
Daniel C. Hayne
Harvey P. Jones

170 Broadway, New York City.
Valentine Bldg., Toledo, O.

### Gilmore, Thomas N.

M. Am. S. C. E., M. Am. S. M. E.
Railroad Shops, Locomotive Terminals, Power Plants, Steam Stations, Industrial Plants.
136 Liberty St. New York, N. Y.

### Hopkins & Field,

Chas. C. Hopkins Arthur M. Field

Water Supply, Sewerage, Wastes Disposal, Municipal Engineering. Expert Testimony Appraisals
Rochester, N. Y., 349 Cutler Building

### Hopkins Construct. Corp.

Surveys Pavements
Design Highways
Construction Sewers
New Brunswick, N.J. Paterson Street.

### Hazen, Whipple & Fuller,

Allen Hazen, G. C. Whipple,
W. E. Fuller, C. M. Everett,
L. N. Babbitt, H. Malcolm Pirnie

*Consulting, Hydraulic and Sanitary Engineers.*

Water Supply, Sewerage, Drainage, Valuations, Supervision of Construction and Operation.

New York City, 30 E. 42nd St

### Hill & Ferguson,

N. S. Hill, Jr. S. F. Ferguson

*Consulting Engineers.*

Water Supply—Sewage Disposal—Hydraulic Development.

| | |
|---|---|
| Reports | Investigations |
| Valuations | Management |
| Design | Construction |
| Operation | Rates |

Chemical and Biological Laboratories

112 East 19th St., New York City.

### Horton, Robert E.

Mem. Inst. C.E. Mem. Am. Soc. C.E.

Expert, Estimates, Design and Construction for Water Power, Water Supply, Storage, Flood Control, Irrigation and Drainage.

Specialist in Hydraulic and Hydrologic Problems, Rainfall, Evaporation, Stream Yield and Ground Water. Water Power Valuation.

Albany, N. Y. Voorheesville, N. Y.

### George A. Johnson Co.

*Consulting, Civil Electrical,*
N. B. Wells
H. C. Stevens C. E. Wyckoff

Water Supply, Sewerage, Refuse Disposal, Power Development and Distribution, Industrial Plants and Public Utilities.

Construction, Management.

### William S. Lee

*M. Am. Soc. C. E., M. Am. Soc. M. Eng. Inst. Con. Engrs. Am. Inst. E. E.*
Chief Eng. Southern Power Co.

Charlotte, North Carolina

# Directory of Engineers

## Herbert C. Keith

M. Am. Soc. C. E.

*Civil and Consulting Engineer*

Design and Construction of Bridge and Structural Work, Masonry and Foundations, Railroads and Street Railways.

Inspection and Valuation of Existing Structures

Legal Engineering.

13 Park Row, New York City

## Walter Kidde & Company

Incorporated

*Engineers and Constructors*

| | |
|---|---|
| Inspections | Industrial Plants |
| Reports | Wharfs and Piers |
| Design | Power Plants |
| Construction | Chemical Works |

New York City, 140 Cedar Street

## Mead, Daniel W., Scheidenhelm, F. W.,

*Consulting Engineers*

Hydro-electric Developments, Water Supply, Irrigation, Drainage, Flood Control.

3 Church St. New York

## Meyer, Strong & Jones, Inc.

Power Plants—Mechanical and Electrical Equipment—Heating and Ventilating.

101 Park Ave., New York City

## Mueser, William

*Consulting Engineer*

Concrete-Steel Bridges
Concrete-Steel Standpipes

New York, Park Row Bldg.

## Moran, Maurice & Proctor

*Consulting Engineers.*

Daniel E. Moran, C. E.

M. Am. Soc. C. E.
M. Am. Soc. M. E.

C. F. Maurice, C. E.

Carlton S. Proctor, C. E.

Foundations for Dams, Bridges, Buildings and all Sub-Structure Work.

New York City, 50 Liberty Street

## North, Allison & Ettlinger

*Consulting Engineers*

City Surveys. Tel. [illegible]

Surveys of large tracts.
City Planning, Field Supervision
Docks, Terminal Development, Staten Island, New York, Cortlandt Bldg.

## Potter, Alexander,

*Consulting Engineer*

Hydraulic Examinations, Concrete Structures. Tel. 3501 Cortlandt.

New York, 50 Church Street

## Potts, Clyde

M. Am. Soc. C. E.

*Consulting Sanitary Engineer*

Sewerage and Sewage Disposal
Water Works and Water Supply
Reports, Plans and Estimates

[illegible] Church St., New York

## Richmond, W. S.

*Consulting Engineer*

Mem. Am. Soc. C.E.
Hydraulic and Civil Engineering
1089 Ellicott Square Bldg.
Buffalo, N. Y.

## Robinson, Geo. L.,

*Consulting Engineer.*

Sewers, Sewage Disposal, Water Supply.

New York, 37-39 East 28th Street

## Dwight P. Robinson & Company, Inc.

*Engineers and Constructors*

With which is consolidated
Westinghouse, Church, Kerr & Co., Inc.

Industrial Plants, Power Developments.

Railroad Shops and Terminals.

125 East 46th St., New York.
Chicago, Youngstown, Los Angeles, Montreal, Dallas.

## Sanderson & Porter,

*Engineers.*

New York, 52 William Street,
Chicago, 72 West Adams Street;
74 Montgomery St. San Francisco

## Seelye, Elwyn E.

*Contractors' Engineer*

101 Park Avenue

New York City.

## Steinman, Dr. D. B.

M. Am. Soc. C. E. M. A. Ry. Eg. A.

*Consulting Engineer for Bridges and other Structures*

Engineering Projects, Design, Supervision Investigation Reports, Valuations, Advisory Service.

New York 25 Church St.

## Vermeule, Cornelius C.

*Consulting and Designing Engineer*

Water Supply, Sewerage
Water & Steam Power Plants
Reports, Valuations

38 Park Row. New York

## Vrooman, Morrell,

Sewerage, Water Supply, Disposal & Treatment of Industrial Wastes.

Gloversville, N. Y., 10 N. Main St.

## Waddell, Dr. J. A. L.

*Consulting Engineer*

Steel and Reinforced Concrete Structures. Waddell's Vertical Lift Bridge. Calculations, Investigations, Reports, Designs of Bridges, Advisory Services, and Appraisals.

[illegible] Street, New York

## The J. G. White Engineering Corporation

*Engineers—Constructors*

Industrial Plants, Buildings, Steam Power Plants, Water Power Developments and Hydro-Electric Transmission systems.

[illegible] New York

## Wallace & Co., Joseph H.,

*Consulting Industrial Engineers*

Industrial and Power Plants.
Hydraulic Developments — Investigations — Consultation — Reports.
New York City, Toronto.

## Ohio and Pennsylvania

## Albright & Mebus,

*Civil and Sanitary Engineers.*

Sewerage, Sewage Disposal, Town Planning.

Philadelphia, Pa., 908 Land Title Building.

## Chester Engrs., The J. N.

J. N. Chester D. E. Davis
J. F. LaBoon J. T. Campbell
E. E. Bankson

Consulting Hydraulic, Sanitary and Valuation Engineers
Pittsburgh, Pa., Union Bank Bldg.

## Clark, Wm. G.

*Consulting Sanitary Engineer*

F. G. Cunningham, Associate
Hydraulic, Sanitary and Municipal Engineering. Power Developments. Expert Examinations and Reports.
1016 Spitzer Bldg., Toledo, O.

## Day & Zimmermann, Inc.

*Engineers*

Industrial Plants, Power Plants, Sub-Stations, Transmission Lines, Examinations and Reports, Valuations, Management of Public Utilities.

911 Chestnut St., Philadelphia.
New York City Chicago.

## Easby, William, Jr.

M. Am. Soc. C. E.

*Civil and Sanitary Engineer.*

Sewerage.
Sewage Disposal.
Water Supply.
Water Purification.
Water Power.
Pavements and Highways.
Investigations, Designs, Supervision of Construction Operation and Valuation

Philadelphia, Pa., 1302-3 Commonwealth Building, 1201 Chestnut St.

## Fayette Engineering Co.,

*Civil, Mining and Consulting Engineer*

J. C. Meredith, E. L. Zearley
Coal, Coke Plants
Uniontown, Pa.

## Fogg, Ralph J., M. A. Soc. C. E.

*Civil and Consulting Engineer*

Investigations & Reports
Steel & Concrete Structures
Design, Inspection, Valuation
Inspection of Steel & Cement at Mills. Inspector of Materials.

Bessemer, Pa.

## Franklin & Company

*Consulting Engineers*

Water Supply, Sewage Disposal
Town Planning
Reports, Valuations, Design
Phila. Electric Co. Power Bldg.

## Gannett, Seelye & Fleming

*Engineers*

Reports - Valuations - Design, Management - Municipalities, Utilities - Industrials.
Erie, Pa. - Harrisburg, Pa.
Memphis, Tenn.

## Ledoux, J. W.

*Consulting Engineer*

Water Works, Water Power, Power Plants, Reports, Designs, Construction Supervision, Valuation, Arbitration, Rate Schedules.
112 North Broad St., Phila, Pa.

## Levinson, H. J.

*Consulting Engineer*

Power Plants, Industrial Plants, Mechanical Refrigeration, Ice Plants, Construction, Installing, Supervision, Inspection, Tests, Reports.
Phila., Pa., 4929 N. Warnock St.

## Moore, W. E. & Co.,

*Engineers*

Reports, Designs and Supervision of Public Service Properties.
Industrial Plant Installations
Electric Furnace Design and Applications
Pittsburgh, Pa., Union Bank Bldg.

## Scofield Engineering Co.,

*Consulting, Designing, Supervising Engineers*

Philadelphia Pennsylvania

## Swigart & Ehrman

S. G. Swigart, M. Am. Soc. C. E.
Geo. L. Ehrman

*Civil Engineers*

Surveys—Plans—Reports
Supervision of Construction.

Sewerage & Water Supply.
Pavements & Highways
Irrigation & Drainage.
Hydraulic Developments.
Railroad & Street Railways
Topographic Mapping.

1118-1120 Second National Bldg., Akron, Ohio

## Watson Engineering Company, The

*Designing and Construction Engineers*

Industrial and Power Plant and Equipment, Bridges and Railway Buildings, Docks, Terminals and Marine Structures.

Warehouses and Commercial Buildings.

Engineering Reports.

[illegible] Prospect Ave., Cleveland

## Wilkins Company, The W. G.

*Engineers and Architects*

Railroad Buildings, Manufacturing Plants, Coal and Coke Plants, Water Works and Sewerage Investigations and Reports.

[illegible] Pa. Westinghouse [illegible]

# Directory of Engineers

## Chicago and Illinois

**Chicago Bascule Bridge Company**

**Alvord & Burdick,**

**The Arnold Company**

Lower Plants

Preliminary Operation

**Byllesby Engineering & Management Corp.**

**Chase, Frank D., Inc.**

**J. L. Jacobs & Company**

**Krauel, H. B.**

**Maury, Dabney H.**

Water Works. Sewerage.

**Randolph-Perkins Co.**

Successors to:

Edmund T. Perkins Eng'g Co.

Stripping Properties Prospected.

1210 First National Bank B'dg.

**Shourds-Stoner Co.**

Mining, Structural, Civil, Mechanical & Electrical Engineering

Harris Trust Bldg., Chicago, Ill. Tribune Bldg., Terre Haute, Ind.

**Stern, I. F.**

Structures, Engineering Projects. Design, Supervision, Investigation, Reports, Valuations, Advis-

## Central West

**American Appraisal Company, The**

Municipal, Mineral, Industrial, Commercial and Residence Properties

**Black & Veatch**

**Burns & McDonnell,**

Appraisals, Rate Investigations, Expert Testimony, Water Works, Sewerage, Lighting.
Kansas City, Mo., Suite 400

**Fargo Engineering Co**

Hydro-Electric and Steam Plants

**Federal Engineering Co.,**

Buildings and Industrial Plants.
Milwaukee, Wis., 218 - 219

**Harrington, Howard and Ash**

and other structures of steel and
vices in municipal problems.
Appraisals. Kansas City, Mo.
101

**Hubbell, Clarence W.,**

Sewage Disposal,
Detroit, Mich., 2348 Penobscot Building

**Koerl & Conklin**

Water Supply and Purification
Treatment of Industrial Wastes
Investigation of Water Pollution
Sanitary Chemical Analyses

**Luten, Daniel B.,**

Reinforced Concrete Bridges exclusively

**Meyer, Adolph F.**

Member. Am. Soc. C. E.

Minneapolis, 628 Met. Bk. Bldg.

**Shenehon, Francis C.**

M. Am. Soc. C. E.
Drainage, River Diversion,
Minneapolis, 628 Met. Bk. Bldg.

**Siteman & Cooper**

Fed. Res. Bank Bldg. St. Louis

**Smith & Co., C. E.**

Appraisals. Expert Testimony.

**Turner, C. A. P.,**

Reinforced Concrete and Structural Steel Buildings and Manufacturing Plants.

**Williams, Gardner S.,**

Hydraulic Investigations, Water Power Developments, Water Supply Systems, Reports, Appraisals. Ann Arbor, Michigan.

## Southern States

**Allen & FitzSimons, Inc.**

James P. Allen, W. S. FitzSimons
Estimates for Dredging Examinations—Reports—Consultation
General Surveying, Mapping.
Broad St. Charleston, S. C.

**Howard D. Bennett**

Dredges of all types Designed and Built Towing service Mechanical Hire, Ice and Derrick Boats Harbor and Terminal Development Plans, Specifications, Reports Estimates
A Advertisement Baltimore, Md.

**Black, McKenney & Stewart**

*Engineers*

W. M. Black,
Maj. Gen. U. S. A. Retired
Charles A. McKenney.
John Stewart.

River and Harbor—
Port and Terminal Work
Hydro Electric Development
Municipal and
Consulting Organization
Administration
618 Seventeenth St., N. W.
Washington, D. C.

**Billingsley, James W.,**

Preliminary Investigations, Detailed Plans and Construction
Supervision, Foundations,
Improvements, Drainage, Drainage and Municipal Improvements
New Orleans, Louisiana

DIRECTORY OF ENGINEERS

RATES:

1¼-inch card
$37.50 per quarter
($ for advertising and
$1.25 for subscription)

¾-inch card
$22.50 per quarter
($21.25 for advertising and
$1.2 for subscription)

# Directory of Engineers

**Brown, W. E.**
Investigations, Surveys, Reports and Designs, Land Drainage and Reclamation. Development of Properties, Dredging, River and Harbor Improvements, Ports and Terminal Work, Coast Protection. Miami Beach, Fla.

**Greiner & Company, J. E.**
*Consulting Engineers*
Design, Construction, Investigation, Advisory Service—Railroad Docks, Piers, Warehouses and other Engineering Structures.
Pittsburgh, Pa. Land Title Bldg.
Baltimore, Md. Fidelity Bldg.

**Morgan Engneering Companies, The,**
*Hydraulic Engineers.*
Flood Prevention — Irrigation—Drainage—Power Development
Memphis, Dayton

**Robert L. Totten**
Mem. Am. Soc. C. E.
*Consulting Engineer*
Valuations & Reports, Railroad & Highways, Mining Investigations, Municipal Improvements.
Jefferson County Bank Bldg
Birmingham, Ala

**Wehr & Walden**
*Engineers and Constructors.*
Examination, Reports and Valuations, Industrial and Public Service Properties, Water Power.
102 West Fayette Street,
Baltimore, Md.

**Weller, Francis R.**
*M. Am. Inst. E. E., M. Am. Soc. C. E.*
*Consulting Engineer*
Hydro-Electric and Steam Power Plants, Reports, Appraisals, Designs, Construction; Properties Operated
201 Mills Bldg Washington, D.C.

## Rocky Mountain and Pacific States

**Bowden Engineering Co.**
Consulting, Surveying
Supervising Construction
Seattle, Wash., L. C. Smith Bldg.

**Carpenter, L. G.**
(Formerly L.G.&R.C.Carpenter. Consulting Engineers, Denver, Colo., and Ithaca, N. Y.)
Water Supply, Irrigation, Drainage, Investigations and Reports for Financial and Legal Interests
Denver, Colo. 702 21st N. Bk. Bldg

**Grunsky, C. E.,**
*Consulting Engineer*
Valuation, Municipal Engineering, Flood Control
"Manager of C. E. Grunsky Co." Supervision
San Francisco and Stockton
Institute Building

**Elrod Co., Henry Exall**
*Consulting Engineers*
Utility Valuations for Public Service Corporations, Special Investigations and Reports, Water Works, Sewerage Systems, Sewage Disposal Plants, Power Plants and Industrial Works.
Imperial Irrigation District Dams.
Los Angeles, Cal. (Temporary address, Hotel Wardman, Santa Monica)
Dallas, Texas, Interurban Bldg

**Miller, M. L. & Co.**
*Consulting Engineers*
Paving, Sewerage, Sewerage Disposal, Water Supply, Light and Power Plants, City Planning, Bridge designing, Investigations and Reports.
2235 Gaylord St., Denver, Colo.

**Thebo, Starr & Anderton, Inc.**
*Engineers and Constructors*
Design and Construction of Power Plants Hydro-Electric Irrigation and Industrial Projects, Appraisals, Investigations Reports, Plans and Specifications Sharon Building, San Francisco., Fresno, Calif.

## Cuba and Foreign

**Alberto A. Ibargüen**
*Civil Engineer and Architect*
M. Am. Soc. C. E.—M. S. C. I.
Designs, Specifications, Estimates, and Supervision for Construction of All Kinds. Specialist in Reinforced Concrete Structure.
Muralla St. Havana, Cuba

**Conrado E. Martinez, Rolando A. Martinez,**
*Consulting Engineers*
Sewers, Water Works, Surveys and Appraisals, Inspections, Town Planning, Reports and Designs, Investigations.
Havana, Cuba, 59 Obispo St.

**W. H. Shields**
B. Sc. (Eq. Hon Glas.); C. E. (Glas.) B. Sc. (W. A.); A. M. I. C. E.; M. W. A. I. E.; M. R. S., W. A.
*Civil and Consulting Engineer and Licensed Surveyor*
Perth, Australia, Princess Bldg.
Cable address Civileng Perth

**J. L. Weller, M. E. I.C.**
*Consulting Engineer*
Canals, Harbors, Docks, Drydocks, Movable Bridges, Dams, Difficult Foundations, Hydro-Electric Developments, Advisory Reports. Herkimer Apartments
Hamilton, Ont.

# Inspecting and Testing Engineers

**Electrical Testing Laboratories,** Electrical, Photometrical and Physical Tests. Inspection and Tests of Electrical and Engineering Materials. Main Office and Laboratories, New York, 80th St., and East End Ave.

**Hunt, Robert W. & Co.**
Robert W. Hunt, Jno. J. Cone, D. W. McNaughter
*Bureau of Inspection, Tests and Consultation*
Chicago, New York, Pittsburgh, St. Louis, San Francisco, Seattle, Montreal, London.

**New York Testing Laboratories**
Chemical and Physical Tests. Metals, Cements, Asphalts, etc.
Electrical Tests
Hydraulic Tests
Pumps, Water-Waste, etc.
Expert Inspections.
For Cities and Industries.
Power Plant Tests
80 Washington St., N. Y. C.

## Professional Card Advertising

furnishes a particularly appropriate type of publicity to those offering a professional service to the field—and it costs less.

## This Directory

is the recognized center where those offering a professional service to the field keep their names and addresses for ready reference.

Directory of Engineers
Inspecting & Testing Engineers
Engineering Schools and Colleges

Rates for Professional Cards

# ENGINEERING Schools and Colleges

**College of Engineering,**
Courses in Civil, Mechanical, Electrical, Sanitary, Municipal, Chemical Engineering. Short course in Structural Drafting
Enter any time. No matriculation or registration fees. Expenses $ to ½ less than at other first-class schools. School year—Four quarters of 12 weeks each.
Length of Courses 120 Weeks
Save one year and $1000.
Experienced Instructors. Splendid Laboratories.
For catalog, bulletins or information address: Albert Edwin Smith, President, Ohio Northern University, Ada, Ohio.

**Lafayette College,**
Technical Courses in Chemical, Civil, Electrical, Mechanical and Mining Engineering. Write for illustrated catalogue to the Registrar, Easton, Pa.

**New York University College of Engineering**
Courses in Civil, Mechanical, Electrical and Industrial Engineering.
For information address Chas. Henry Snow, Dean, University Heights, New York.

**Norwich University,**
(Founded 1819)
The Military College of Vermont. Academic Courses in Civil and Electrical Engineering. Address Prof. H. R. Roberts.
Northfield, Vermont.

**Clarkson College of Technology,**
Courses leading to the degrees of Bachelor of Science in Chemical, Civil, Electrical and Mechanical Engineering.
Catalog upon application.
Potsdam, N. Y.

**College of Engineering**
Northwestern University
Five years of broad, thorough training; small classes, in which each student receives individual attention from head professors. Unsurpassed opportunities to see great engineering projects and meet engineers.
A young thriving College in an old University.
Write for "Preparation for Engineering" and "Booklet of Views."
John F. Hayford, Director.
Evanston, Ill., Swift Hall.

# WHAT AND WHERE TO BUY

**A Classified Index of Advertisers in this Issue**

## Equipment, Apparatus and Supplies Used in the Civil Engineering and Contracting Fields with Names of Manufacturers and Distributors

See Last Page for Alphabetical Index

**Air Reduction Sales Co.**

**Webster Manufacturing Co.**

**Carey Co., Philip**

**Parsons Co**
**Pawling & Harnischfeger Co**

**Coal & Iron National Bank**

**Ambursen Construction Co Inc.**

**Ryerson & Son, Joseph T**

**Mitchell Tappen Co.**

**Texas Co.**

**Robins Conveying Belt Co.**

**Atlas Powder Co**

**Boston & Lockport Block Co.**

**Hayward Co.**

**(See Elevators Bucket)**

**Industrial Works**
**Kinzler Co., Joseph F**
**McMyler Interstate Co**

**Vulcan Iron Works of N. J.**

**Carey Co., Philip**

**Belmont Iron Works**
**Blaw Knox Co**
**Hydraulic Steelcraft Co.**

**Blaw Knox Co**

**Mundy Hoisting Engine Co**

**National Hoisting Eng. Co.**
**Wickwire-Spencer Steel Corp**

**Lakawanna Steel Co.**

**Air Reduction Sales Co.**

**Easton Car & Constr Co**
**Lakewood Engr. Co.**

**Koppel Industrial Car &**

**Western Wheeled Scraper Co.**

**Lakewood Engr. Co**

**Fox & Co., John**

**Raymond Concrete Pile Co.**

**Virginia Bridge & Iron Co.**
**Wisconsin Bridge & Iron Co.**

**Strauss Bascule Bridge Co.**

**Bridge Operating Mchy.**
**Earle Gear & Machine Co.**

**Lakewood Engr. Co.**

**Clam Shell**

**Hayward Co**
**Industrial Works**

**Lakewood Engr. Co.**

**McMyler Interstate Co**
**Orton & Steinbrenner Co**

**Vulcan Iron Works of N J**

**Concrete**
**Insley Manufacturing Co.**
**Lakewood Engr. Co.**
**Union Iron Works**

**Dragline**

**Electric Motor**
**Hayward Co.**

**Elevator**
**(See Elevators Bucket)**

**Orange Peel**

**Industrial Works**
**Kinzler Co., Joseph F**
**McMyler Interstate Co**

**Vulcan Iron Works of N. J.**

**Carey Co., Philip**

**Buildings, Steel**
**Belmont Iron Works**
**Blaw Knox Co**
**Hydraulic Steelcraft Co.**

**Blaw Knox Co**

**Mundy Hoisting Engine Co**

**National Hoisting Eng. Co.**
**Wickwire-Spencer Steel Corp**

**Lakewood Engr. Co.**

**Air Reduction Sales Co.**

**Easton Car & Constr Co**
**Lakewood Engr. Co.**

**Koppel Industrial Car &**

**Western Wheeled Scraper Co.**

**Lakewood Engr. Co**

**Lackawanna Steel Co.**

**Fox & Co., John**

**Jeffrey Mfg. Co.**
**Lakewood Engr. Co**
**Link Belt Co.**
**Marion Malleable Iron Wks**

**Foundry Co**
**Warren Fdry & Mach Co**

**Central Foundry Co.**

**Fdry Co**

**Terry Mfg. Co.**

**Lawrence Cement Co.**
**Pennsylvania Cement Co**
**Vulcanite Port Cement Co.**

**Cement Gun Co.**

**Allis-Chalmers Mfg. Co.**
**Austin Machinery Corp.**

**Vulcan Iron Wks of Wilkes-Barre**
**Wilsea Works, The**

**Ingersoll Rand Co**

**Blaw Knox Co.**
**Hydraulic Steelcraft Co**

**Ryerson & Son, Joseph T.**

**Sprocket**
**Hans Mfg. Co., Geo.**
**Jeffrey Mfg. Co.**

**Webster Manufacturing Co.**

**Ingersoll Rand Co**

**General Concrete Constr. Co**
**Heine Chimney Co**
**Polk Genung Polk Co**

**Summerhays & Sons Co**

**Weber Chimney Co.**
**Wiederholdt Construction Co.**

**Custodis Chimney Construc-**

**Kellogg Co., M. W**
**Rust Engineering Co**

**Wiederholdt Construction Co**

**Blaw Knox Co.**
**Chicago Bridge & Iron Wks**

**Penna Salt Mfg. Co**

**Wallace & Tiernan Co.**

**Electro Bleaching Gas Co.**
**Wallace & Tiernan Co.**

**Concrete**
**Insley Manufacturing Co**
**Lakewood Engr. Co**

**Friction**
**Webster Manufacturing Co.**

**Conveying Ma-**

**Brown Hoisting Machy Co.**
**Byers Mach Co**
**Hayes Mfg. Co. Inc Geo**

**Link Belt Co.**
**McMyler Interstate Co**
**Webster Manufacturing Co.**

**Ludgerwood Mfg Co**

**Steel**
**Lackawanna Steel Co**

**Universal Form Clamp Co**

**Blaw-Knox Co.**
**Concrete Steel Co.**
**Hydraulic Steelcraft Co.**

**Heavy Duty**
**Allis-Chalmers Mfg. Co.**
**Chicago Pneumatic Tool Co.**
**De Laval Steam Turbine Co.**
**Ingersoll-Rand Co.**
**McKiernan-Terry Drill Co.**
**Sullivan Machinery Co**
**Westinghouse Traction Brake Co.**
**Worthington Pump & Machinery Corp.**

**Air, Portable**
**Cement Gun Co.**
**Chicago Pneumatic Tool Co.**
**Ingersoll-Rand Co.**
**Sullivan Machinery Co.**

**Bond**
**Living-Stone Co., The**

**Floor Hardener**
**Waterproofing**

**General Chemical Co.**

**Making Machinery**
**Willsea Works, The**

**Reinforcement**
**Brown Hoisting Machy. Co.**
**Buffalo Steel Co**
**Concrete Steel Co**
**Consolidated Expanded Metal Co.'s**
**Hydraulic Steelcraft Co.**
**Keystone Gypsum Fireproof Inc Co**
**Lackawanna Steel Co.**
**Mitchell-Tappen Co**
**Northwestern Expanded Metal Co.**
**Ryerson & Son Joseph T.**
**Wickwire-Spencer Steel Corp.**

**Belt**
**Jeffrey Mfg. Co., Inc., Geo**
**Robins Conveying Belt Co.**
**Webster Manufacturing Co.**

**Bucket**
**Jeffrey Mfg. Co.**
**Robins Conveying Belt Co.**
**Webster Manufacturing Co.**

**Metal**
**Consolidated Expanded Metal Co.**

**Full Circle**
**Terry Mfg. Co.**

**Locomotive**
**Amer. Hoist & Derrick Co.**
**Ball Engine Co**
**Brown Hoisting Machy Co.**
**Browning Co**
**Clyde Iron Works Sales Co.**
**Davenport Locomotive Wks.**
**Industrial Works**
**McMyler Interstate Co.**
**Marion Steam Shovel Co.**
**Ohio Locomotive Crane Co.**
**Orton & Steinbrenner Co.**
**Pawling & Harnischfeger Co.**

**Traveling**
**Brown Hoisting Machy Co.**
**Link Belt Co.**
**Pawling & Harnischfeger Co.**
**Toledo Crane Co.**

**Wrecking**
**Industrial Works**

**Timber,**
**American Creosoting Co**
**Eppinger & Russell Co.**
**S.P.F. Wood Preserving Co**
**Wyckoff Pipe & Creosoting Co.**

**Creosoting**
**American Creosote Works**
**Barrett Co.**
**Republic Creosoting Co.**
**Wyckoff Pipe & Creosoting Co.**

**Creosoting Oils**
**Barrett Co.**
**Northeastern Co.**
**Protexol Corp**
**Republic Creosoting Co.**

**Crushers and Pulverizers**
**Allis-Chalmers Mfg. Co.**
**Jeffrey Mfg. Co.**
**Orton & Steinbrenner Co**
**Smidth & Co., P. L.**
**Smith Engineering Co**
**Universal Road Machinery Co.**
**Worthington Pump & Machinery Corp.**

**Culverts, Corrugated**
**Newport Culvert Co.**

**Culverts, Metal**
**Amer. Sheet & Tin Plate Co**
**Newport Culvert Co., Inc**
**Foundry Co**

**Culverts, Nestable & Riveted Corrugated**
**Newport Culvert Co.**

**Curb, Steel Protected**
**Concrete Steel Co.**

**Cutting Blowpipes, Oxyacetylene**
**Milburn Co., Alexander**

**Dams**
**Ambursen Construction Co**

**Derricks and Derrick Fittings**
**Amer. Hoist & Derrick Co**
**Bay City Bridge Works**
**Byers Mach Co**
**Clyde Iron Works Sales Co**
**Dobbie Fdry & Machine Co**
**Haiss Mfg. Co., Geo**
**Hayward Co**
**Insley Manufacturing Co**
**Ludgerwood Mfg. Co.**
**McMyler Interstate Co**
**Mundy Hoisting Engine Co**
**J. S.**
**Terry Mfg. Co.**

**Disinfecting Chemicals**
**Electro Bleaching Gas Co**
**Wallace & Tiernan Co**

**Distributors, Pressure Oil**
**(See Road Oilers, Pressure)**

**Ditching Machinery**
**(See Excavators)**

**Docks and Harbor Work**
**Parsons, Klapp, Brinkerhoff & Douglass**
**Snare Corp., Frederick**

**Drafting Machines**
**Universal Drafting Mach Co**

**Drafting Room Furniture**
**Dietzgen Co Eugene**
**Hamilton Manufacturing Co**
**Pease Co., C. F.**

**Drawing Materials**
**Dietzgen Co, Eugene**
**Hamilton Manufacturing Co**
**Keuffel & Esser Co.**

**Drawing Tables**
**(See Tables and Boards Drawing.)**

**Dredges**
**Hayward Co.**
**Ludgerwood Mfg. Co**
**Marion Steam Shovel Co**
**Osgood Co**

**Dredges, Dipper**
**Austin Machinery Corp**
**Lidgerwood Mfg. Co.**
**Osgood Co**

**Dredges, Hydraulic**
**Atlantic Gulf & Pacific Co**
**Marion Steam Shovel Co**
**Morris Machine Co.**

**Drills, Core**
**Ingersoll Rand Co.**
**McKiernan Terry Drill Co**
**Sullivan Machinery Co.**

**Drills, Rock**
**Chicago Pneumatic Tool Co**
**Jeffrey Mfg. Co**
**Ingersoll-Rand Co**
**McKiernan-Terry Drill Co.**
**Sullivan Machinery Co.**

# Porter Fireless Locomotives

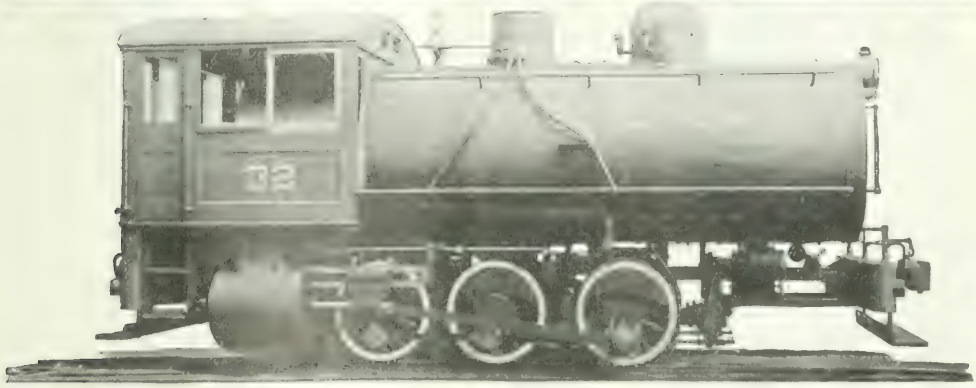
## *Made For A Definite Purpose*

The PORTER Fireless Steam Locomotive is offered on its merits for a wide range of shifting and similar service, for either standard or narrow gauge track, for use inside buildings, as well as outdoor use, and where the radius of operation is not excessive and where a suitable steam boiler plant is available.

The Porter Fireless Locomotive is competent to handle heavy trains and it is also ideal for use where the service is not great enough, or is too irregular, to justify the purchase of a steam locomotive of usual type.

***Complete data and catalogue on request***

**H. K. Porter Company, Union Bank Bldg., Pittsburgh, Pa.**



Blaw-Knox Co.
Hayward Co.

Blaw-Knox Co.

Atlas Powder Co.

Elevators, Bucket
Hendrick Mfg. Co.

Webster Manufacturing Co.

Elevators, Contractors' Material
Byers Mach. Co.
Insley Manufacturing Co.
Smith Engineering Co.

Elevators, Factory

Engineers and Contractors
Raymond Concrete Pile Co.

Engineers' and Draftsmen's Instruments and Supplies
Hamilton Manufacturing Co.
Leupold-Voelpel Co.
Lufkin Rule Co.

Engines, Gas Gasoline & Oil
Allis Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
Fairbanks Morse & Co.
Ingersoll-Rand Co.
Wisconsin Motor Mfg. Co.

Engines, High Duty Waterworks
Morris Machine Co.

Engines, Hoisting
See Hoists

Engines, Portable
Lidgerwood Mfg. Co.

Engines, Steam
Chicago Pneumatic Tool Co.

Engines, Traction
Best Tractor Co., C. L.

Excavators, Clamshell
Clyde Iron Works Sales Co.
Lidgerwood Mfg. Co.
Mundy Hoisting Engine Co.

Sauerman Bros.

Excavators, Dutch & Trench
Bay City Dredge Works

Brown Hoisting Machinery Co.
Brunning & Sons, W. G.
Marion Steam Shovel Co.
Osgood Co.
Parsons Co.
Thew Shovel Co.

Excavators, Dragline
Austin Machinery Corp.

Byers Mach. Co.
Hayward Co.
Marion Steam Shovel Co.
Monighan Machine Co.

Bawling & Harnischfeger Co.
Sauerman Bros.
Smith Co., T. L.

Expanded Metal
Expanded Metal Co.

Explosives, Powder Co.

Feed Water Heaters
Ingersoll-Rand & Machinery Corp.

Fences & Gates, Iron & Wire
Amer. Fence Constr. Co.

Filters, Water, Municipal and Industrial
International Filter Co.
Filtration Co.

Roberts Filter Mfg. Co.
Simplex Valve & Meter Co.

chinery Corp.

Fire Clay
Delaware Clay Products Co.
Dickey Clay Mfg. Co.

Flooring Material and Composition
Keasbey & Mattison Co.

Floor Hardener, Concrete
owner.)

Floor, Wood Block
Barrett Co.
Republic Creosoting Co.

Flooring, Fireproof
Irving Iron Works

Flumes, Iron & Steel
Blaw-Knox Co.

Form Clamps
Concrete Steel Co.

M. & M. Form Clamp Co.
Universal Form Clamp Co.

Form Tighteners
Concrete Steel Co.
Marion Malleable Iron Wks.

Forms, Culvert, Road, Sewer, Tunnel, etc.
Blaw-Knox Co.
Foote Co.
Hydraulic Steelcraft Co.

Forms for Curb and Gutter
Blaw-Knox Co.

Forms for Walls, Building Construction, etc.
Blaw-Knox Co.
Concrete Steel Co.
Hydraulic Steelcraft Co.

Foundations
American Bridge Co.
Lackawanna Steel Co.
Foundation Co.
Raymond Concrete Pile Co.
Underpinning & Foundation Co.

Frogs and Switches, Railway
Easton Car & Constr. Co.
Ramapo Iron Works

Furnaces, Annealing & Tempering
American Gas Furnace Co.

Furnaces, Gas
American Gas Furnace Co.

Garbage Disposal Apparatus
Jeffrey Mfg. Co.

Gas, Chlorine
Electro Bleaching Gas Co.

Gas Producers
Blaw-Knox Co.

Gates, Sluice
Caldwell-Wilcox Co.
Crane Co.
Ludlow Valve Mfg. Co.

Gauges, Loss of Head
Simplex Valve & Meter Co.

Gauges, Rates of Flow
Simplex Valve & Meter Co.

Gears
Earl Gear & Mach. Co.

Generators, Electric
Allis-Chalmers Mfg. Co.
Fairbanks-Morse & Co.

Glass, Fireproof
(See Wire Glass)

Governors, Waterwheel
Woodward Governor Co.

Graders, Road
Western Wheeled Scraper Co.

Gratings, Subway

Gravel Washing Plants
Link Belt Co.
Sauerman Bros.

Gypsum
Gypsum Fireproof

Hammers, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll Rand Co.

Hammers, Steam Pile

Heaters, Concrete Water
Lakewood Engr. Co.

Co.

Hoists, Contractors' Electric

Co.

Byers Mach. Co.
Clyde Iron Works Sales Co.
Dobbie Foundry & Mach. Co.

Lidgerwood Mfg. Co.
Monighan Machine Co.
Mundy Hoisting Eng. Co.

National Hoisting Eng. Co.

Hoists, Contractors' Gasoline
Gray Iron Foundry Co.
Lidgerwood Mfg. Co.
Mundy Hoisting Eng. Co.

National Hoisting Eng. Co.
Stroudsburg Engine Works

Hoists, Contractors' Steam
Allis-Chalmers Mfg. Co.
Amer. Hoist & Derrick Co.
Byers Mach. Co.
Clyde Iron Works Sales Co.
Flory Manufacturing Co., S.
Ingersoll Rand Co.
Lansing Co.
Lidgerwood Mfg. Co.
Mundy Hoisting Eng. Co.
National Hoisting Eng. Co.
Stroudsburg Engine Works
Vulcan Iron Wks of Wilkes-Barre, Pa.

Hoists, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll Rand Co.
Stroudsburg Engine Works
Sullivan Machinery Co.

Hoppers, Concrete
Insley Manufacturing Co.
Lakewood Engr. Co.

Hose, Air
Chicago Pneumatic Tool Co.

Hydrants
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Rensselaer Valve Co.
Wood & Co., R. D.

Incinerators
Power Specialty Co.

Inserts, Concrete
Concrete Steel Co.

Inspecting Laboratories

Instruments, Drawing

Instruments, Surveying
Gurley, W. & L. E.
Lietz Co., A.

Iron Work, Structural and Ornamental
Hendrick Mfg. Co.
Irving Iron Works
Ryerson & Son Co., Jos.
Snead Architectural Iron Works

Jacks, Lifting
McKiernan-Terry Drill Co.

Joints, Expansion Paving
Barrett Co.
Carey Co., Philip

Joints, Filler Paving
Barrett Co.
Standard Oil Co. of N. Y.

Joints, Flexible Pipe
Central Foundry Co.
Crane Co.
Foundry Co.

Lath, Expanded Metal
Metal Co's

Mitchell Tappen Co.

Leadite
Leadite Co., Inc., The

Lights, Contractors'
Leaders, Wagon

Locomotives, Compressed Air
Barre, Pa.

Locomotives, Electric
Jeffrey Mfg. Co.

Locomotives, Fireless Steam
Porter Co., H. K.

Locomotives, Gasoline
Hadfield-Penfield Steel Co.
Lakewood Engr. Co.
Vulcan Iron Wks of Wilkes-Barre, Pa.
Whitcomb Co., Geo. D.

Locomotives, Steam
Kopper Industrial Car & Equip. Co.
Vulcan Iron Wks of Wilkes-Barre, Pa.

Locomotives, Storage Battery
Whitcomb Co., Geo. D.

Lubricants
Greene, Tweed & Co.
Texas Co.

Lumber
Exchange Sawmills Sales Co.
Lawson & MacMurray

Manhole Covers
Central Foundry Co.

Manometers
Simplex Valve & Meter Co.

Meter Boxes
Pittsburgh Meter Co.

Meter Provers
Hersey Mfg. Co.
Pittsburgh Meter Co.

Meters, Boiler Feed Water
Builders Iron Foundry

Meters, Current
Gurley W. & L. E.

Meters, Gas and Steam
Builders Iron Foundry
Wallace & Tiernan Co.

Meters, Venturi
Builders Iron Foundry

Meters, Water, Oil, etc.
Builders Iron Foundry
Gamon Meter Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Meter Co.
Simplex Valve & Meter Co.

Mixers, Asphalt
(See Mixers, Hot)

Mixers, Concrete
Austin Machinery Corp.
Cement-Gun Co.
Foote Co.
Knickerbocker Co.
Lakewood Engr. Co.
Lansing Co.
Smith Co., T. L.

Mixers, Grout
Austin Machinery Corp.
Lakewood Engr. Co.
Union Iron Works

Mixers, Hot
Austin Machinery Corp.

Mixers, Mortar
Austin Machinery Corp.
Knickerbocker Co.
Lakewood Engr. Co.
Lansing Co.

Mixers, Paving
Austin Machinery Corp.
Foote Co.
Lakewood Engr. Co.
Smith Co., T. L.

Motors, Electric
Allis-Chalmers Mfg. Co.
Fairbanks-Morse & Co.
Westinghouse Traction Brake Co.

Motors, Gasoline
Wisconsin Motor Mfg. Co.

Motor Trucks
(See Trucks, Motor)

Oil Lubricating
Texas Co.

Oxy-Acetylene Process
Air Reduction Sales Co.
Blaw-Knox Co.

Oxygen
Air Reduction Sales Co.

Packing, Water Pipe
Greene, Tweed & Co.
Jenkins Bros.

Paints, Graphite
National Lead Co.

Paints, Metal Protective
Barrett Co.
Co., Philip
National Lead Co.
Protexol Corp.

Partitions
Keystone Gypsum Fireproofing Co.

Paving, Asphalt
Texas Co.

Paving Blocks, Creosoted Wood
See Creosoted Block Lumber, Poles, Cross Arms, Lumber etc.

Paving Blocks, Granite
Leopold & Co., J.

Paving Brick
Dunn Wire-Cut Lug Brick Co.

Paving Joint Filler
Texas Co.

Penstocks
Blaw-Knox Co.
Lackawanna Steel Co.

Pile Drivers
Industrial Works
McKiernan-Terry Drill Co.
McMyler Interstate Co.
Union Iron Works
Vulcan Iron Works of Chicago

Pile Hammers, Steam
Industrial Works
McKiernan-Terry Drill Co.
National Hoisting Eng. Co.
Union Iron Works

Piles, Concrete
MacArthur Concrete Pile & Foundation Co.
Raymond Concrete Pile Co.

Piling, Interlocking Street
Carnegie Steel Co.
Lackawanna Steel Co.

Pipe Bends
East Jersey Pipe Co.

Pipe, Cast Iron
Amer. Cast Iron Pipe Co.
Central Foundry Co.
Fox & Co., John
Glamorgan Pipe & Fdry. Co.
U. S. Cast Iron Pipe & Foundry Co.
Warren Fdry. & Mach. Co.
Wood & Co., R. D.

Pipe, Concrete
Independent Concrete Pipe Co.
Lock Joint Pipe Co.

Pipe, Corrugated
Newport Culvert Co.

Pipe Covering, Asbestos
Carey Co., Philip

Pipe Covering, Wood
Michigan Pipe Co.
Standard Wood Pipe Co.
Wyckoff & Son Co., A.

Pipe, Dredge
Machold & Riddell

Pipe Fittings
Builders Iron Foundry
Central Foundry Co.
U. S. Cast Iron Pipe & Foundry Co.
Westinghouse Traction Brake Co.

Pipe Joint Compounds (Pressure)
Leadite Co., Inc., The

Pipe, Lap Welded
American Spiral Pipe Wks.

Pipe, Lock Bar
East Jersey Pipe Co.

Pipe, Lock Joint
Lock Joint Pipe Co.

Pipe, Reinforced Concrete
Independent Concrete Pipe Co.
Lock Joint Pipe Co.
United Concrete Pipe Co.

Pipe, Riveted Steel
American Spiral Pipe Wks.
Blaw-Knox Co.
East Jersey Pipe Co.
Machold & Riddell
Pittsburgh Iron Works Co.
Tippett & Wood

Pipe Shoes
Marion Malleable Iron Wks.

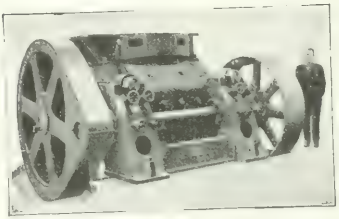
Pipe, Spiral Riveted
Abbottsforth & Reed Mfg. Co.
American Spiral Pipe Wks.
Blaw-Knox Co.

Pipe, Vitrified Clay
Dickey Glass Mfg. Co.
Delaware Clay Products Co.

Pipe, Wood
American Wood Pipe Co.
Michigan Pipe Co.
Pacific Tank & Pipe Co.
Standard Wood Pipe Co.
Wyckoff & Son Co., A.

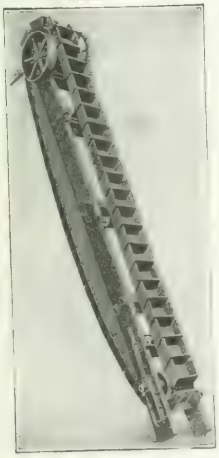
Plaster
Keystone Gypsum Fireproofing Co.

Poles, Steel Structural
Blaw-Knox Co.

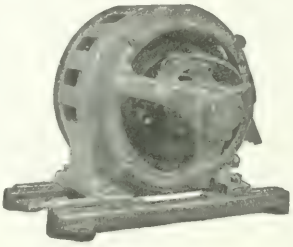


# UNDIVIDED RESPONSIBILITY

## FOR ENTIRE CRUSHING PLANT EQUIPMENT



The many crushing plants which have been completely equipped by the Allis-Chalmers Manufacturing Company is evidenced by the satisfactory service which these plants are giving. The Allis-Chalmers Manufacturing Company takes the entire **responsibility** for the design of the plant and its equipment. These plants are built on the highest engineering standard following the best engineering practices.



**Our Engineers at Your Service** to make complete installation drawings.

*Write for our Bulletins.*

# ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

**Powder**
Atlas Powder Co.

**Pressed Steel Products**
Blaw-Knox Co.
Hydraulic Steelcraft Co.

**Pulverizers**
Jeffrey Mfg. Co.

**Pumps, Air Lift**
Ingersoll-Rand Co.
Sullivan Machinery Co.

**Pumps, Boiler Feed, Steam**
Fairbanks-Morse & Co.
Ingersoll-Rand Co.
Lea-Courtenay Co.
McGowan Co., John H.

**Pumps, Centrifugal and Multi-Stage High Lift**
Earle Gear & Machine Co.
Fairbanks-Morse & Co.
Ingersoll Rand Co.
Lea-Courtenay Co.
Manistee Iron Works
Morris Machine Works
Worthington Pump & Machinery Corp.
Yeomans Brothers Co.

**Pumps, Contractors'**
Edson Manufacturing Co
Ingersoll-Rand Co
Worthington Pump & Machinery Corp.
Smith Co., T. L.

**Pumps, Deep Well**
Cook, A. D.
Fairbanks-Morse & Co.
Ingersoll-Rand Co
Worthington Pump & Machinery Corp.

**Pumps, Diaphragm**
Domestic Eng. & Pump Co
Edson Manufacturing Co
Smith Co., T. L.

**Pumps, Dredging and Sand**
Worthington Pump & Machinery Corp.

**Pumps, Elevator**
Worthington Pump & Machinery Corp.

**Pumps, Power**
Cook, A. D.
Fairbanks-Morse & Co
Gould's Mfg. Co.
Ingersoll-Rand Co.
Lea Courtenay Co.
McGowan Co., John H.
Worthington Pump & Machinery Corp

**Pumps, Underwriters' Centrifugal**
Allis-Chalmers Mfg. Co
Earle Gear & Machine Co.

**Purifiers, Feed Water**
Filtration Co.

**Pyrometers**

**Rail and Rail Joints Fastening & Specialties**

**Redwood Butchers**
Osgood Co.

**Railroads, Industrial**
Lakewood Engr. Co.

**Recorders, Water Stage**

**Reinforcing Bar Couplings**

**Reinforcing Metal for Concrete Work**

**Reinforcing, Concrete**

**River and Harbor Work**
Raymond Concrete Pile Co.

**Riveting Machines**
Allen, John F.
Chicago Pneumatic Tool Co.

**Road Oilers, Pressure**

**Road Oils & Preservatives**
Barrett Co.
Standard Oil Co. of N. Y.
Universal Road Machinery Co.

**Road Rollers, Gasoline and Steam**
Buffalo-Springfield Roller Co.

**Rolls, Crushing**
Allis-Chalmers Mfg. Co.
Jeffrey Mfg. Co.

**Roofing, Metal**
Amer. Sheet & Tin Plate Co.

**Roofing, Prepared**
Barrett Co.
Carey Co., Philip
Texas Co.

**Roofing, Tile**
Amer. Cement Tile Mfg. Co.

**Rope, Wire, Transmission Hoisting or Haulage**
American Steel & Wire Co.
Leschen & Sons Rope Co
Moon Co., Geo. C.
Roeblings Sons Co., J. A
Wickwire-Spencer Steel Corp.

**Sash Operating Apparatus**
Allison Steel Products Co
Lord & Burnham Co.

**Sash Steel, Window**

**Saw Rigs, Portable**
Industrial Works
Knickerbocker Co.

**Scales**
Fairbanks-Morse & Co.

**Schools & Colleges**

**Scrapers, Scarifiers, Plows, Etc.**
Lansing Co.
Western Wheeled Scraper Co

**Screens, Rotary**

**Screens, Sand, Gravel and Coal**
Hauss Mfg. Co., Inc., Geo
Hendrick Mfg. Co
Link Belt Co.
Webster & Co.
Wickwire-Spencer Steel Corp.

**Screens, Water Intake**

**Sewage Disposition**
Wallace & Tiernan Co.

**Sewage Ejectors**
Yeomans Brothers Co

**Shafting**

**Sharpening Machines, Drill**
Ingersoll-Rand Co.

**Sheeting**

**Sheets, Iron and Steel**

**Shovels, Ditchers & Scrapers**
Ryerson & Son, Joseph T.

**Shovels, Steam**
Myers Whaley Co

**Signals, Electric**

**Skids**
Marion Steam Shovel Co
Myers Whaley Co.
Thew Shovel Co.

**Skylights**

**Slag Wool**

**Slings, Steel and Metallic**

**Smoke Flues**
Ball Engine Co
Buffalo Co

**Snow Melting Devices**
Osgood Co.

**Snowsheds, Ballast**

**Sprinklers and Sweepers**
Austin Machinery Corp.

**Standpipes, Tanks & Towers**
American Bridge Co.
Blaw-Knox Co.
Chicago Bridge & Iron Wks.
Pacific Tank & Pipe Co.
Pittsburgh-Des Moines Steel Co.

**Stave & Wood**

**Steam Specialties**
Jenkins Bros.

**Steel**
Buffalo Steel Co.
Midwest Steel & Supply Co.
Ryerson & Son, Joseph T.

**Steel Plate Construction**
Blaw-Knox Co.
Chicago Bridge & Iron Wks.
East Jersey Pipe Co
Graver Corporation
Hendrick Mfg. Co.
Lackawanna Steel Co.
Memphis Steel Constr. Co
Petroleum Iron Works Co.
Pittsburgh-Des Moines Steel Co.
Stave & Wood
Union Iron Works
Vulcan Iron Wks. of N. J.
Williams Co., G. H.

**Steel, Structural**
American Bridge Co.
Belmont Iron Works
Berlin Construction Co
Blaw Knox Co.
Buffalo Steel Co.
Eastern Bridge & Struc. Co
Fort Pitt Bridge Works
Kellogg Structural Steel Co.
Kenwood Bridge Co.
King Bridge Co.
Lackawanna Bridge Co.
Lackawanna Steel Co.
Louisville Bridge & Iron Co
Memphis Steel Constr. Co
Milwaukee Bridge Co.
Minneapolis Steel & Machinery Co.
Morava Construction Co.
Mount Vernon Bridge Co.
Phoenix Bridge Co.
Pittsburgh-Des Moines Steel Co
Riverside Bridge Co.
Shoemaker Satterwait Bridge Co.
Snare Corp. Frederick
Snead Architectural Iron Works
Strauss Bascule Bridge Co.
Virginia Bridge & Iron Co
Wisconsin Bridge & Iron Co.

**Steel, Tool**
Ryerson & Son Co., Jos. J.

**Stokers**
Babcock & Wilcox Co.

**Strainers Well**
Cook, A. D.

**Superheaters**
Babcock & Wilcox Co.
Power Specialty Co

**Tables and Boards, Drawing**
Hamilton Mfg. Co.

**Tarpaulins Duck**
Pawling & Harnischfeger Co.

**Tools, Air Compressor**
Chicago Pneumatic Tool Co
Brake Co.

**Tools, Rock**
Blaw Knox Co
N. Y. Central Iron Works

**Tanks, Steel**
(See Steel Plate Construction).

**Ties, Wood**

**Tapes, Steel and Metallic**

**Tuftan Rule Co**

**Turnbuckles**
Barrett Co

**Testing Laboratories**
(See also Engineers' Directory).

**Thermometers**
Taylor Instrument Co.

**Ties, Steel**
American Bridge Co.

**Tile, Concrete Bldg.**
Keystone Gypsum Fireproofing Co.

**Tile, Roof Cement**
American Cement Tile Manufacturing Co.

**Tin Plate**
Amer Sheet & Tin Plate Co.

**Towers, Concrete**
(See Reinforced Concrete Tower)

**Towers, Radio**
Blaw Knox Co.

**Towers, Transmission**
Blaw-Knox Co.
Lakewood Engr. Co.

**Track, Industrial and Portable**
Easton Car & Constr. Co.
Koppel Industrial Car & Equip. Co.
Lackawanna Steel Co.

**Tractors**
Best Tractor Co.
Holt Mfg Co.
Lakewood Engr. Co.

**Tractors, Storage Battery**
Lakewood Engr. Co.

**Transits and Levels**
Ainsworth & Sons, Wm
Berger & Sons Co., C. L.
Gurley, W. & L. E.
Heller & Brightly
Kolesch & Co.

**Trailers**
Lakewood Engr. Co.

**Transmission Machinery, Power**
Leffel & Co., Jas.
Link Belt Co.

**Treads, Safety**
Concrete Steel Co.
Irving Iron Works
Universal Safety Tread Co.

**Trolleys, I-Beam**
Brown Hoisting Machy. Co.

**Trucks, Motor**
Chicago Pneumatic Tool Co.

**Trucks and Trailers, Factory**
Lakewood Engr. Co.

**Tunnel Liner Plates**
Blaw-Knox Co.
Hydraulic Steelcraft Co.

**Turbines, Hydraulic Impulse and Reaction**
Allis-Chalmers Mfg. Co
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan
Worthington Pump & Machinery Co.

**Turbines, Steam**
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.

**Turntables**
Easton Car & Contr. Co
Lakewood Engr. Co.

**Underpinning**
Smith Hauser & Mathesius Underpinning & Foundation Co.

**Unloaders, Car**
Hauss Mfg. Co., Geo.

**Valves, Air, Water, Steam and Gas**
Chapman Valve Mfg. Co
Coffin Valve Co
Coldwell-Wilcox Co
Crane Co.
Golden-Anderson Valve Specialty Co
Kennedy Valve Mfg. Co
Ludlow Valve Mfg. Co
Lunkenheimer Co.
Power Specialty Co.
Rensselaer Valve Co
Simplex Valve & Meter Co.
Smith Mfg. Co., A. P.

**Valves, Altitude**
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.

**Valves, Angle, Check, Gate and Globe**
Coffin Valve Co.
Golden-Anderson Valve Specialty Co
Jenkins Bros.
Ludlow Valve Mfg. Co.
Simplex Valve & Meter Co
Brake Co

**Valves, Automatic**
Golden-Anderson Valve Specialty Co
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.
Westinghouse Traction Brake Co.

**Valves, Float**
Golden-Anderson Valve Specialty Co.

**Valves, Regulating**
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Simplex Valve & Meter Co.

**Valves, Return**
Golden-Anderson Valve Specialty Co.
Lunkenheimer Co.

**Valves, Safety**
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Lunkenheimer Co.

**Valves, Sewage**
Chapman Valve Mfg. Co.

**Valves, Sluice**
Chapman Valve Mfg. Co.
Coffin Valve Co.

**Ventilators**
Allison Steel Products Co.
Drouve Co., G.
Lord & Burnham Co.

**Wagons, Dumping**
Western Wheeled Scraper Co.

**Wagon Loaders**
Austin Machinery Corp.
Hauss Mfg. Co., Inc., Geo.
Jeffrey Mfg. Co.
Link Belt Co.

**Washers, Cut, Cast, Malleable**
Smith Engineering Co.

**Water-Main Cleaning**
National Water Main Cleaning Co.

**Waterproofing Compounds and Materials**
Anti-Hydro Waterproofing
Barrett Co
Carey Co., Philip
General Chemical Co.
Somerborn Sons, L.
Texas Co.

**Water Purification**
Electro Bleaching Gas Co
Wallace & Tiernan, Inc.

**Water Softeners**
Amer. Water Softener Co.
Graver Corporation
International Filter Co.
N. Y. Continental Jewell Filtration Co.
Roberts Filter Mfg. Co.

**Water Stage Recorders**
Leupold Voelpel Co.

**Water Sterilization**
Electro Bleaching Gas Co.
Wallace & Tiernan, Inc.

**Water Wheels, Impulse and Reaction**
Leffel & Co., Jas
Pelton Water Wheel Co
Smith Co., S. Morgan
Worthington Pump & Machinery Corp.

**Welding and Cutting Apparatus**
Air Reduction Sales Co.
Blaw Knox Co
Milburn Co., Alexander
Prest-O-Lite Co.

**Wheelbarrows**
Lansing Co.

**Winches, Ship, Hand, Steam and Electric**
Brown Hoisting Mchy. Co.
Dobbie Tools & Mach Co
Flory Mfg. Co., S.
Lakewood Engr. Co.
Lidgerwood Mfg. Co.
National Hoisting Eng. Co.

**Window Sash Steel**
Allison Steel Products Co.

**Wire Glass**
Mississippi Wire Glass Co.

**Wire Mesh, Reinforcing**
Wickwire-Spencer Steel Corp.

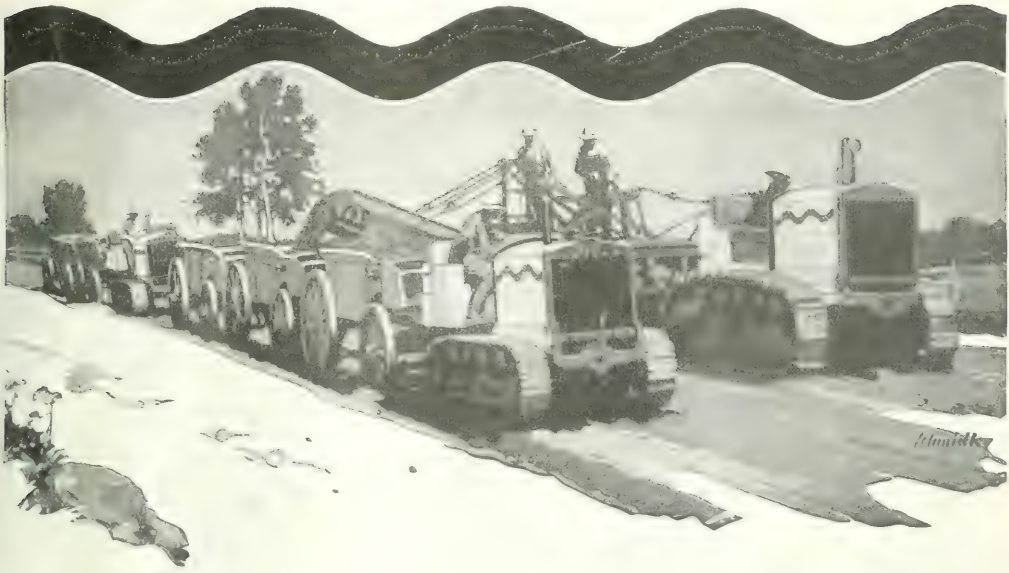
**Wire Rope**
(See Rope, Wire)

**Wire and Cable, Electrical**
American Steel & Wire Co.

**Wood Casings**
Michigan Pipe Co., The

**Wood Preservatives**
Barrett Co.
Northeastern Co.
Protexol Corp.
Reynolds Creosoting Co
S. P. F. Wood Preserv. Co.

**Wrenches**
Greene, Tweed & Co.
Lowell Wrench Co.



# Setting The Pace For Low-Cost Road Work

*The "Caterpillar's"* field of usefulness is by no means limited to road making. On farm or ranch, in the mining, oil and lumber industries, for snow removal and other civic work—wherever power and endurance are at a premium, the "Caterpillar"* has no real competitor.*

The most essential unit in any efficient road-building outfit today is a "Caterpillar"* Tractor. It is the safest investment a road official or contractor can make. After hitching a 10-ton "Caterpillar"* to an elevating grader in place of 18 head of mules, an Illinois contractor says: "From August 25 to September 25, 1921, we moved 29,975 yards of dirt with the "Caterpillar"* outfit as against 18,000 yards a month formerly averaged with the mules. The "Caterpillar,"* running 10 hours a day for over three months, has not cost us a penny for upkeep." Similar accounts come from "Caterpillar"* users throughout the country. Working singly or for replacing teams entirely, "Caterpillars"* speed up every dirt moving and hauling operation, and save money on every job. Let us prove it on *your* job.

CATERPILLAR
Reg. U.S. Pat. Off.
HOLT
PEORIA, ILL.
STOCKTON, CALIF.

**There is but one "Caterpillar"—Holt builds it*

THE HOLT MANUFACTURING CO., *Inc.*
*Branches and service stations all over the world.*
Eastern Division: 50 Church St., New York

2429 Farnam St., Omaha, Neb. 5th and Court Sts., Des Moines, Ia.
417 Washington Ave., N., Minneapolis, Minn. 2045-47 Main St., Kansas City, Mo.
Holt Company of Texas, Dallas, Texas

# ALPHABETICAL INDEX TO ADVERTISEMENTS


Page

Allen Co., John F. ..... 112
American Cheosoting Co. ..... 82
American Steel & Wire Co. ..... 93
Austin Machinery Corp. ..... 19

Fairbanks-Morse & Co. ..... 106
Flory Mfg. Co., S. ..... 97
Foote Concrete Mchy. Co. ..... 23
For Sale Ads. ..... 63

Gamon Meter Co. ..... 102
Glamorgan Pipe & Fdry. Co. ..... 104
Golden-Anderson Valve Spec. Co. 37
Greene, Tweed & Co. ..... 99

Hadfield-Penfield Steel Co. ..... 75
Haiss Mfg. Co., Geo. ..... 15
Hamilton Mfg. Co. ..... 116

Independent Concrete Pipe Co. ..... 80
Ingersoll-Rand Co. ..... 31
Inspecting Engineers ..... 121

Jeffrey Mfg. Co. ..... 40

Kellogg Structural Steel Co. ..... 114
Kennedy Valve Mfg. Co. ..... 100
Kiesler Co., Joseph F. ..... 95
King Bridge Co. ..... 113

Lakewood Engr. Co. ..... 27

Page

Foundation Co. ..... 86
McGowan Co., John H. ..... 108
McGraw-Hill Book Co. ..... 7, 83, 112
McKiernan-Terry Drill Co. ..... 88
McMyler Interstate Co. ..... 94
M. & M. Form Clamp Co. ..... 85
Manistee Iron Works Co. ..... 108
Marion Steam Shovel Co. ..... 16
Memphis Steel Construction Co. 109
Midwest Steel & Supply Co. ..... 86
Milwaukee Bridge Co. ..... 112
Mitchell-Tappen Co. ..... 87
Moon Co., Geo. C. ..... 90

National Hoisting Engine Co. ..... 88
Newport Culvert Co., Inc. ..... 80
N. Y. Central Iron Works, Inc. .. 109
N. Y. Con. Jewell & Filt. Co. .. 100
Norton, Inc., A. O. ..... 112

Pacific Tank & Pipe Co. ..... 103
Pawling & Harnischfeger Co. ..... 90
Pease Co., C. F., The ..... 117
Pelton Water Wheel Co. ..... 108
Pennsylvania Salt Mfg. Co. ..... 100
Petroleum Iron Works Co. ..... 109
Pittsburgh Meter Co. ..... 100
Polk, Genung, Polk Co. ..... 111
Porter Co., H. K. ..... 123
Power Specialty Co. ..... 111

Rail Joint Co. ..... 75
Ramapo Iron Works ..... 73
Rensselaer Valve Co. ..... 99
Roberts Filter Mfg. Co. ..... 99
Robins Conveying Belt Co. ..... 92
Roebling's Sons Co., John A. ..... 96
Rust Engineering Co. ..... 111
Ryerson & Son Co., Jos. T. ..... 39

S. P. F. Wood Preserving Co. ..... 82
Sauerman Bros. ..... 92
Searchlight Section ..... 58
Shoemaker-Satterthwait Bridge Co. ..... 114
Simplex Valve & Meter Co. ..... 102
Smith & Co., F. L. ..... 82
Smith Engineering Works. ..... 26
Smith Mfg. Co., A. P. ..... 104
South Co., S. Morgan ..... 108
Smith Co., T. L. ..... 25
Smith, Hauser & Miller, Inc. ..... 86
Snare Corp., Frederick ..... 113
Snead Architectural Iron Wks. .. 114
Somerborn Sons, Inc., L. ..... 86
Spencer, White & Prentis, Inc. .. 76
Standard Oil Co. of N. Y. ..... 78
Standard Wood Pipe Co. ..... 103
Steel & Concrete Eng. ..... 112
Strauss Bascule Bridge Co. ..... 114
Stroudsburg Engine Co. ..... 91
Sullivan Machinery Co. ..... 91
Summerhays & Sons, Wm. ..... 110

Taylor Instrument Co.'s ..... 102
Terry Mfg. Co. ..... 93
Terry & Tench Co., Inc. ..... 113
Texas Company ..... 77
Thew Shovel Co. ..... 35
Tippett & Wood. ..... 109
Toledo Crane Co. ..... 6

Underpinning & Foundation Co. 86
Union Iron Works ..... 88
United Concrete Pipe Co. ..... 80
U. S. Cast Iron Pipe & Fdry. Co. 104
Universal Clamp Co. ..... 85
Universal Drafting Mach. Co. .. 117
Universal Road Machinery Co. .. 80
Universal Safety Tread Co. ..... 87

Virginia Bridge & Iron Co. ..... 113
Vulcan Iron Works of Chicago .. 90
Vulcan Iron Works, Inc., Jersey City, N. J. ..... 95
Vulcan Iron Works of Wilkes-Barre ..... 93
Vulcanite Portland Cement Co. .. 84

Wallace & Tiernan Co. ..... 96
Want Advertising ..... 64
Warren Foundry & Mach. Co. ..... 94
Weber Chimney Co. ..... 93
Wellman Mfg. Co. ..... 111
Western Wheeled Scraper Co. ..... 36
Westinghouse Traction Brake Co. 76
Whitcomb Co., Geo. D. ..... 95
Wickes Bros. ..... 115
Worcester Steamer Steel Corp. ..... 94
Wrightwood Construction Co. ..... 110
Williams Co., G. H. ..... 95
Wilson Works, The ..... 84
Wisconsin Bridge & Iron Co. ..... 114
Wisconsin Motor Mfg. Co. ..... 21
Wood & Co., R. D. ..... 104
Woodward Governor Co. ..... 106
Worthington Pump & Machinery Co. ..... 109
Wyckoff & Son Co., A. ..... 103
Wyckoff Pipe and Creosoting Co. Inc. ..... 82

Yeomans Brothers Co. ..... 108

BINDING CLOTH AUG 19 1500

TA
1
E6
v.87
cop.2

Engin.

Engineering news-record

ENGIN STORAGE

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY